KODEX AI

Adopting generative AI in banking

In partnership with
Deutsche Bank

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This white paper looks at how Generative AI (GenAI) can transform the financial services industry. It shows how GenAI can improve compliance, engage clients better, and manage risks more effectively while helping companies share expertise and bring new solutions to market faster. However, to fully benefit from GenAI, high-quality systems are needed, and it can be tough to tell different AI models apart.

The paper explains what makes an AI system good, including the quality of data, the complexity of the system, and cybersecurity measures. It also covers important tools like Retrieval-Augmented Generation (RAG) and Parameter Efficient Fine Tuning (PEFT), which help reduce mistakes.

A step-by-step approach for adopting GenAI is recommended, starting with simple tasks and gradually expanding to more complex uses to ensure a smooth transition. Key suggestions for the industry include using standard test data, setting up fair usage policies, creating AI testing environments (sandboxes), and simplifying regulations to make AI integration more effective.

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Disclosure: This white paper has been passionately authored by humans.

Foreword

GenAI is emerging as a transformative force in financial services, enabling efficiencies in compliance, client engagement, and risk management. They offer significant advantages to super-scale human productivity for more to be achieved with the same with higher quality. Other benefits include institutionalising expertise, raising strategic competitiveness and high speed-to-market when more business or non-technical users can access such systems to achieve better results faster. Social compacts between the firm and society can also be reinforced too, for example if a mature professional's domain experience is further extended as model trainer and evaluators.

A structured and incremental adoption roadmap is critical, beginning with language processing and automating routine workflows and scaling up to more complex decision-augmentation applications that can include Agentic AI in the future. Such a strategic approach ensures that benefits, learnings and risks can be optimally internalised at each stage before the organisation progresses; effectively allowing business and applications to mature together.

However, for such value creations to be realised, the GenAI system needs to be of a certain quality even if differentiating between GenAI systems can be difficult as all appears similar.

Hence, taking a business-technical approach, this white paper seeks to highlight quality determinants such as data, system components and cybersecurity of GenAI text-to-text systems. It also introduces key infrastructure components like Retrieval-Augmented Generation (RAG), Parameter Efficient Fine Tuning (PEFT) and Low Rank Adaptation (LoRA) that catalyses benefits like system adaptability, reduced running costs and to support data confidentiality segregation in more controlled fashion.

While Gen AI may look like a new technology because of many new terms, deeper examinations would reveal that many deemed challenges are familiar from previous technological advancements that the financial industry have successfully addressed. For example, Hallucination – a large word – is about inaccurate, unreliable or incomplete data from information retrieval technologies that have been addressed in previous innovations like early expert systems through improved data validation, user oversight and iterative model training. Premature responses to these risks believing they are novel to GenAI can only hinder and add unnecessary costs to an industry that needs new growth tools.

The paper concludes with key insights and suggestions for the future of adopting the GenAI system by the financial industry; including availability of industry test data, fair usage policies, upskilling, AI sandboxes and streamlined existing regulations relevant to AI systems for cost-effective adherence.

We hope you find this paper engaging and invites further discussions in this exciting field. Thank you for reading.

01 Introduction, GenAI and its use cases

In recent years, Generative Artificial Intelligence (GenAI) has evolved from a futuristic concept to a practical transformative tool that can reshape industries. For financial services industry professionals, stakeholders, employees and clients, it has reignited excitement in this field with broader interests to use GenAI systems for a huge range of use cases.

To this goal, the white paper aims to raise awareness of key factors involved in implementing GenAI systems and to provide guidance on approaches, success factors, risks and regulatory considerations. In the process, we also attempt to highlight what differentiates quality between different GenAI systems and propose some next steps that we believe can facilitate industry adoption of this extraordinarily powerful tool that can greatly empower users to achieve more with the same.

1.1 GenAI: a powerful transformative tool

The versatility of GenAI allows it to be deployed across a variety of use cases, and the ease of its use makes it a democratising transformative tool across industries and skill levels. At its most basic level, GenAI can be used for automating simple tasks, such as generating marketing messages, automating data entry, or creating boilerplate content with helper functions. These applications are already useful to augment productivity and speed, even by early-career professionals or those without the relevant background to achieve a measure of success. This is because at the core of GenAI is a superb human-computer interface that allows everyday language to be translated into precise computer instructions for machine execution. This allows more and different types of users to manage more complex tasks.

For example, an intern can use GenAI to create email invitation templates in different languages to a technology webinar, while a product manager can generate user flow diagrams without needing specialised design tools.

On the other end of the spectrum, GenAI powers complex and highly specialised systems such as Microsoft's Co-Pilot product launched in 2023. This AI-driven assistant integrates into productivity software to help users automate tasks like code generation, document drafting, and real-time collaboration, enhancing workflows for seasoned professionals. Co-Pilot can, for instance, assist software developers by generating large blocks of code based on minimal input, significantly reducing development time and improving efficiency. Similarly, in a legal setting, other GenAI systems can help attorneys draft legal documents by understanding context and offering suggestions, potentially transforming how professionals in high-stakes environments operate.

1.2 Use in financial services

Beyond these examples, GenAI's adaptability can be seen in its use within financial services. Financial institutions are increasingly leveraging AI for applications such as fraud detection, customer service automation via chatbots, and even risk assessment models that evolve as markets change. For instance, a compliance officer can use GenAI to query, without knowing SQL (the structured query language for manipulating data into relational databases), other machines for transaction anomalies in data sets to help flag potential compliance risks faster than in traditional ways.

Figure 1: GenAI models

Type of models	What they are
Foundation model	A broad, general-purpose model trained on diverse data.
Instruction-trained model	A model based on Foundation Model but refined with specific instructions to perform particular tasks.
Fine-tuned model	A Foundation Model or an Instruction-Trained Model that is further trained on specialised datasets to enhance performance for specific domain applications
Deployed model with prompt engineering	The practice of users crafting inputs to guide the Fine-Tuned or Instruction-Trained model towards desired outputs

This is possible because GenAI systems can be fine-tuned for specific tasks and specific domains to make them adaptable. Whether through low-code or no-code platforms, businesses can customise GenAI systems to meet their specific requirements in near real-time. A GenAI model fine-tuned for the financial sector, for instance, would be focused on understanding financial language and providing insights on the applications like market analysis or drafting financial reports.

1.3 Use case considerations

As GenAI and the range of AI technologies continue to evolve, their abilities to solve complex situational challenges would also expand and appear to be infinite. As expectation builds with each news of new capabilities or of another successful use case, GenAI systems risk becoming the silver bullet to everything that needs to be solved, which is unrealistic.

1.3.1 Key differences

Hence, in deploying GenAI, which is a highly powerful tool that augments and creates super productivity benefits when properly applied, it is important to understand what and where it should be deployed with grounded expectations. This would facilitate business case success and fit-for-purpose governance.

This paper examines the GenAI system, with Figure 2 highlighting key differences between GenAI, AI, and other comparable systems. While these systems may seem alike, each possesses unique capabilities, risks, and regulatory profiles.

Figure 2: Not all AI is the same

	Robotic Process Automation (RPA)	'Traditional' AI	Generative AI	Agentic AI
What is this for?	Automate repetitive tasks and workflow. No "new" output	Pattern recognition, regression analysis/prediction, classification	Content generation (eg, text, images, code, etc)	Autonomous decision making and action
Main capability	Copy human interactions with systems. Does not create new methods of interaction	Analysis, application and prediction based on existing data/ model. Arguably little real time learning	Output new data and generate output. Real-time learning, self-course correction	Interact with other systems, learn and act in real time
Learning	Imitation rule-based. Do not learn	Single algorithm to machine learning. More structured and constrained than GenAI.	Self-supervised, unsupervised, latent space representation	Reinforcement learning, unsupervised learning
Use case type	Task automation; data entry, process automation	Human enablement; risks management, customer segmentation, predictions	Human augmentation; Text, image, audio, code generation	Autonomous AI assistants and team

GenAI as a human interface/integration into RPA, Traditional AI or Agentic AI

Source: SES Views, Deutsche Bank

1.4 Alignment of a problem statement with GenAI

When determining whether a problem statement is more appropriate for GenAI, several key criteria should be considered.

1.Problem variability:

is the goal to create new content with tolerance for variations, or to classify/predict existing data with the same results to the same queries?

GenAI systems excel at tasks such as generating text, images, audio, and code. For instance, in text generation, their capabilities include summarisation, extraction, sentiment analysis, inference, and applying one concept to another. They also adeptly connect related topics, akin to a mind map.

It is not suitable for quantitative data analysis, classification, prediction, or tasks commonly linked with 'traditional AI.' For example, if a business seeks to generate personalised client emails based on past interactions and understanding of their behaviour/buying criteria, GenAI can analyse the historical textual data and generate tailored responses in highly scalable ways.

Conversely, for tasks such as quantitatively analysing financial data to find correlations, classify information, or make predictions, a traditional AI system would be more appropriate than a standalone GenAI system.

2. Data sufficiency:

is there sufficient quantity and quality of data to train the model?

GenAI processes highly unstructured data, such as human queries, to produce desired outcomes. To achieve this, it relies on a substantial amount of high-quality data for training, fine-tuning, and generalisation. The quality and quantity of this data directly influence the accuracy, ease of generation, and relevance of the content produced. Additionally, the tokenisation strategy, which breaks down input data for model processing, can also affect these outcomes.

With comprehensive data for the domain and the right infrastructure and training, the model's ability to understand queries, context, and generate accurate outputs improves significantly.

To ensure effective solutioning, it is crucial to clarify data topics such as completeness, relevance, and balance. Addressing data quality involves considering synthetic data, data augmentation, resampling, and under-sampling. Additionally, Self-Play Fine Tuning (SPIN stands out as an advanced technique that enables large language models to enhance their capabilities by generating their own training data. Selecting an appropriate tokenisation strategy is also vital for LLMs, as it can help mitigate hallucination risks while impacting running costs.

Other related data topics include confidentiality and personal privacy treatment for data in transit, at rest and in archive. Remember, user prompts are likely to be retained for audit and investigative purposes and they can be regarded as business confidential data in which case, teams and vendors dealing in that GenAI system will need to observe banking confidentiality requirements; these prompts may also need to be retained for the duration of regulatory requirements.

Contributed intellectual property, such as using reinforcement learning with human-in-the-loop as intellectual property, can greatly benefit from early discussions among AI engineers, business professionals, and legal experts. Engaging in these tripartite conversations ensures a comprehensive understanding and strategic alignment.

3. Results materiality:

is the problem to be solved mission critical and would the GenAI system directly interact with external users?

For mission critical applications where the outcome can directly impact business reputation and clients, allowing external users access to your GenAI system can be high risks due to the less predictable nature of its creative outputs. For example, to use GenAI to generate investment strategies based on end investors queries would be risky not least because GenAI per se is unsuitable for quantitative statistical analysis. Requirements that '98% accuracy' is not good enough can point to a non-GenAI as a primary solution too.

Hence, considerations in deploying a GenAI system to a problem statement include the criticality of the problem to business operations, the level of GenAI/AI governance maturity in the organisation and whether the generated outcome can be validated by inhouse expert humans before being used. GenAI can also be used as a computer-human interface to accept imprecise language as instructions to trigger other deterministic tools to generate results.

4. Extent of human decisions:

are there multiple decision-making stages, or a decision waterfall, in the problem statement?

A problem statement utilising a 'what-if-then-else' decision structure is often better addressed by non-generative AI systems, with humans validating or making decisions at key points. Generative AI can still play a role as a computer-human interface, complemented by traditional AI systems that manage specific statistical analyses and decision-making tasks, with human oversight involved.

5. Cost of solution:

the running costs of GenAI

From an economic perspective when deploying a GenAI system, several factors that impact running costs should be considered to ensure the sustainability of the AI solution. These factors include compute power especially for real-time applications. Storage and memory, as part of AI specific infrastructure that includes vector databases, RAG architecture and knowledge graphs, can grow with larger parameter models with longer token sequences. Hence, assessing token usage and context length should be performed to manage this cost driver.

A token-based pricing model can drive expenses particularly for frequent lengthy chat-based interactions that retain prior chats as context which is valuable but can be expensive.

Data transfer costs are another consideration as LLMs can involve API calls and bandwidth for data inputs and outputs. Ongoing maintenance and fine tuning of the model should also budget for retraining to enhance performance or accommodate new data. Hence, these new cost considerations need to be managed to allow the maximum number of users to access the system, and therefore, the magnitude of benefits and strategic advantages.

6. Jobs:
questions on job concerns

When AI or GenAI emerges as a solution to a problem, discussions often turn to job security, particularly if the investment promises transformation and efficiency. Addressing these concerns early on is vital to avoid misunderstandings. Highlighting the significant benefits of AI/GenAI—such as enhancing roles, boosting productivity, and expanding human capabilities—can lead to a more fulfilling work experience for employees.

AI and GenAI augment human potential rather than replace it. While it may be possible that AI/GenAI systems could reduce the number of positions in the longer time horizon, the primary value of implementing AI/GenAI right now is not about cutting jobs but rather to drastically increase the efficiency and the capacity of human workers.

In experiments conducted by Deutsche Bank using a GenAI system (Aggie) in collaboration with Kodex AI, Aggie significantly reduced the time needed to summarise and write complex regulatory text from two hours, or 120 minutes, to just minutes, all while maintaining maker-checker governance. This time savings allow expert staff to spend more on client interactions than on keyboards.

Once the decision is made to adopt GenAI systems, clear communication, active employee engagement, and opportunities for staff to re-skill are essential. These efforts will foster an environment of innovation, growth, and transformation. Figure 3 outlines their relevance in understanding the fit of the problem statement with GenAI.

Figure 1: GenAI models

	Considerations	Relevance to problem statement fit with GenAI
1	**Create new content or to classify/predict?**	Assess whether the solution requires generating creative content, suitable for GenAI, or if it involves structured tasks such as classification or prediction, which may not necessitate GenAI
2	**Sufficient quantity and quality of data**	The performance of GenAI largely relies on robust training data. The nature of this data, whether public or private, can significantly influence the time-to-market and complexity of the solution
3	**Mission criticality or "I cannot accept 98% accuracy"**	For mission-critical tasks requiring absolute accuracy, a layered solution might be necessary. This could involve integrating GenAI with other technologies and implementing process governance
4	**"What-if-then-else" decision structure**	Problems governed by structured rule-based logic are well-suited for traditional AI, whereas GenAI excels in handling complex, creative, and ambiguous scenarios
5	**Business case benefits**	Is the key benefits centred on business non-technical users for productivity gains which GenAI can catalyse such benefits, or for specialised/tech teams for niche non-generative applications which other AI systems could better fit?

Source: SES Views, Deutsche Bank

02

Building a portfolio of GenAI use cases

Even when a problem seems to require a GenAI solution, navigating the business case, governance, and compliance processes for GenAI can be significant, making a one-time effort inefficient. Instead, a strategic, composable approach to incrementally scale its applications across different use cases can better support the expected return on investment (ROI) from this powerful productivity and competitive tool. This method allows the organisation to learn and build trust in these tools with each successful application, enabling risks and controls to mature progressively and allowing for more accurate ROI estimates and realisation.

2.1: Three-stage approach

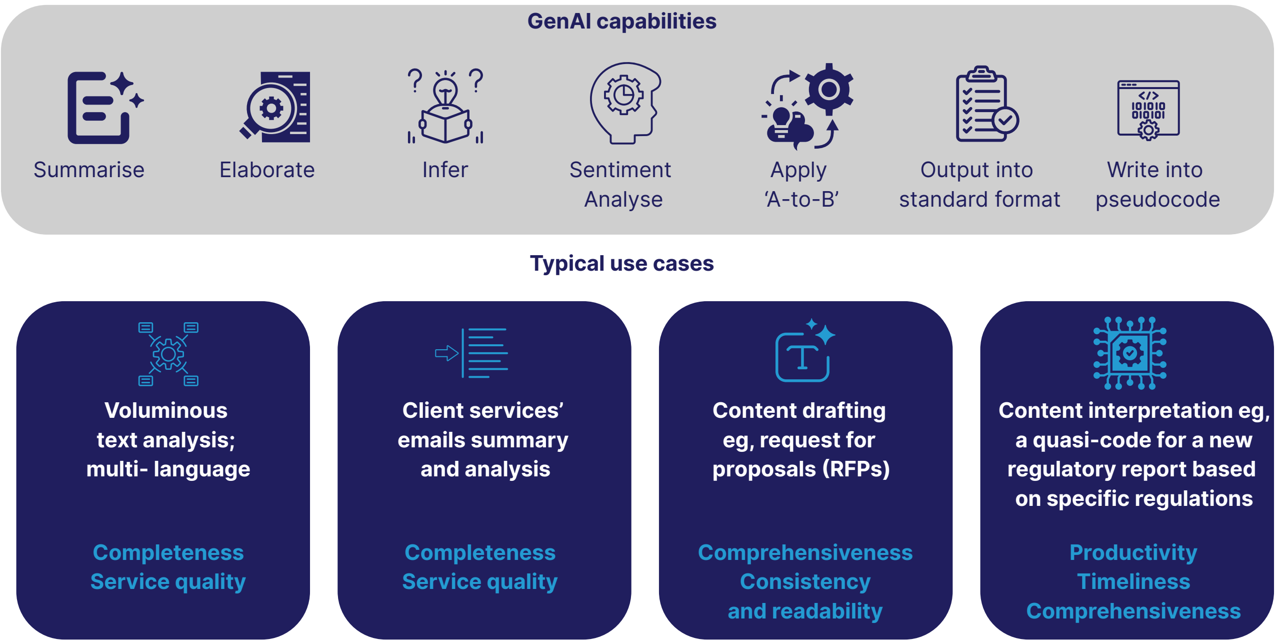
To harness its full potential, we suggest a three-stage composable approach to develop a GenAI roadmap of use cases, where each use case and stage builds on the prior ones yet will have tangible benefits to be delivered to the organisation.

Figure 4: Composable portfolio for GenAI applications

2.1.1 Stage 1: apply GenAI's core text and language analysis capabilities

Core GenAI language capabilities allow the system to accurately understand and interpret natural language queries to perform text analysis tasks like summarisation, language and comprehension that Figure 5 illustrates.

Figure 5: Text generative capabilities (non-exhaustive)



Source: Project Aggie with Kodex AI Gmbh and Deutsche Bank

This stage builds up the accuracy and capabilities of the natural language handling capability for the domain even as it is applied to solve domain problems like better client service summaries, drafting content that contribute to value creation. This first stage lays the foundation for the next stage "Chat-to-Agent" use cases, where the human natural language query is translated by an executing agent into a precise database and code commands for execution.

2.1.2 Stage 2: chat-to-agent use cases

A 'chat-to-agent' solution is where human language queries would trigger the appropriate tools or models by an executing agent to perform specific tasks. An executing agent can be a Python program that receives the queries to write code and execute for results, acting as a pipeline where language models, code interpreters and other AI models would work in harmony.

While text analysis alone is based on language processing, use cases in this stage will see GenAI systems calling other libraries and AI models to allow users to tackle more complex and multi-step tasks like generating codes, querying databases or automating workflows by using natural language as a primary human-computer interface.

A use case at this stage can include data analytics that business users can perform using natural language queries to understand data patterns and relationships.

Figure 6: linked GenAI-AI capabilities

GenAI capabilities		+ Code interpreters		+ Statistical models		= Allows
Text and language understanding capabilities (from Figure 5)	+	To generate and execute codes such as Python	+	Models to process, analyse and perform statistical functions on structured or unstructured data	=	Chat-to-agent capability to allow non-tech users to query datasets that otherwise needed data specialists

Source: Project MILA 2023 with Jia-Wei Lee, NUS STEM intern with Deutsche Bank

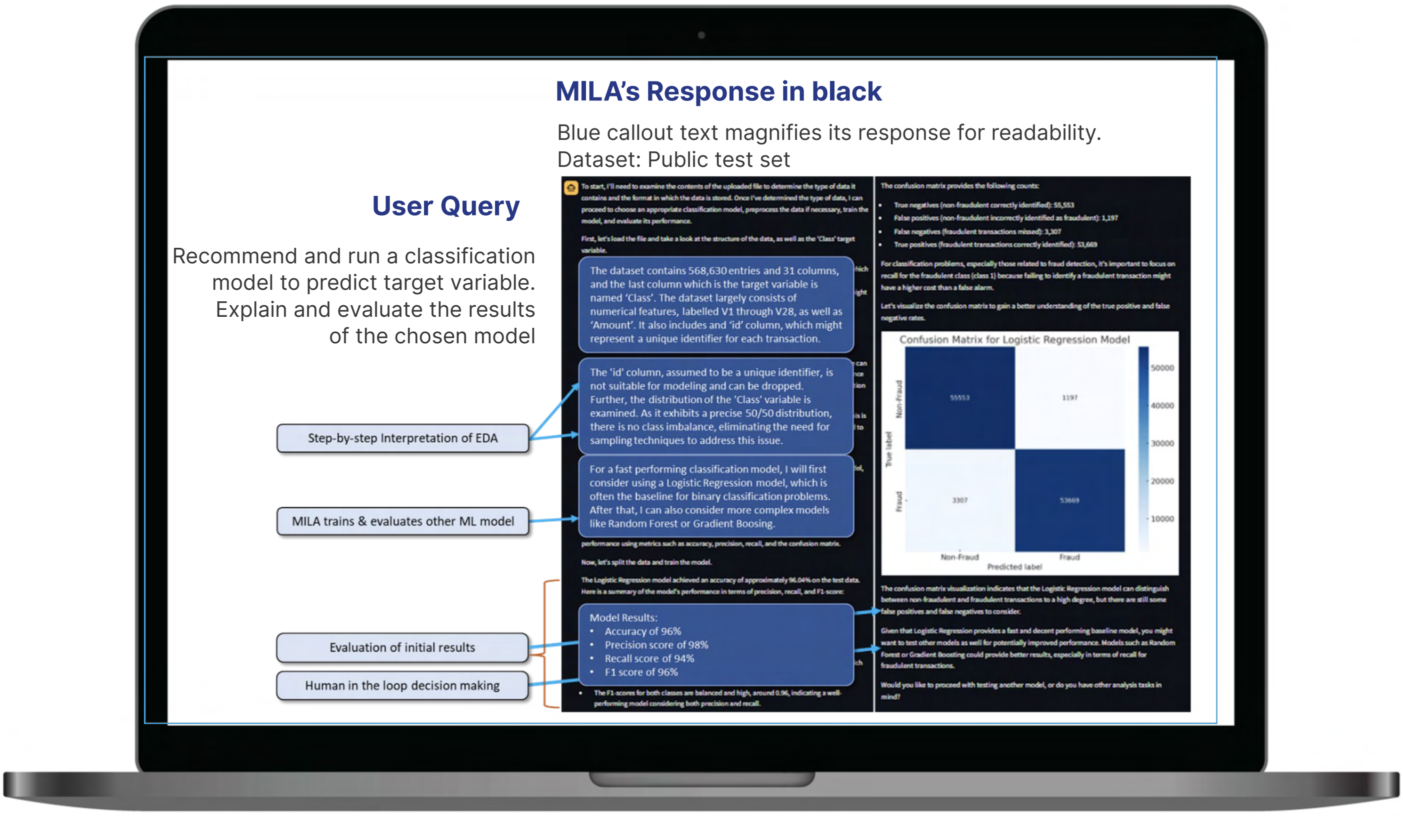
For example, in a 2023 wireframe experiment (Project MILA), a ‘chat-to-agent” model directly helped business users to understand relationships between multiple factors with a comprehensive analysis that was also accompanied by visualisation. MILA was also integrated with ReACT (reasoning and acting) and self-reflection mechanisms to reason through complex problems, and provided transparency to users, which allowed it to decide when to call specific libraries or models based on the query received.

Such basic self-reflection qualities enabled MILA to evaluate whether its output was aligned to the query, and to seek human feedback for next steps.

The experiment used a labelled structured public test data set with 31 features and about 520,000 entries. A user asked MILA to “analyse and help me understand the insights and relationships in this data set” as shown by Figure 7 MILA took the human query, translated it into Python code requirements and performed the following steps:

1. Data structure discovery with step-by-step interpretation of the exploratory data analysis;
2. Identified dataset features as possible unique identifiers or those that could be dropped from the analysis;
3. Analysed data balance/imbalance and proposed appropriate sampling techniques ;
4. Firstly called on more transparent and straightforward algorithms to perform statistical analytics;
5. Evaluated the initial results including Precision, F1 scores and Recall;
6. Asked the human evaluator if the results are satisfactory, which if not, MILA would call on other algorithms to retry; and
7. Output both statistical analysis with natural language explanations and analysis;

Figure 7: screenshots based on actual execution, no real data is used



Source: Project MILA 2023 with Mr Jia-Wei Lee, NUS STEM intern with Deutsche Bank

It was empirically estimated that an experienced data engineer would require about 3 hours to perform the above seven steps that MILA took about three minutes to complete including asking the user to evaluate initial results.

Chat-to-agent empowers non-technical users to perform tasks that once required data scientists, through intuitive no-code queries. However, rather than rendering the data scientists obsolete, this shift should allow them to work on more advanced and interesting tasks such as fine-tuning systems for domain deployments. The data scientist roles evolve from executing manual data operations to developing more intuitive and accurate AI systems.

2.1.3 Stage 3: chat-to-execution. The autonomous capabilities

The transition from a “chat-to-agent” system to an Agentic AI system marks a significant advancement in autonomous digital capabilities. In a system like the MILA experiment, users make requests in natural language, which are then converted into specific actions, such as querying a dataset. The “chat-to-execution” stage elevates this by adding the AI system's autonomy in decision-making, contextual awareness, and action execution capabilities to the foundational “chat-to-agent” framework (Figure 8).

Figure 8: Additional qualities as an agentic AI (non-exhaustive)

Decision making autonomy

The capacity to make decisions based on complex inputs and acquired behaviours is achieved through techniques like reinforcement learning, where an AI system learns via incentives and disincentives

Contextual awareness

Ability to retain memory from past interactions and historical content to enable more informed decisions

Action execution

Ability to interact with systems, trigger 'mouse clicks' on virtual desktops and to navigate through digital workflows to perform action

Self-adaptation

Ability to self-adapt for example, by modifying its algorithm parameters based on errors, feedback or contextual changes to improve its performance in real time. For example, in autonomous vehicles

Source: crewai.com, DeepLearning.AI, various

As GenAI evolves from simply generating text responses to autonomously making decisions and taking actions, it introduces concerns about new risks and ethical challenges. The constant evolution of current transparency and explainability methods are crucial, improving systems logging to ensure accountability by human overseers. Appropriate data privacy and cybersecurity measures will continue to be necessary, especially if advanced GenAI systems have access to sensitive, commercial, or personal information. New practical accountability models can be required as autonomous AI agents can blur traditional lines of responsibility.

Integrating GenAI applications into a firm's operating model opens vast opportunities for innovation, automation, and competitiveness. However, it is crucial for firms and regulators to establish clear guidelines and adaptive sandboxes to learn, prevent preventable errors and plans for unintended consequences. This approach fosters a balance between innovation, growth, safety, and regulation, enabling the industry to effectively harness the power of GenAI systems.

Each GenAI system is unique, and the following chapters offer insights into key components used which differentiates the quality between systems.

03

Identifying excellence

With a growing range of available GenAI solutions, determining the quality of a GenAI system that looks to be similar but can perform differently should become a key determinant for organisations, particularly those in highly regulated sectors like financial services.

The investment into a GenAI solution is best justified when the GenAI system delivers on a range of crucial quality indicators that are aligned to the use case. Understanding what constitutes a high-quality system is essential for decision-makers, especially when implementing GenAI for financial industry activities.

3.1 Accuracy and relevance (benchmarks)

One of the best indicators of quality is the accuracy and relevance of the model's outputs. Benchmarks provide industry agreed metrics as a basis to compare different LLMs, indicating which model performs relatively better against a common minimum standard. Additionally, they reveal the progress of an individual LLM as it learns and enhances over time.

3.1.1 Benchmarks at the foundation model level

LLM benchmarks consist of meticulously crafted tasks, questions, and datasets that assess a language model's performance in standardised manners. These benchmarks can consist of diverse tasks, datasets, and evaluation metrics that test a model’s capabilities across a range of areas such as natural language understanding, reasoning, and knowledge retrieval. By comparing performance across different LLMs, benchmarks provide standardised and objective measures of quality. Some of the most highly regarded general LLM benchmarks include:

GLUE (general language understanding evaluation)	GLUE is one of the most widely used benchmarks for evaluating LLMs. It consists of a variety of tasks that test a model's ability to perform sentence-level classification, sentence similarity, and textual entailment. High performance on GLUE reflects a model's general competency in understanding and processing natural language.
SuperGLUE	An extension of GLUE, SuperGLUE is a more challenging benchmark designed for models that have surpassed the performance limits of GLUE. It introduces more difficult tasks that require deeper reasoning and problem-solving, making it an essential bench-mark for evaluating cutting-edge models.
LAMBADA	Tests the ability of a model to predict a missing word in a narrative context, focusing on text coherence and contextual understanding while Winograd Schema Challenge (WSC) evaluates co-reference resolution capabilities and commonsense reasoning for text use cases.
SQuAD (Stanford question answering dataset):	Tests a model's ability to answer reading comprehension questions based on a passage of text. It is widely used to evaluate how well a model can extract relevant information from text and answer fact-based questions with precision.
MMLU	MMLU (massive multitask language understanding): MMLU tests a model's ability to handle a wide range of tasks across numerous domains, including STEM, humanities, and social sciences. This benchmark evaluates how well models generalise across different subject areas, which is crucial for assessing versatility and depth of knowledge. Also has a translation subset focusing on a wide range of languages, including Chinese, Indonesian, and other non-English contexts. It tests how well a model can translate complex text between languages, making it a good benchmark for cross-linguistic performance evaluation.
BIG-bench (Beyond the imitation game benchmark):	This large-scale benchmark focuses on testing models in diverse, challenging, and open-ended tasks. It includes complex reasoning, mathematics, and world knowledge tasks, providing a thorough evaluation of an LLM's advanced reasoning capabilities and real-world problem-solving skills.
Chat-to-Agent	For Chat-to-Agent use cases, Dialogue Natural Language Inference (DNLI) measures a model's ability to maintain consistent, logical, and contextually accurate dialogue responses. Whereas MultiWOZ (Multi-Domain Wizard-of-Oz) is a dialogue dataset that spans multiple domains and intents, testing the ability of a model to perform complex goal-oriented conversations.
Chat-to-Execution	For Chat-to-Execution use cases, THOR Benchmark evaluates the ability of agentic models to execute actions and plans in a simulated environment based on natural language instructions. While ALFRED (Action Learning From Realistic Environments and Directives) measures a model's ability to follow complex, multi-step directives and interact dynamically with a simulated environment.

3.1.2 Domain specific benchmarks

After the foundation model has been fine tuned for domain specific applications (we refer back to Figure 1 on GenAI Types), the application should now be tested against specific standards which in this context would be the financial services. Some of these specific benchmarks are÷

FinanceBench	FinanceBench evaluates models based on their ability to process and interpret financial data accurately, making it critical for assessing models that handle market analysis, risk assessments, or regulatory compliance reports. The detailed nature of the benchmark tasks ensures that the GenAI model can handle intricate financial datasets, such as balance sheets or regulatory filings.
FinQA	FinQA focuses on question-answering capabilities specific to financial contexts. It tests how well a GenAI system can handle fact-based queries drawn from financial reports, earnings calls, and other structured financial documents, ensuring the model provides not only accurate but also contextually relevant answers.
FNS	FNS (financial narrative summarisation) evaluates a model's ability to summarise complex financial narratives from dense data sets such as earnings reports or annual reviews. This helps organisations assess a model's potential for automating the generation of key insights from voluminous financial text data.

Financial benchmarks ensure that models are stress-tested in the environments they will operate in, reflecting real-world complexities and regulatory expectations. Another benchmark would be those for language translations for the financial industry for non-English working language markets. Without these specific financial tests, an AI model might perform well in general language tasks but can still fail to meet the high standards necessary for tasks like compliance reporting or financial analysis, leading to potential issues and risks.

Models that integrate retrieval-augmented generation (RAG) strategies, for example, enhance the relevance and precision of their responses by retrieving and synthesising external data sources in real time. The next chapter elaborates on main architectural and process components that influence the benchmarks.

3.2 Architecture and Process Factors

While the underlying core LLM is a crucial part of any GenAI application, it is only the tip of the iceberg. A robust and effective GenAI system consists of different interconnected components that work together to deliver meaningful and contextually relevant outputs. These components include data handling, Retrieval-Augmented Generation (RAG) strategies, fine-tuning methods, and pre- and post-processing techniques; and there are others too like Knowledge Graph, memory management and others. We highlight some of these factors below that play important roles in the functioning, reliability and trust of a GenAI – or indeed any AI – system.

3.2.1 Data

Data forms the bedrock of any GenAI system. There are two critical types of data to consider: training data and RAG (Retrieval-Augmented Generation) data. Curated training data is used to fine-tune the LLM to a specific industry, topic domain, or use case. On the other hand, RAG data is specific to real-time applications; it consists of the systems knowledge bases, often structured documents, that are queried during inference to provide more accurate and relevant responses.

RAG is an advanced technique that augments the generative capabilities of AI models by retrieving relevant information from external data sources. Different strategies can be applied here, from basic keyword search-based retrieval to more sophisticated semantic search mechanisms that leverage embeddings and vector databases. An emerging strategy is Knowledge-GraphRAG, which uses structured data stored in a knowledge graph to improve response accuracy and context relevance. This approach allows the GenAI system to tap into more complex relationships between data points, thereby providing richer and more meaningful outputs.

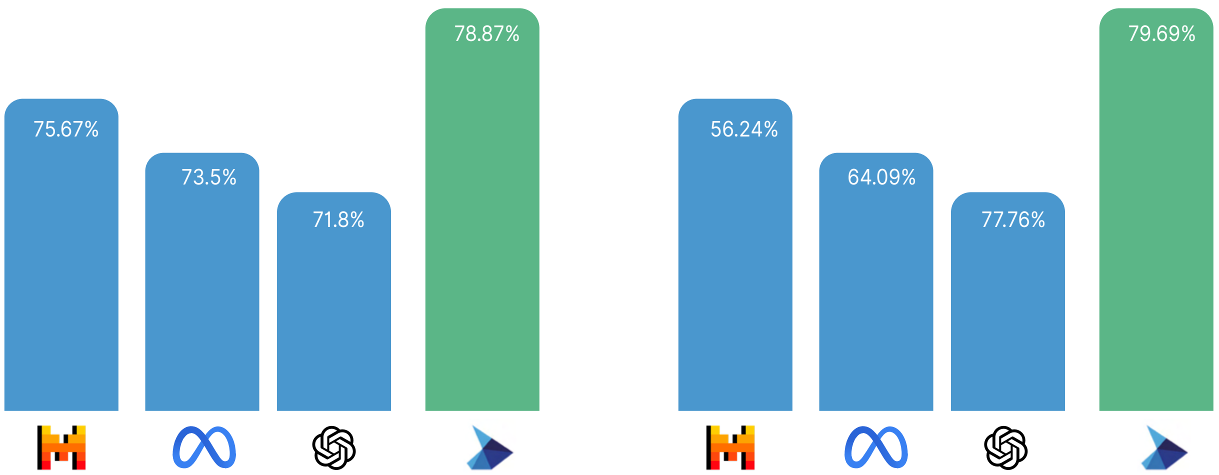
Fine-tuning a GenAI model involves adjusting its parameters to better suit specific tasks or domains. Several approaches are available, including Parameter-Efficient Fine-Tuning (PEFT), Low-Rank Adaptation (LoRA), and its quantised version, qLoRA. These methods enable effective fine-tuning with significantly reduced computational resources.

Another technique, SPIN (Selective Parameter Injection), focuses on injecting domain-specific knowledge directly into specific layers of the model. Each method offers distinct advantages, making it essential to choose the right strategy based on resource availability, desired output quality, and specific business needs.

Chunking, Parsing and Content Filters are pre- and post-processing steps that can be overlooked but which are vital to the success of a GenAI system. Pre-processing tasks involve parsing and chunking multimodal data to ensure the model handles different data types effectively. Content filtering is another crucial step to remove unwanted or harmful content, ensuring outputs align with business and ethical standards. Additionally, question classifiers can be employed to guide the model toward relevant RAG data and tailor responses more precisely.

Meta-prompt templating helps structured model outputs for better readability and consistency. Source highlighting is a post-processing method that adds explainability and transparency by indicating the origin of the generated content, which is particularly important in enterprise applications where verification is crucial.

Figure 9: Financial benchmark performance: specialised versus generalised



FinQA Benchmark

Assesses AI systems in handling complex, multi-step financial queries, for numerical reasoning and financial text comprehension

- Industry-best for financial relevancy and specifitcty
- The most comprehensive results and analyses

FinanceBench Benchmark

Evaluates the performance of AI models in understanding processing financial documents; detect hallucinations an more

- Kodex RAG has highest industry performance
- More accurate (no hallucinations), less computational needs

3.2.2 Customisation

Whether through fine-tuning or model customisation, GenAI systems should be able to be deployed seamlessly with an enterprise's existing workflows and data environments.

High-quality models leverage techniques such as Parameter-Efficient Fine-Tuning (PEFT) and Low-Rank Adaptation (LoRA/qLoRA) allow the GenAI system to be customised without requiring massive computational resources. These features are particularly valuable in industries like banking, where data privacy is vital and localised, secure training can offer both customization and compliance advantages. Benefits that come from such techniques include faster responsiveness, more adaptive deployment and logical data separation to ensure confidentiality between groups of different users within a firm.

Planning also needs to consider if the system will need to access data from multiple different domains, whether such data is streaming or not and how the infrastructure can also support subsequent use cases.

3.2.3 Data and Training for language and cultural sensitivity

Language and cultural sensitivity ensure that output from the system —whether for internal or client-facing—can reflect precision, accuracy and intent of the culture that it serves. High-quality GenAI models, especially those tailored for financial services, should be capable of processing and generating content that reflects linguistic nuances, context, and cultural sensibilities across different use cases within that specific market. Having those abilities would reflect the intensity of training, the infrastructure that runs the system and the human expertise involved. The right type of training data set and subject matter trainers who are effectively bilingual are key success criteria.

3.2.4 System's creativity, reasoning and problem-solving

Beyond basic task execution, a high quality GenAI solution should exhibit an acceptable degree of creativity, reasoning and problem-solving ability. Reasoning ability includes ReAct and Chain-Of-Thoughts explanation. Whether it is generating insights from financial reports or developing new strategies for regulatory compliance, quality GenAI systems such as those in a Chat-To-Agent are those that can propose, reflect and test relevant solutions to complex queries with inputs from human decision makers.

3.2.5 Speed, performance and costs

Performance efficiency—measured through response time and system throughput—is another key aspect that differentiates quality GenAI systems from others. Speed influences the level of user and client experience, and real-time data processing, handling large datasets or providing outputs based on multi-turn chats in complex financial scenarios. If the model is optimised and quantised, this can also mean lower running costs which will be important for sustainable deployments.

Equally important is the cost-effectiveness of deploying quantised models like QLoRA, which significantly reduce the computational overhead and energy consumption compared to full-size models. By ensuring the model size is appropriate for the complexity of the task, organisations can optimise the trade-off between accuracy and resource usage, resulting in better performance without excessive costs. Speed and performance are also driven by hardware factors such as memory size, processor speed, and geographic proximity between users and cloud servers, which can influence latency and overall user experience.

3.2.6 Support and upgrades

Long-term quality also involves continuous support, updates and upgrades. Financial environments evolve rapidly, and GenAI models must adapt to new regulations, emerging market trends, and evolving user needs, and the potentials of retraining of the fine tuned model. Infrastructure will also need to be future-proofed to allow upgrades of model, vector database, RAG, and other components, thereby incorporating “no model lock-in”, “no cloud lock-in” and/or “no database lock-in” design principles.

Close collaboration between AI engineers and business users allow fast iterations to synergise system evolutions and fixes to address pain points and align with user expectations. Regular iterations based on user feedback can significantly enhance both usability and relevance, leading to higher adoption rates and better results. Additionally, a well-designed GenAI system should avoid model lock-in by supporting modularity and interoperability. This means enabling seamless migration to more powerful models and alternative frameworks without disrupting existing workflows, thus ensuring flexibility and the capacity to integrate future advancements as they become available.

04

Factors that compromise quality

The prior section has highlighted some components that drive a GenAI system’s accuracy and trust, which in turn reflects the extent by which some of the key data and model risks of these components are addressed. This section highlights the associated key risks and their mitigants.

4.1 Data risks

In the development and deployment of GenAI systems, data quality and associated risks are critical factors that significantly impact the system's performance, accuracy, and reliability. For highly regulated sectors like financial services, where the margin for error is low, ensuring robust data handling processes and practices is crucial. Risks can arise from various stages of the model lifecycle—from training to deployment—and mitigating these risks requires a combination of technology tools and human oversight. The quality of data used to train GenAI models is foundational to the system's success. Poor-quality, biassed, or incomplete data can lead to inaccurate outputs which can compromise the integrity of decision-making processes.

4.1.1 Data risks mitigants

Several techniques can be employed during the training phase to mitigate these issues:

Data cleaning and preprocessing: Before feeding data into the model, it is essential to clean and preprocess it to eliminate noise, redundancies, and inconsistencies. This ensures that the GenAI system learns from reliable and accurate information.

Bias mitigation: Addressing inherent biases in the training data is necessary. Techniques such as reweighting data samples and adversarial training can help reduce the likelihood that the model will replicate or exacerbate biases in its outputs.

Continuous monitoring: Once a GenAI system is trained, continuous monitoring of the model's performance on real-world data helps detect any drifts or deviations from expected outcomes.

4.1.2 Synthetic data to enhance training

One emerging solution to data scarcity and privacy concerns is the use of synthetic data. Synthetic data, generated through algorithms that mimic real-world data, enables organisations to train GenAI models on datasets that reflect real-world conditions without exposing sensitive or personally identifiable information (PII). This approach is particularly useful in financial services to navigate data protection regulations.

Examples of synthetic data in action include creating financial transaction datasets for fraud detection models or generating customer profiles to train recommendation engines. By leveraging synthetic data, companies can maintain high standards of data privacy while ensuring that their GenAI systems are trained on diverse and representative datasets.

Mitigating data risks and ensuring quality in GenAI systems requires a holistic approach that integrates cutting-edge data techniques, synthetic data solutions, and continuous human oversight.

4.2 System risks

Data and system are two closely interconnected and interdependent factors that drive a number of implementation details and safeguards. As GenAI systems become more integral to augment decision-making, understanding the possible type of model and system risks is critical to ensure sustained accuracy, reliability and trust. Model risks such as drifts, hallucinations, and degradation from feedback loops can undermine the system's precision and effectiveness. The following explains further.

4.2.1 Model Drifts

GenAI systems can also suffer from model drift, where performance degrades over time as its output starts to deviate from the data it was initially trained on. This happens when real-world data start changing leading to mismatch between the training data and the data the model encounters on a daily basis. Certain use cases are more susceptible to drifts, such as client service where daily client questions (behaviour) starts to differ because of product changes that the original data has not captured for the model's training.

To mitigate this risk, continuous monitoring with metrics such as prediction accuracy, error rates and consistency of answers can flag when the system's results are starting to drift from acceptable boundaries.

Automated alert systems can notify administrators when performance metrics fall below predefined thresholds. These alerts enable rapid intervention, ensuring that models are retrained or adjusted before their outputs lead to significant errors.

In conjunction with monitoring, regular retraining on updated datasets is essential to keep the model aligned with current trends and information. For example, a model fine-tuned for regulatory analysis and reporting should be considered for retraining when existing regulations or new AI-specific regulations are to be accurately interpreted for GenAI characteristics.

Model drifts and hallucination are related but they are different issues; the former relates to data match between real world data and training data, while the latter involves falsehood.

4.2.2 Hallucination risks

Hallucination risk is where the model generates outputs that are plausible-sounding but factually incorrect or irrelevant. The risk is related to the nature of GenAI but it does not mean it is chronic or cannot be minimised. Mitigants to this risk includes:

Source verification systems: One method for mitigating hallucinations is to implement retrieval-augmented generation (RAG) techniques, where the model cross-references external, verified data sources to ensure the accuracy of its outputs. This is particularly important in contexts where the model is required to generate responses based on complex or specialised knowledge, such as regulatory compliance or legal interpretation.

Human-in-the-loop oversight: Expert human oversight also plays a critical role, firstly in training, and then in identifying and rectifying hallucinations. By integrating human-in-the-loop (HITL) systems, organisations can have human evaluators review and correct model outputs, especially for high-stakes decisions.

Conservative model settings: For critical tasks, configuring the model to favour conservative outputs (where uncertainty is high) can reduce the risk of hallucinations. Instead of generating specu-lative responses, the model can be set to signal uncertainty or prompt human intervention when it lacks confidence to answer the query.

4.2.3 Feedback loop degradation: addressing user influence

The quality of GenAI systems can degrade over time due to feedback loop degradation, a situation where user interactions inadvertently reinforce undesirable behaviour in the model. This issue often arises in systems that rely heavily on user feedback for learning and optimisation. For example, if a GenAI system in customer service receives frequent but incorrect user feedback, it may learn to prioritise irrelevant or incorrect responses over time.

Feedback filtering mechanisms: To counteract this risk, systems must incorporate robust feedback filtering mechanisms that evaluate the quality of user inputs before using them to influence future outputs. Not all feedback is equal, and the system must be able to discern between valuable inputs and those that could degrade its performance.

Controlled retraining cycles: Rather than relying on continuous learning from user feedback, organisations can implement control-led retraining cycles. This allows time for proper evaluation and validation of feedback before it influences the model's behaviour. Controlled cycles help ensure that only high-quality data is used to update the model, maintaining its integrity.

Diverse feedback sources: Another method for mitigating feedback loop degradation is to introduce diversity in feedback sources. Relying too heavily on a small set of users or a specific subset of interactions can lead to overfitting and degradation. By integrating feedback from a broad range of users and scenarios, the model can maintain a more balanced and accurate output profile.

4.2.4 Mitigants

There are also several mitigants that can be deployed to address these risks. These include

1 **Human-in-the-loop (HITL) evaluation:** While automated systems can handle vast amounts of data, human oversight remains a key mitigant for ensuring model quality and ethical decision-making. Human-in-the-loop (HITL) methodologies involve human evalua-tors at various stages of the model lifecycle, particularly in the areas of:

2 **Model training and validation:** Before deployment, human experts validate the outputs of GenAI systems to ensure that they align with industry standards and ethical guidelines. This is especially important in financial services, where errors can lead to regulatory violations or financial losses.

3 **Ongoing feedback loops:** In live environments, HITL systems allow for continuous evaluation, where human feedback is incorporated to refine the model's outputs over time. This iterative process ensures that the model adapts to evolving conditions and remains aligned with the organisation’s goals.

4 **Robust model governance framework:** includes version control, continuous validation, and anomaly detection systems that flag irregularities in model behaviour.

4.2.5 Model evaluation techniques as mitigants

To ensure that GenAI models perform optimally, a variety of evaluation techniques that are in addition to benchmarks can be applied. For example,

Cross-validation: During model training, cross-validation techniques are used to assess the model's performance across

Performance metrics: Models are evaluated using performance metrics such as precision, recall, and F1 score, which measure the accuracy and relevance of the outputs. These metrics are especially important in compliance and risk management applications, where high precision is critical.

Scenario testing: In the financial industry, models are often tested on edge cases or rare scenarios to ensure that they perform robustly under all conditions. For example, GenAI models used in market predictions might be tested against historical data from financial crises to assess their resilience.

4.3 Other risks

4.3.1 Dependency risks

GenAI requires specialised infrastructure and expertise which can create dependency risks on models, databases and providers, and such risks can be mitigated with design principles and architecture that allows transferability of model, databases, Cloud and other core components. For example, vector data format portability for data transfers and ensuring dependencies such as libraries can be independently changed or updated. Other considerations include÷

Open-source alternatives: Open-source AI models, such as those from Hugging Face or similar platforms, offer more flexibility and control, allowing organisations to tailor solutions according to their specific requirements.

Partner with specialised GenAI startups: Collaborating with smaller AI firms that can provide access to niche technologies and expertise.

Implement multi-cloud strategies: Reducing the dependency on a single vendor while allowing a broader range of services.

4.3.2 Cybersecurity risks

In financial services, security and compliance are non-negotiable. A high-quality GenAI solution should adhere to the battle-tested industry cybersecurity standards including those that are related to the uses of third party open-source codes, and forward-looking human expertise to ensure data protection and system's resilience. Implementation needs to consider LLM-specific types of attacks including data poisoning, prompt injection and adversarial ones that can lead to data leakage, misleading information or generation of harmful outputs.

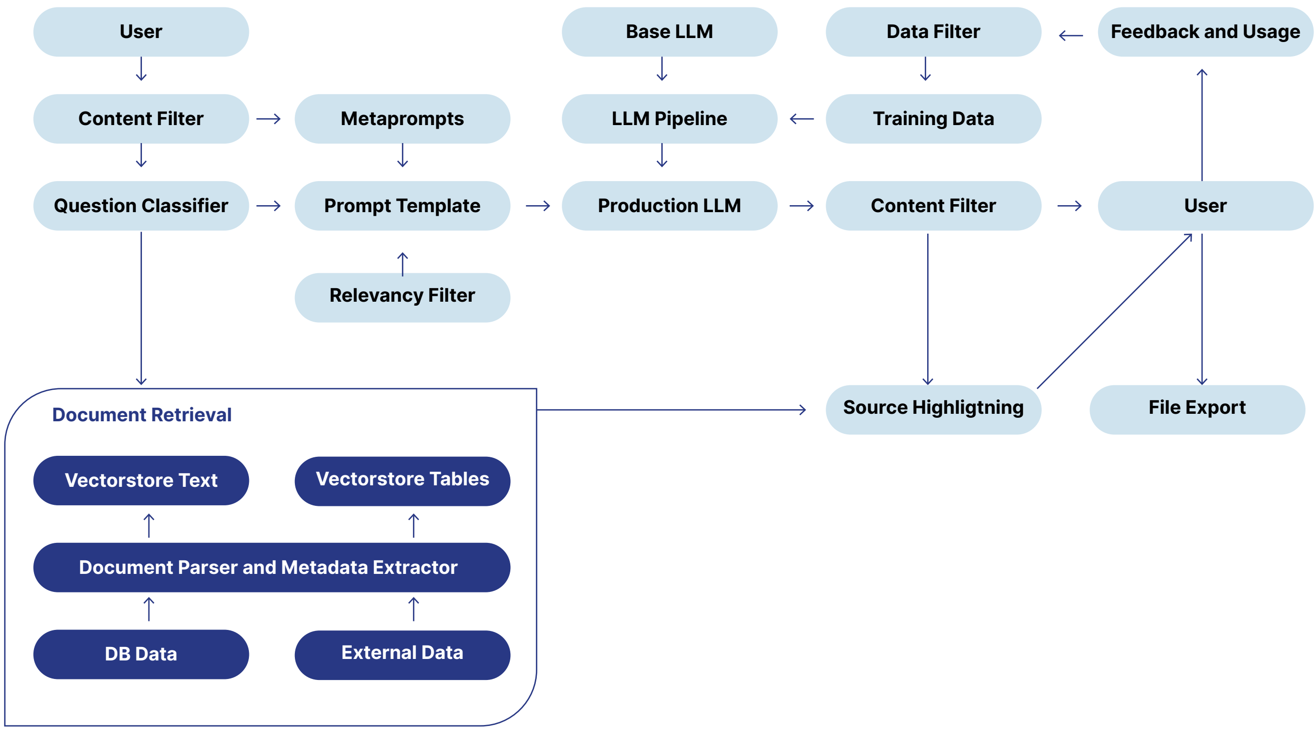
Figure 10: Attacks specific to LLMs

Attack Type	Description	Probability	Likelihood (same user over time)	Implications
Data Poisoning	Malicious data is injected into the training dataset to alter model behaviour	Low to Medium. Depends on foundation model and fine tuned model data sets	Low	Biassed, misleading or harmful outputs
Prompt Injection	Manipulate model behaviour with misleading input prompts	High	High	Biassed, misleading or harmful outputs
Adversarial	Inputs crafted to exploit known model weaknesses	Medium	Medium	Biassed, misleading or harmful outputs

Source: Securities Services, Deutsche Bank

See the figure (Figure 12) below for an example of a GenAI system
architecture that is created to minimise cyber risks including risks of inappropriate results.

Figure 11: High level architecture with filters and feedback loop



Source: Kodex AI

4.3.3 Sustainability risks

The energy consumption associated with training large models can contribute to a company's carbon footprint, especially given the high computational requirements for training and deploying of such models. One approach to mitigate these impacts is the use of smaller models, quantised models and/or green data centres that leverage renewable energy sources. Another is on efficient model design which optimises the efficiency of model training and inference. Techniques such as Parameter-Efficient Fine-Tuning (PEFT) and Low-Rank Adaptation (LoRA/qLoRA) allow models to achieve high performance without requiring extensive retraining on new datasets, thereby reducing the computational power needed. These methods can cut down on energy use while maintaining the model's effectiveness.

05

Implementing GenAI & Recommendations

Even after assessing a GenAI as being fit for use and addressing the risks of the systems, there are still significant regulatory, ethical and market considerations that are crucial for successful implementation. This section shares a selection of insights and challenges that can still arise on the road to deployment, and makes some recommendations that private-public sector forums and collaboration can consider to advance the uses of this technology in the financial industry.

5.1 Regulatory considerations

Recognising its power to transform, policymakers and regulators in capital markets globally are also increasingly concerned about the unknown and extensive impacts of GenAI and AI advancements on both markets and individuals.

Currently, policy and regulatory responses can be categorised into several approaches: horizontal AI regulations that apply across all AI types, vertical AI regulations that target specific AI types and their associated risks, ethical guidance, and industry positions asserting that existing regulations are adequate to govern GenAI and AI systems without adding further compliance burdens. Figure 13 provides a non-exhaustive inventory of regulatory topics pertinent to GenAI systems, highlighting the compliance challenges organisations can encounter as they work to implement GenAI.

Figure 12: Regulatory topics relevant to GenAI systems, not in any order of priority

Related relevant regulatory topics (not exhaustive)

Ethics, Fairness, Explainability and Transparency	Data Quality, Completeness and Bias	Outsourcing and vendor risks management
Model Evaluation and A lgorithmic Discrimination	Confidentiality and Privacy	Third Party Risks and Open-Source Code
Accountability and Shared Responsibility	Localisation	End User Agreement
Content which includes harmful content, misinformation, falsehood	Intellectual Property and Copyrights	Technology Risks Management, Cybersecurity and Resilience
Environment, Sustainability and Employment	Cloud and Infrastructure	Market Manipulation, Systemic Risks

Source: Authors' views, not representative of Deutsche Bank or Kodex AI

However, the technology itself is neither inherently good nor bad, even though it may mirror the philosophies of its creators; rather the degree of risks depends on the use case where the technology is applied. Therefore, implementing GenAI systems will require detailed understanding of the use case, context and applications, and careful articulation of how technology would meet both the business goals and regulatory adherence in a manner that is cost-effective, and not unnecessarily complicated.

Clarity and continued public-private discussions on key topics to streamline governance can be tremendously helpful to the global financial industry. Not new regulations but rather, an equivalent of a mind-map that goes across all the different existing regulations to link sections that are relevant to GenAI can be most helpful for effective and efficient start to compliance and adherence.

5.2 Explainability and transparency

GenAI text-to-text handles imprecise human language and is “creative” by its very nature. However, the probabilistic characteristics of GenAI outputs, along with concerns over accuracy, security, and data privacy, can be significant barriers to adoption which needs trust in the system’s outputs. This is why a sequenced composable approach (Figure 4 refers) to implementing GenAI can be helpful.

Related to the topic of trust is the issue of understandable explainability and transparency in GenAI model’s output. It is recognised that LLMs are complex and therefore, its explainability and transparency can be complex but not understandable by lay persons, or risks being too simplified. Together with the public sector, the financial industry can benefit from clarity on how these values can be satisfactorily achieved. Currently, techniques followed to ensure explainability and transparency include÷

Model and process documentation: Documenting the training data, model architecture, and decision pathways.

Source attribution: Highlighting clearly the source of any generated content.

Audit trails: Retaining the prompts and recording the model’s decision-making process to enable comprehensive post-hoc analysis.

Human oversight: Integrating human-in-the-loop (HITL) systems to review and validate critical outputs.

Navigating ethical guidelines require a robust governance framework that incorporates data quality and accountability. Organisations should consider AI-focused forums and oversight teams to guide GenAI deployments, ensuring that these systems meet both internal standards and external regulatory expectations.

5.3 Data and Hallucination

The effectiveness of GenAI training and the accuracy of its outputs hinge on the quality and comprehensiveness of the data used. High-quality data significantly reduces the risk of "hallucinations," which we define here informally as errors, falsehoods, or outdated information. GenAI models depend on training data to be finely tuned for specific applications, ensuring that the content generated aligns with the requirements. Incomplete or low-quality training data can result in flawed, misleading, or biassed outputs.

For example, models trained on unrepresentative data would only be effective within a narrow context. There can also be data distribution mismatch – that is where the data set that trained the model does not match the actual live ways it needs to respond. When systems extend beyond such scope, the resulting outputs can be misleading, out-of-date, with falsehood to have harmful implications depending on the application.

It's not just the data that matters. A lack of suitable infrastructure to fit business requirements, from either insufficient expertise or budget, can also lead to inaccurate or hallucinated outcomes. Key factors such as text tokenisation strategies, Retrieval Augmentation Generation (RAG) methods, dynamic content filters, and the involvement of human domain experts throughout the fine-tuning and training stages play crucial roles in the precision of a GenAI's output.

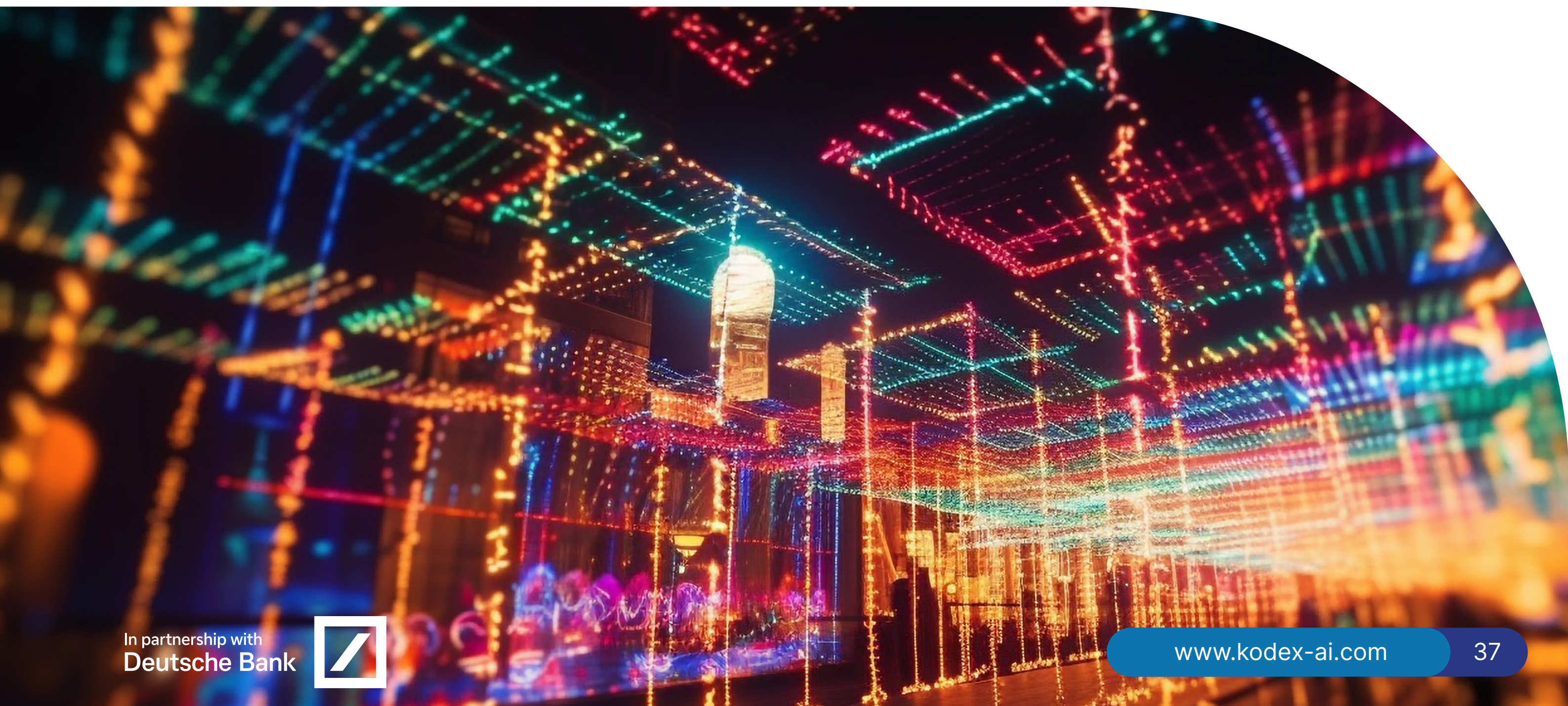
Therefore, while hallucination is a risk related to GenAI, it can be effectively managed via data pre-post processing, architecture that includes input-output content filters, training, retraining and reinforcement learning by domain experts as well as hardware considerations including RAG and memory size. Users setting the creativity level of the system, for example through the "Temperature level", Top K and/or Top P, can also influence the degree of creativity-hallucination.

Concerns of this risk are legitimate but should be grounded by these factors and mitigants.

5.4 Synthetic data

Synthetic data can augment incomplete data sets and also offers the potential for privacy preservations.

Utilising synthetic data or data augmentation techniques like Self Play Fine Tuning (SPIN) to tackle incomplete datasets presents both opportunities and challenges. On the positive side, synthetic data can effectively mitigate privacy concerns and address issues with limited or biassed datasets by offering more diverse examples. However, it also necessitates scrutiny to ensure that the synthetic data remains representative and accurate without perpetuating the inherent weaknesses of the original training dataset. There is also a risk of synthetic data being flawed and failing to capture real-world complexities, potentially leading to inaccurate outcomes.



To help data quality and completeness, the financial industry can establish centralised repositories of standardised, anonymised, and high-fidelity datasets that are purpose-built to test and fine tune financial applications as well as applicable benchmarks. Awareness of synthetic data and how it can be generated should be fostered, supported by clear documentations and assumptions used in its creations. Indeed, industry-wide collaboration is essential on synthetic data, and to create industry-specific training datasets to accelerate progress and reduce implementation barriers.

5.5 IP and copyrights

Without synthetic data, the risks of flawed and incomplete data can become more pronounced from the rise of intellectual property and copyright issues that would constrain the availability of public data for use in GenAI applications. The copyright paradox is both ironic and challenging. Intellectual property rights and its protection are vital to ensure creators of content are protected for their work and their generosity in sharing. But on the other hand, these same rights and protection can prevent access to the comprehensive-ness of data that GenAI needs to be effectively trained. Limited access to good quality data can ultimately lead to lower quality inaccurate outcomes.

For example, announcements by regulators about market changes, which serve the public good, can be subject to terms and conditions prohibiting commercial use. However, the definition of 'commercial use' for public information has become increasingly ambiguous. For instance, if a library of public market change news is integrated into a GenAI system for comprehensive textual analysis for clients, enabled by GenAI systems, is it considered commercial use even if no fees are charged for using the system?

This would bring us to fair data use that the next point touches on.

5.6 Open standards and fair data practice

To address the broader implications of lack of suitable training data, industry and regulatory bodies should consider policies that promote fair data practices – policies that facilitate data sharing while protecting IP and copyrights. This will have certain “Butterfly Effects” to benefit level playing fields for smaller AI firms to develop competitive AI solutions, mitigating concentration and dependency risks, as well as addressing data-related risks like hallucination.

Data is the glue and catalyst that allows any GenAI model to become a domain relevant application, and in doing so, ensures system resilience and mitigating dependency risks.

5.7 Cross-border scalability

The diversity, volume and scope of regulatory requirements within and across jurisdictions complicate GenAI implementations. Considerations include data protection laws, cross-border data flow restrictions, data sovereignty, transfer, data usage rights, guidelines on algorithmic accountability, and specific rules on model validation and auditability.

For instance, some jurisdictions may require that personal or any data be stored locally or impose restrictions on cloud-based solutions. As a result, firms looking to implement GenAI across regions need legal and compliance capabilities to handle these nuances, together with informed technologists and AI engineers, to discuss topics like hybrid cloud strategy or leveraging federated learning which allows training to occur locally without moving sensitive data across borders. That is to say, combining technology and compliance views as a solution to address regulatory concerns.
Scalability discussions also extend to maintaining consistent quality and adherence across diverse regulatory environments. Ensuring that a GenAI system can generate consistent, high-quality outputs while respecting local laws can require training data customisation and will need ongoing monitoring.

In their use cases, organisations would also need to consider adapting models to dialects, local legal contexts and regulatory nuances to ensure that the system's output can remain relevant and trusted. This leads us to the next point on non-English benchmarks that would play a central role here.

5.8 Non-English benchmarks

An earlier chapter has highlighted the importance of benchmarks as quality assessors and indicators. In markets where non-English languages dominate, deploying GenAI systems can be challenging if it is without sufficient linguistic datasets for training and benchmarks. Such a situation can lead to inaccurate translations, misunderstandings, and cultural insensitivity, and to heightened concerns about legal liabilities in commercial applications.

From a practical perspective, there's a trade-off to consider. Adopting a conservative approach by delaying GenAI deployment until the necessary benchmarks are available could be a solution. However, depending on how swiftly these benchmarks become accessible, firms risk falling behind and widening the technology gap. On the other hand, rushing to implement GenAI systems on a large scale might expose them to various risks, including reputational damage.

Therefore, non-English markets can benefit from its own industry developed, published local LLM benchmarks with an emphasis on translation and industry specialised nomenclature. This would allow simple but powerful functions like English queries directly into local language materials for effective communication by that market to the world at large.

5.9 Expertise availability, jobs and reliability

The successful integration of GenAI within regulated entities is not merely a techni-cal challenge but also a human one. The complexity of these systems requires not only deep technical expertise but also a nuanced understanding of regulatory requirements, ethical considerations, and business domain dynamics. As such, GenAI talent pipeline is important, and one that an organisation can already build through reskilling, practical experiences and vocational training that is also age inclusive.

A strategic plan that includes upskill/reskilling can also assuage a level of fears of job loss due to AI-driven automation and internal focus on cost streamlining, which could lead to resistance from employees in various ways. A resistance can come in the form of not accepting anything less than 100% perfection from a GenAI system. Addressing this requires transparent communication around how GenAI will augment rather than replace human roles and thoughtful new procedures that allow AI systems with probabilistic results to fit.

Reskilling and vocational skills initiatives can focus on model training, writing new operational procedures, supervising, managing, and improving AI systems with reinforcement learning. This can foster a culture of innovation and growth, and to accept AI systems as a positive driver of change and career opportunities in an organisational fabric.

5.10 Quantifying ROI and productivity gains

For GenAI to be accepted for implementation within regulated entities, it has to demonstrate tangible business value. A challenge lies in being able to quantify the return on investment (ROI from GenAI implementations that generates productivity gains as its main benefit. Traditional ROI metrics such as cost savings and efficien-cy gains are unlikely to fully capture the benefits of enhanced decision-making capabilities, better compliance, and faster informed processes. To objectively assess GenAI's value, firms can consider productivity metrics that include:

Reduction in compliance review times: How much time GenAI saves teams in reviewing and analysing large text datasets.

Accuracy in risk assessments: Comparing pre- and post-GenAI deployment risk management effectiveness.

Enhanced customer experience: Measuring the impact of GenAI on customer satisfaction and engagement scores.

Scalability and flexibility: Evaluating the ability to scale regulatory processes with minimal additional cost or resource strain.

Industry ROI and risk assessment frameworks that are accepted by participants and regulators can create a consistent minimum business case standard and enable smoother adoption of AI systems in organisations.

06

Conclusion Can GenAI thrive in the regulated financial industry?

Implementing GenAI in highly regulated sectors like financial services presents a unique set of opportunities and challenges. While the potential benefits—ranging from greater operational efficiency, augmented people capacity and enhanced customer service to risk management and compliance automation—are substantial, these advantages come with a backdrop of complex regulatory landscapes, ethical considerations, and technological expertise availability.

These and other challenges underscore that shared responsibility can become dispersed among various parties with unclear boundaries, leading to increased distrust when issues arise. Perception of novel risks to the industry is itself a risk that can result in excessive regulations on GenAI and AI systems, potentially stifling their capacity for positive impacts. However, the financial industry is a highly regulated one that has been using AI in different forms and there is a well of experience to pivot and address challenges in GenAI. For example, responsibility can be shared based on the level of control that stakeholders have in the deve-lopment and deployment of a Gen AI system, referencing and leveraging established standards in Cloud environments.

To harness such experiences, accessible and regular public-industry engagements are important to raise awareness in forward looking specific topics and to agree on pragmatic approaches towards new but yet old topics; like determining level of control for responsibility assignments, data and privacy enhancing technologies, IP and copyrights for access to quality data, local benchmarks, public trusted training data sets, agreed good practices for explainability and transparency; and other topics.

Such discussions are also important to find balance, understand trade-offs and accept those that can be accepted at this time, establish clear governance frameworks, and foster good practices across different stakeholder segments that AI sandboxes can be useful.

The focus is not all about risks, but growth and the relevant risk management that should be applied for it to be sustainable. An environment for local GenAI ecosystem development – including education, infrastructure, research and homegrown AI – to ensure that GenAI's transformative potential can benefit the broader economy and the participants therein.

GenAI represents a significant transformative leap forward in human-computer interface to unlock new possibilities for organisation and people alike. It democratises user access to powerful tools that enhance creativity, efficiency, responsiveness and decision making. As we advance forward, pragmatic approaches to ensure that it drives business outcomes and inclusivity would benefit a diverse empowered workforce to create and thrive in an AI-enhanced future of the financial industry.

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KODEX AI

THE GERMAN BANKING & FINTECH MARKET IN 2025

CONTEXTUAL SOLUTIONS

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Untapped Growth Potential

Germany's Fintech Evolution

Germany is often seen as a nation of precision engineering and industrial might, but an untapped technology and digital finance potential lies beneath the surface. This transformation is driven by cultural nuances, rigorous regulations, and a uniquely resilient ecosystem. At Contextual Solutions, we've been fortunate to play a role in this evolution, working with local and foreign companies and entrepreneurs and helping them navigate their entrepreneurial journey in Germany.

If you can make it in Germany, you can make it anywhere—but success doesn't happen by chance. It requires strategic planning, cultural awareness, and a deep understanding of what makes businesses thrive in this unique market. This report is a combination of all our first-hand learnings.

This report goes beyond the obvious, uncovering the key factors driving success for local and 'localized' companies. We explore emerging trends, 2025 market predictions, and invaluable insights from industry experts. To bring these insights to life, we've also highlighted inspiring success stories from those who have effectively navigated the German business landscape.

A heartfelt thank you to all the experts who contributed their knowledge and perspectives - your input has been instrumental in shaping this report.

Let's explore this dynamic landscape together. Wishing you all a successful year!

Best wishes from Berlin,
on behalf of
Contextual Solutions GmbH

Şebnem Elif Kocaoglu Ulbrich, LL.M., MLB

Managing Director & Founder

Executive Summary

MARKET DYNAMICS

In 2024, tight budgets put a lid on new product innovation, leading to fewer start-ups and even fewer new unicorns. Yet, it was the year of scale-ups and SMEs - many seized the moment to accelerate growth and solidify their market positions (See: 5-8)

TRENDS AND RECOMMENDATIONS

In 2025, German fintechs should prioritize low-risk, value-driven financial products that stand out through uniqueness and a strong focus on customer education. Meanwhile, banks must carve out a distinct identity to ensure long-term success. Innovation that drives new revenue streams while optimizing costs will be key to strengthening their brand and staying competitive (See: 16-21).

GERMAN MARKET CASE STUDIES

What gives Raisin and Pliant their competitive edge? And which misstep knocked Solaris off its BaaS throne? Check out our case studies throughout the report.

Ecosystem Focus and Fintech Unicorns

Hamburg

#E-Commerce #Investment #OpenBanking #RealEstate #Trade

Berlin

#BaaS #Banking #CoreBanking #Crypto #Trading

TRADE REPUBLIC, raisin., N26, taxfix, Solaris*

Frankfurt

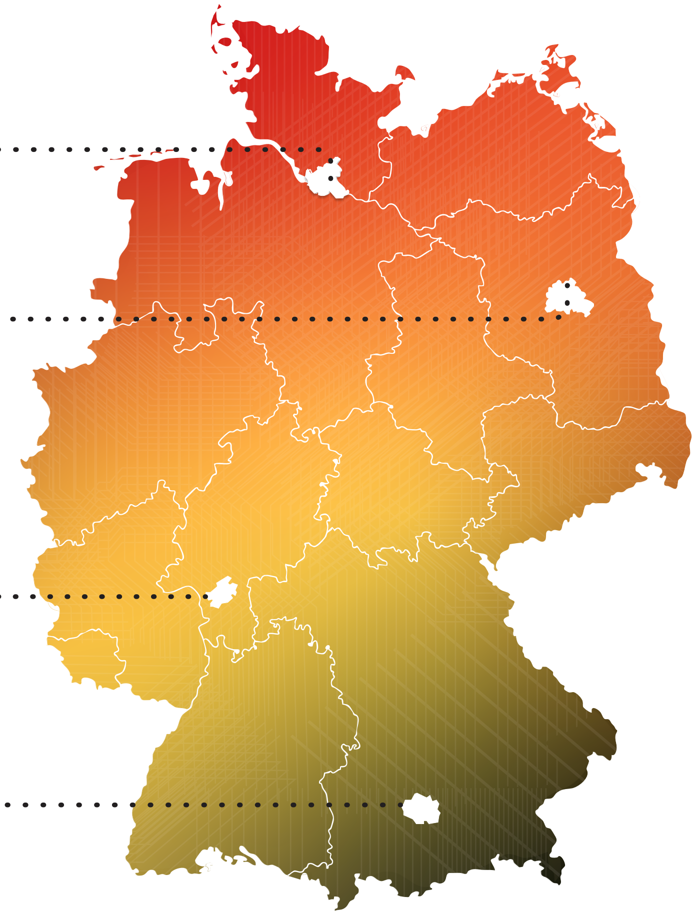
#Banking #Crypto #Data #FX #Insurance #Payment #Trading

CLARK

Munich

#Asset Management #Insurance #Investment #Payment #PersonalFinance

CHECK24, scalable CAPITAL



** Solaris likely lost its unicorn status after the latest funding round in 2025. Several sources reported a significant valuation drop. However, the current valuation remained undisclosed when this report was finalized. Thus, Solaris is still included in this overview.*

GERMAN FINTECH LANDSCAPE:

FROM 2024 TO 2025

2024 FLASHBACK

H1: VC FUNDING AND DEBT FINANCING SPEEDS UP

Q1

- Trade Republic reported its first annual profit
- Neobroker Lemon Markets received a license from BaFin
- Berlin-based Pliant raised funds and **enters a growth phase**
- BaFin released its **IT outsourcing risks report**
- **Bitkom study**: digitalization as a lever for achieving climate targets
- Anti-money laundering authority coming to Frankfurt
- BaFin: Deutsche Bank must fix its money-laundering controls again
- Deutsche Börse launched a crypto spot trading platform for institutions
- **Bundesbank:** "The digital euro is a critical infrastructure for Europe"
- Germany's VC ecosystem **lagging behind**
- BaaS Solaris loses Grover as a customer
- N26 launches instant savings
- Mondu secured €30M debt financing
- Monite raises €5.5M
- Creditshelf filed for insolvency
- Solaris raised €96M

Q2

- Bundesbank partners MIT for CBDC privacy research
- Commerzbank **missing** its sustainability targets
- LBBW forms crypto partnership with Bitpanda
- Fintech-Festival FIBE kicks off with BaFin's pop-up stand
- British SME fintech Tide launched in Germany
- BaFin lost its patience with Solaris
- Germany's most active VCs investing only at seed and below
- LIQID closed its second venture capital fund, reaching €130M
- Berlin-based Cloover secured €105
- lemon.markets raised €12M for EU expansion
- FFWD24 conference hosts the Wirecard whistleblower Pav Gill

H2: INSOLVENCIES & NEW CRYPTO LICENSES

Q3

- EPI launches its M2M payment solution WERO
- BaFin's new **MiCA opinion piece** went live
- PBA's German fintech map **updated**
- BaFin **considers** many life insurance policies to be too expensive and nonsensical
- Bitpanda selects Solaris KYC solution for onboarding in Germany
- Düsseldorf-based Compeon filed for insolvency
- Delivery Hero's lending plans are revealed
- Dock Financial filed for insolvency. Later, police **raided** Dock Financial's offices as part of a money laundering investigation
- Ride Capital files for insolvency, gets acquired by a family company
- Wirecard verdict **extends the personal liability to the former management board members**
- Investment app Forget finance started looking for a buyer
- Pliant won Volksbank as a partner

Q4

- Neobank Tomorrow raised a €5m round
- Berlin-based UnitPlus raised €4.7m
- Germany announces European digital identity wallet plans
- Boerse Stuttgart tested the use of blockchain settlement solutions
- Solaris started seeking fresh funding
- BaFin withdraws special representative at Deutsche Bank
- German neobank N26 reported its first-ever profitable quarter in Q3
- Deutsche Bank acquired a stake in AI start-up Aleph Alpha
- Solaris sold its UK entity
- German bank DekaBank **received** a crypto custody license from BaFin
- Cashlink secured a custody licence from BaFin
- Deutsche Bank and Crypto.com sign corporate banking deal
- Scalable Capital launched a unified investment platform
- Mambu acquires French payment technology provider Numeral
- Smava entered an acquisition process

GERMANY'S FINTECH MARKET SHOWS STRENGTH DESPITE ECONOMIC PRESSURE

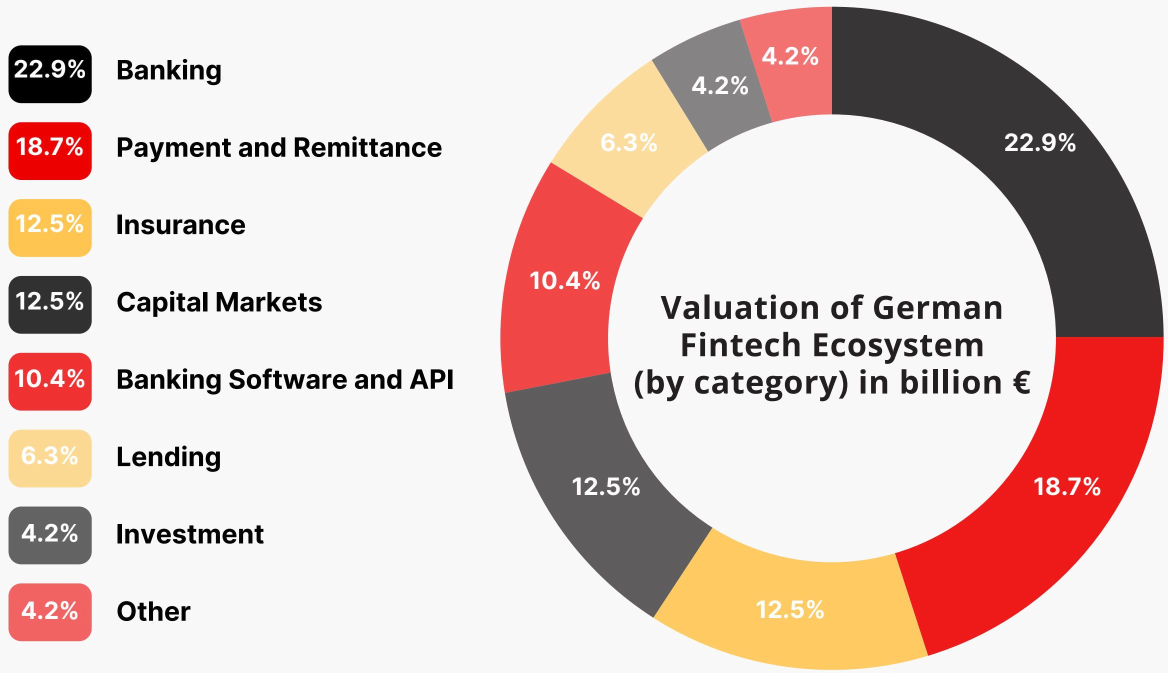
AI and embedded finance lead Germany's fintech resurgence

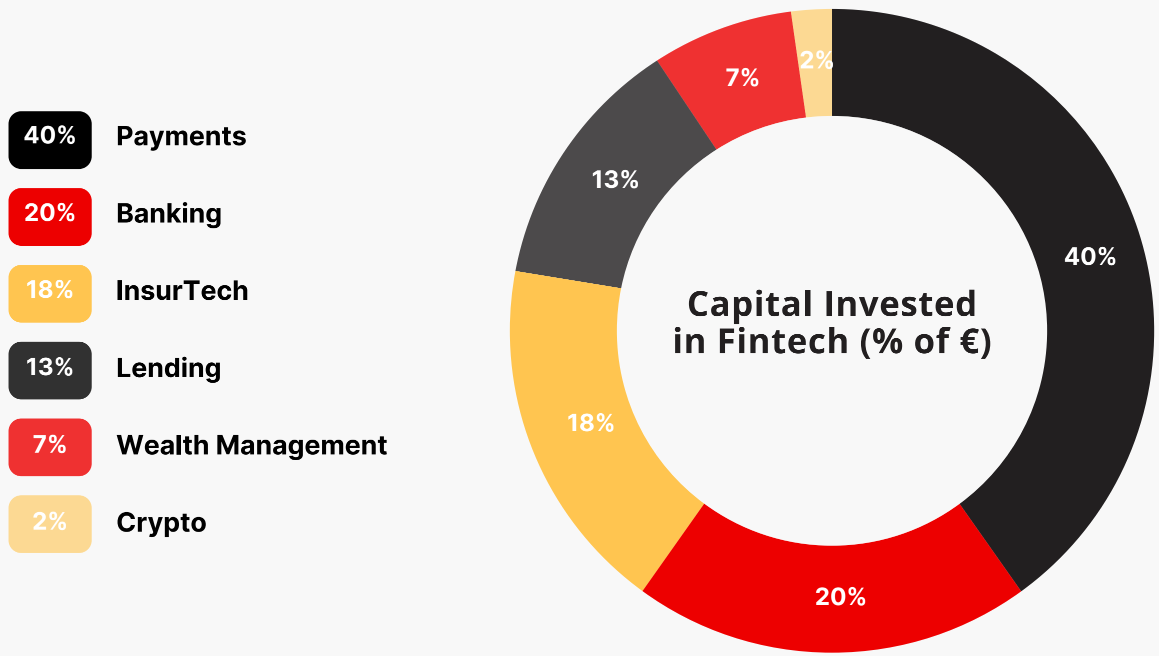
Germany's fintech market showcased resilience in 2024, with total startup funding reaching $8.2B, a 4% increase from 2023, reflecting a stabilizing ecosystem despite global economic challenges.

Fintech-specific funding in H1 2024 amounted to $482.06M, with a 21% increase compared to H2 2023, although H2 funding dropped by 43%.

The startup ecosystem experienced growth, with 2,766 new startups founded, an 11% increase from 2023, making 2024 the second-strongest year for startup creation in Germany after 2021. Berlin and Munich continued to dominate as fintech hubs, while Munich saw a 13% growth in VC investment, driven by key deals.

Key focus areas included AI-driven solutions, embedded finance, and software startups, with the software sector growing by 33%, reaching a record 618 new companies. Corporate Venture Capital (CVC) investments grew 81% year-over-year, fostering strategic collaborations and supporting scalable fintech models.





MID-SIZED DEALS AND PARTNERSHIPS DRIVE FINTECH GROWTH IN 2024

Late-stage scaling remains a test for FinTech

Partnerships between banks and fintechs flourished in 2024, emphasizing innovation in credit services and embedded finance.

M&A activity in Germany saw a 9.4% increase in deal value, with mid-sized deals leading the consolidation trend despite an overall drop in deal volume.

The broader startup ecosystem benefited from a record 33% growth in the software sector, which likely bolstered fintech B2B and SaaS solutions.

However, economic challenges such as rising insolvencies in B2C-heavy sectors continued to create headwinds. (1,3) Top-performing fintechs like Finanzguru (+168% CAGR) highlighted the ecosystem's potential for consumer-focused innovation. (3,6)

The ecosystem's ability to scale late-stage startups will depend on overcoming regulatory hurdles and increasing collaboration across regions.

Germany's Top FinTech Performers by 2-yr revenue CAGR

1	Finanzguru	Personal Finance	168.67% CAGR
2	Circula	CFO Tech	140.48% CAGR
3	Bezahl.de	Payment Solutions	102.96% CAGR
4	Timeless Investments	WealthTech	76.27% CAGR
5	Spotixx	Data and Analytics	73.21% CAGR
6	ProNoblis	Insurance	66.40% CAGR
7	Prestatech	RegTech	41.42% CAGR
8	PAIR Finance	Debt Collection	35.32% CAGR

Finanzguru

Personal Finance App | AI powered

Finanzguru helps users manage subscriptions, optimize contracts, and gain full transparency over personal finances.

Frankfurt | 2015 | ~80

Largest Fundraise	2-Year CAGR
€13 million (2023)	+168.67%

	Deal Type	Investment Size	Strategic Focus	Key Differentiator
Cloover	Seed Funding	$114M	Renewable Energy	Climate Tech FinTech
Pliant	Series A Extension	$8M	Corporate Finance	AI-driven Credit Cards
Lakestar	Fund Closure	$600M (Fund Total)	Multi-sector Growth	Multi-sector VC Focus
Allianz	Innovation Fund	Undisclosed	Innovation Ecosystem	Institutional Leadership
TIS	M&A Majority Stake	Undisclosed	Payment Solutions	Payments and Liquidity
Finmid	Early-Stage Funding	$35M	SME Financial Tools	SME Platform Tools
Finom	Series B Funding	$50M	SME Banking	SME Banking Reach

GERMAN MARKET SPECIFICS

SOLARIS' STORY: SCALING BAAS SUCCESS MEETS REGULATORY REALITY

BaaS: More Compliance, Less Tech

Germany's leading BaaS provider showcases the opportunities of embedded finance and the risks of rapid growth. Solarisbank's journey offers a lesson for fintechs entering Germany's competitive market.

With €96 million raised in 2024 and over 1.3 million credit card accounts under management, its role in embedded finance is undeniable.

Yet, regulatory scrutiny from BaFin over anti-money laundering controls and operational challenges with key partnerships highlight the fine line between growth and compliance. Solarisbank's case demonstrates the importance of balancing innovation with infrastructure and regulatory rigor.

Solaris SE

Banking-as-a-Service | API solutions

Solarisbank provides APIs that enable companies to integrate financial services into their platforms.

Berlin | 2016 | ~450

Largest Fundraise	2-Year CAGR
€190 million (2021)	N/A

2016
Founded in Berlin Germany as a Banking-as-a-Service (BaaS) platform offering APIs to integrate financial services into partner ecosystems.

2018
Expanded services across Europe leveraging the EU's regulatory passporting framework to reach multiple markets.

2020
Partnered with Samsung Pay to provide digital payment services in Germany and Europe.

2021
Raised €190M in Series D funding achieving unicorn status with a valuation of €1.4B.

2022
Appointed a special monitor by BaFin due to concerns over anti-money laundering (AML) compliance.

2023
Initiated a high-profile partnership with ADAC managing 1.3M credit card accounts.

2024
March
Raised €96M in Series F funding to support scaling initiatives like the ADAC credit card program.

July
Faced BaFin fines and extended regulatory oversight highlighting continued AML compliance issues.

September
Operational challenges surfaced with the ADAC partnership including difficulties in data migration and card issuance delays.

2025
After facing economic turmoil, including layoffs, a vital €140M series G funding was secured. Solaris is believed to have lost its unicorn status as the valuation dropped substantially.

PLIANT'S STORY: GERMANY AS A EUROPEAN LAUNCHPAD FOR AI POWERED SOLUTIONS

Scalable Corporate Credit Card Solutions

Berlin-based Pliant has established itself as a key player in the European fintech ecosystem, showcasing the potential of specialized corporate credit card solutions.

Founded in 2020, Pliant leverages AI-driven tools to streamline expense management, catering to industries like hospitality. Its anticipated Annual Recurring Revenue (ARR) of up to €28 million in 2024 underscores its ability to meet market demands. In 2024, Pliant achieved two major milestones: securing an Electronic Money Institution (EMI) license in Finland and obtaining Visa Principal Membership, enabling it to issue corporate credit cards independently.

These developments solidify its leadership in the embedded finance sector while enhancing its capacity for international expansion. Strategic partnerships with Commerzbank and Vereinigte Volksbank have further expanded its reach, enabling innovative features like multi-currency credit options.

Germany, despite its stringent regulatory landscape, serves as a powerful launchpad into the broader European ecosystem. Pliant exemplifies how businesses can harness the unique strengths of even the most demanding environments to drive global expansion and establish a strong brand presence.

Pliant

Corporate Credit Cards | API solutions

Scalable corporate credit card solutions powered by AI, optimizing expense management.

Berlin | 2019 | ~50

Largest Fundraise	2-Year CAGR
€163 million (2024)	+133.5%

GERMAN BUSINESS CULTURE – THE OVERLOOKED SUCCESS FACTOR

BACKGROUND

Newcomers to the German market often perceive the German way of doing business as procedural, cold, or static but also as professional, honest, or determined.

Depending on the origin, the culture gap can be enormous when starting operations in Germany. However, adopting the local business culture is essential.

Finding business clients, collaborating with partners, or communicating with relevant authorities – German business culture must be mastered.

RISK APPETITE

Germans are risk-averse, resulting in a high degree of formalism and reluctance towards change and innovation.

Valuing proven ways  Embracing change

Focusing on risks  Focusing on opportunities

COMMUNICATION

Germans say what they mean and mean what they say. This directness can be considered rude but reflects a strong need for efficiency.

Direct, unfiltered feedback  Indirect, sugarcoated feedback

Concise, simple, clear  Multilayer, extensive, subtle

OPERATIONS

Germans follow a clear, thorough, and detailed plan. This can ensure perfect results but often lowers flexibility and pragmatism.

Planning  Exploring

Static order  Flexible order

LEADERSHIP

Most German organizations are hierarchically organized, with decision-making power being attributed to the top management.

Consensual  Approachable

Distant  Top-down decisions

GERMAN CONSUMERS ARE SLOWER TO ADOPT DIGITAL SOLUTIONS

BACKGROUND

Risk aversion also characterizes German consumer behavior, which is reflected in a strong need for data privacy, transparency, and trust.

Hence, German consumers are hard to convince, especially concerning digital solutions. Consequently, adoption rates are lower compared to other nations (see selected examples).

Despite Germany having the largest population in the EU, it is, therefore, important not to overestimate the market size for digital solutions and to pay attention to brand- and trust-building.

SHARE OF CASH TRANSACTIONS (% POS)

68% ▼ 20%

SHAREHOLDER RATE

18% ▲ 58%

ONLINE AND MOBILE BANKING USAGE

67% ▲ 98%

CRYPTOCURRENCY OWNERSHIP RATE

6% ▲ 19%

E-COMMERCE PENETRATION (% OF RETAIL REVENUE)

13% ▲ 47%

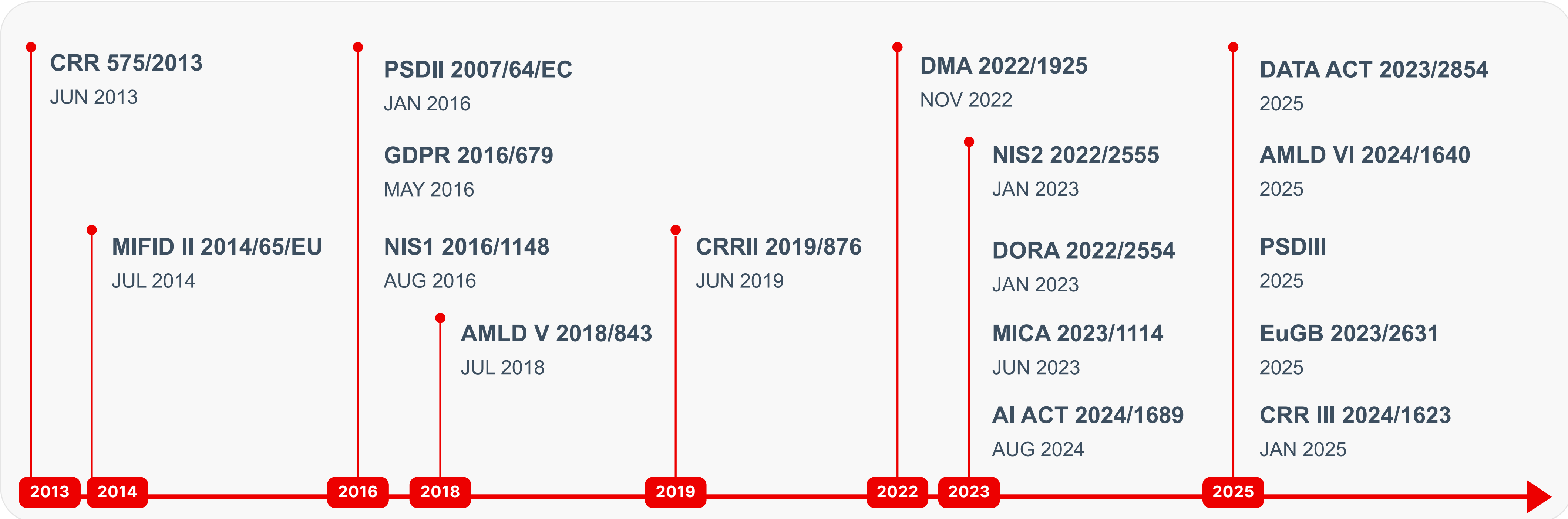
REGULATORY CLIMATE REMAINS COMPLEX AND RESTRICTIVE

BACKGROUND

Regulation in the EU remains extensive and complex (see graph), affecting not just banks but several companies engaged in financial services and IT in multiple ways.

Additionally, BaFin's approach of financial supervision remains tight. This leads to many FIs main priority being compliance with new rules rather than seeking its innovation potential.

Therefore, acting in the German market will likely result in increased compliance efforts. However, licenses obtained in Germany can be considered a 'gold standard.' Additionally, embracing the innovation potential of regulations can provide competitive advantages.



RELEVANT EU REGULATION FOR THE FINANCIAL SERVICES INDUSTRY (NON-EXHAUSTIVE, DATE OF ENTRY INTO FORCE)

2025 TRENDS AND OPPORTUNITIES

2025: CHALLENGES CONTINUE, REQUIRING ADAPTIVE STRATEGIES

More companies going bankrupt	Layoffs continue	Consolidation among neobrokers and neobanks	Decrease in customer risk appetite
More brands becoming banks (embedded finance)	More systematic cyberattacks on German companies	Consumers become less loyal and more pragmatic	Increased cost cutting & revenue pressures for banks

BANKING TRENDS: MARKET GAPS REVEALED FOR NEW MODELS AND APPROACHES

HYPER-PERSONALIZED SERVICES AND PRODUCTS AS THE NORM

Generic banking products fail to address today's customers. For a future-centric product strategy, German banks should invest in hyper-personalized services that know the user better than the user.

BANKING-AS-A-SERVICE BECOMES MORE "BANK" LESS "FIN"

BaaS models are a must, but should they be offered by FinTechs? Or are banks more prepared for such offers? In 2025, BaaS brands will need to focus more on compliance. There will be a natural selection among the providers.

LIFESTYLE BANKING EMERGES AS A REVENUE-GENERATION CHANNEL

As Asian and American banks prove, banking isn't limited to regulated activities anymore. Banks that embrace lifestyle services can enjoy lucrative margins while improving customer engagement and loyalty.

INCREASED TOKENIZATION PROJECTS

The projects converting real-world assets into digital tokens are gaining popularity and will likely increase speed with MiCA. In addition, groups of German banks are known to be working on a PoC for tokenized deposits - the first results look good.

HYBRID BRANCH MODELS TESTED

Hundreds of bank branches in Germany have been closed in the past year due to digitalization and cost-cutting measures. Nevertheless, the f2f service is still in demand in some regions, and banks should consider testing hybrid concepts, such as mobile and pop-up branches.

A-LIST FRAUD INFRASTRUCTURE

Consumers and businesses are not the only groups embracing AI; fraudsters do, too. Amid a lower digital and financial literacy spectrum, consumers in Germany are increasingly exposed to cyber threats, which will likely force banks to invest in state-of-the-art fraud prevention tools and approaches.

FINTECH TRENDS: USP IN THE TIMES OF CONSOLIDATION

AI, AI, AND EVEN MORE AI

This trend is evident, but it still needs to be highlighted. Due to the privacy and governance-related concerns of the German banks, advanced, innovative AI use cases will likely be led by FinTechs and RegTechs instead of banks.

SAVINGS PRODUCTS

Contrary to the past years, B2C customers want to save and create side hustles due to the market conditions. Products that provide economic benefits, discounts, cashback, or encouraging savings would be in demand.

EMBEDDED FINANCE

Major retailers are looking into diversification and embedded finance as well as embedded security, and cloud solutions will emerge as additional retail revenue channels, eventually heating up the competition. Fintechs can connect the dots by offering embedded finance solutions for retail.

NFC BASED PRODUCTS

Apple opening its NFC technology to third-party-providers in 2024 will finally enable German FinTechs to integrate NFC features into their apps and offer contactless in-app transactions based on NFC, enabling various wallet use-cases.

DIGITAL ASSETS & CRYPTO 2.0

As of JAN 25, MiCA is fully in force, unifying the EU crypto market. Amid the increased entry barriers and standards, MiCA might re-establish consumer trust in crypto products. Three companies in Germany, Boerse Stuttgart, Bitpanda, and Crypto Finance, are already licensed as CASPs and counting.

ALTERNATIVE INVESTMENTS AND WEALTHTECH

The political and economic instability urges customers to seek alternative investment and wealth management methods. Enhanced open banking offers can create additional value for new WealthTech use cases.

CHALLENGES AND OPPORTUNITIES

LIMITED OUTSOURCING BUDGETS

Economic pressures will force banks and SMEs to focus on cost-cutting and limit their outsourcing budgets.

DECREASED MARKET COMPETITION

The economic pressures will consolidate the market, cutting down the unnecessary noise.

LONGER SALES CYCLES

Upcoming regulatory requirements deprioritize innovation and prioritize compliance for the FinServ industry. It's an opportunity for RegTech companies, but it can prolong the sales cycles for TechFins.

COST-CUTTING AND AUTOMATION

Advanced AI productivity tools could help SMEs thrive, decreasing costs increasing efficiency.

SOCIAL FABRIC CHANGING

Last year's learnings are not applicable anymore due to the change of social fabric. FinServ must invest in understanding the changes in user needs and problems.

M&A AND GROWTH OPPORTUNITIES

Value-driven, consistent, and creative companies will have many growth or investment opportunities this year.

HOW CAN BANKS & FINTECHS MAKE THE BEST OF 2025?

Conduct and repeat user research

Invest in localization and your German market trust building over sales

Understand the regulations' impact on your customers (B2B) and your business

Ensure that you are 150% compliant to avoid waiting times and long sales cycles

Collaborate with competitors

Attend smaller events

Less generic more specific services

Invest in areas your end customers care about to show that you care

TL; DR: SUGGESTIONS FOR BANKS AND FINTECHS

BANKS

STOP UNDERUTILIZED CHANNELS

As market developments and competition pressure banks, they need to be more specialized and stop underutilized services and channels.

INVEST IN RELATIONSHIP BUILDING

The value of some business models has been questioned in the past year. Banks can create a competitive advantage using their market trust if they invest in brand and relationship building.

USE MONETIZATION OPPORTUNITIES

It's never too late for banks to dive deeper into the existing data sets to find monetization, cost-cutting, and operational efficiency opportunities.

FINTECHS

FOCUS ON ORIGINAL MODELS

As European competition gets heated, formerly hot business models such as neobanking and neobrokerage gets harder to crack, unless there is a unique edge.

CHERRY PICK EVENTS

The number of relevant industry events keeps on increasing, but at times, attending only the events that address potential investors, customers, or partners and avoiding basic PR could help you focus on clients and gain momentum.

EMPHASIZE YOUR CUSTOMERS

What do your customers think? What are their current pain points? If you only assume the answers, it might be time to engage in user research.

CASE STUDIES

CASE STUDY: RAISIN'S SUCCESS STORY
'DO ONE THING, BUT DO IT WELL.'

Learnings

- Raisin's success story began with identifying a clear user need and the relevant success factors (e.g., strong and trust-worthy partners), ensuring 'product-market-fit.'
- While some of Raisin's competitors focused on fast growth, Raisin improved its core product by prioritizing user feedback.
- Having become the market leader in a specific domain, Raisin entered new segments strategically and with the market requirements in mind, allowing Raisin to grow the core business and acquire new skills and revenue streams such as embedded finance.

Challenge

- German consumers are highly risk-averse. Hence, low-risk investments such as fixed-term or overnight deposits are highly popular.
- However, due to the ECB's low-interest rate policy in the past decades, the return rates of such products in the German market reached a historic low.
- Additionally, consumers could not access foreign offers as there was no European Single Market for traditional saving products.

Solution

- Raisin established partnerships with European banks that offer higher returns on deposit products and gave German consumers access via their platform 'Weltsparen.'
- Over the years, the platform was strategically grown by entering new markets, extending partner banks, and offering additional investment products such as ETFs.
- Additionally, 'Weltsparen' was offered as an 'Investment-as-a-Service' solution, and in 2019, Raisin acquired its former banking partner, MHB-Bank AG, now a leading BaaS provider, operating under the name 'Raisin Bank AG.'
- Today, Raisin is a global savings & investments marketplace serving the US market, the UK, and Europe.

Michael Stephan
Co-Founder/COO at Raisin

Since its founding in 2012, Raisin has grown into a global fintech leader, making savings and investments more accessible across borders. With a strong international footprint and a scalable business model, we continue to expand, innovate, and shape the future of banking. Looking ahead, we remain focused on driving sustainable growth, entering new markets, and offering smarter financial solutions to meet evolving customer needs.

AI IN BANKING:
FROM HYPE TO USE CASES

Despite Trump's push to dominate AI, Germany remains a strong contender in the global race. With 208 AI university programs launched in just two years and a consistent top-ten ranking in AI patents, the country is doubling down on innovation.

The German AI Association boasts over 400 members, including 15 leaders in Finance & Insurance, while startups and SMEs are fueling AI-driven disruption. Even the Bundesbank has been actively testing AI use cases, regulatory uncertainty, and BaFin's questions aside.

Several banks have tested and invested in AI, but there is nothing "headline-worthy" yet. The big question is: **Which German banks and SMEs will seize the opportunity, lead the charge, and bridge the market gap in AI?**

Let's take a closer look at the test cases.

Bank Use Cases

- Last year, Sparkassen announced that it would operate AI models in its own data center, not the cloud. This year, they are planning to enable AI assistants for all their employees until the summer of 2025.
- Landesbank Baden-Württemberg (LBBW) launched its own GenAI solution for its employees with blue.gpt. It enables the bank to design products and services as well as customer communications.
- Commerzbank launched a project with Microsoft Azure OpenAI Service to implement a banking avatar.
- German private bank Metzler partnered with Swiss start-up Unique to leverage AI technology for streamlined workflows and enhanced productivity.
- Baader Bank launched a first-of-its-kind 'AI-enhanced' active ETF.
- In 2024, Deutsche Bank published a white paper with Kodex AI about Gen AI in Banking. In addition, they became a strategic investor of the Heidelberg-based AI start-up Aleph Alpha.
- DZ Bank showcased a GenAI platform as a holistic approach for the entire bank during Frankfurt Digital Finance 2025.

MARKET ENTRY CHECKLIST

OUR PLAYBOOK FOR A SUCCESSFUL GERMAN MARKET ENTRY

Assess Country Fit

Evaluate if Germany aligns with your growth strategy by analyzing market size, cultural nuances, and economic conditions.

Validate Business Resources

Ensure you have the required budget, staff, and operational capacity for a successful market expansion.

Analyze Competition

Research competitors and alternative solutions used by your target audience to identify your unique positioning.

Confirm Timing Readiness

Align market entry with favorable economic, political, or regulatory conditions and internal strategic priorities.

Ensure Regulatory Compliance

Familiarize yourself with BaFin regulations, licensing requirements, and other compliance standards in Germany.

Tailor Value Proposition to Market Feedback

Refine your product or service offering based on feedback from German customers and stakeholders to build trust and relevance.

EXPERTS’ 2025 PREDICTIONS

EXPERTS' 2025 PREDICTIONS

Jochen Biedermann

Managing Partner,
FinTech Consult

The financial industry is experiencing rapid transformation, driven by the widespread adoption of digitalization and significant advancements in artificial intelligence (AI). These technological shifts are reshaping the provider landscape and unlocking new opportunities for financial service users, notably through the emergence of intelligent agents.

This evolution presents considerable prospects for FinTech companies but also necessitates the development of new regulatory frameworks and enhanced international collaboration, particularly concerning the secure and compliant transfer of AI training data across borders.

In addition, we are witnessing the rise of new financial hubs, particularly in regions such as Africa and Asia. Countries like Indonesia, Nigeria, and Kenya are at the forefront of this change, spearheading innovation and growth. As a professional supporting FinTech companies' global expansion, I view these developments as highly encouraging.

Michael Stephan

Co-Founder/COO,
Raisin

In 2025, the global fintech market will enter a new era of maturation. Many companies will continue to place a stronger focus on profitability and consolidate their business models to maintain sustainable growth. This sometimes goes hand in hand with centralizing operations and developing more in-house solutions, such as launching their own products.

While valuations are high and some fintechs are preparing for public listings, growth will continue, but success will depend on how fintechs navigate the regulatory environment and create long-term value.

This development signals a shift from pure disruption to sustainable innovation. Established fintechs must - and will - find a balance between competitiveness and resilience in an ever-changing global landscape.

Jochen Siegert

Co-Founder & Partner,
Payment & Banking - PBA
Experts GmbH

For the year 2025 we will see a significant impact from changes on governmental policies for fintechs. The crypto-push by the Trump administration in the US will elevate DLT-, stablecoin-and web3 business models on a complete new level.

At the same time traditional financial institutions will embrace DLT based models both via in-house developments as well as via fintech partnerships. We also see clear signals towards lighter regulation both in the US and the new EU. The EU commission is following the recommendations by the Dragi Report towards a higher competitiveness of Europe.

Especially fintechs targeting multiple European states will benefit from one harmonized setting of rules and regulations. I would expect pan-EU fintech category leaders to embrace and leverage this opportunity very swiftly. This means a faster execution of internationalization. Last but not least the ongoing cuts on the interest rates on both sides of the Atlantic, will ease the funding situation even more for Fintechs compared to 2024.

EXPERTS’ 2025 PREDICTIONS

Karolina Decker

CEO & Founder,
Finmarie

Artificial intelligence will irreversibly transform the finance industry. In the years to come, particularly agile startups without outdated structures will have a decisive advantage.

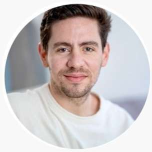
They can develop innovative financial products faster than established banks and scale them globally. The future belongs to all-in-one solutions: a single app that integrates all payment functions and completely rethinks financial services. Investing in AI-supported fintech innovations now means investing in the next big revolution in the financial sector.

Achim Oelgarth

Co-Founder,
Berlin Finance Initiative

The German fintech sector is entering a phase of maturity, marked by growing consolidation, strategic collaborations, and a shift towards profitability. Key areas to watch include the expanding role of embedded finance in reshaping customer experiences, the integration of AI and data analytics for personalised services, and the increasing interest in green finance.

For fintech founders, 2025 will demand a laser focus on differentiation, robust compliance strategies, and scalable business models to thrive in a market that is becoming both more competitive and more collaborative.



Michael Offermann

VP Growth & Strategy,
re:cap

The SME FinTech space remains dynamic as different market players focus on similar target groups. SME neobanks are expanding into FP&A and accounting tools, expense management providers are issuing payment cards, and payment platforms are offering short-term working capital solutions, to name a few examples. This shows the ongoing fusion of finance and technology, which is likely to accelerate with AI.

The key question is whether established FinTech leaders can leverage AI to deliver smarter, outcome-driven solutions, or if this shift will open the door for new challengers to emerge. In that context, monetization & pricing strategies will potentially be thought differently than before.

Anne-Sophie Gógl

Member of the Board,
Digital Euro Association

A digital euro for wholesale settlements is the basis for a competitive digital financial ecosystem in Europe. The high number of participants in the ECB's wholesale settlement trials and experiments in 2024 has shown the need that banks have in this regard.

I assume that the ECB has also recognized the momentum and that we will take big steps in this area in 2025. In contrast, I assume that the retail digital euro will be delayed, because the proposal for the digital euro will not be finalized in 2025 and therefore the ECB will not be able to make a final decision on the introduction of the digital (retail) euro.

TOP FINTECH & BANKING EVENTS IN 2025

Here is a list of the top industry events for banks, fintechs and PIs eyeing the German market as well as exclusive discounts for our community members (applicable using the link and the code):

Event	City	Date	Focus	Language	Discount Code
Frankfurt Digital Finance (FDF)	Frankfurt	February (11-12)	Banking, Fintech	EN	FINTECH ISTANBUL (20%)
Payment Exchange (PEX)	Berlin	March (12-13)	Payments	DE	FintechReportLovesPEX (20%)
Merchant Payments Ecosystem (MPE)	Berlin	March (18-20)	Payments	EN	fti10 (10%)
Digital Euro Conference	Frankfurt	March (27)	Digital Euro, Stablecoins	EN	CS20 (20%)
FIBE	Berlin	April (9-10)	Fintech	EN	FIBE_BFI (€450 discount)
GITEX Europe	Berlin	May (21-23)	Technology, Start-ups	EN	Exhibitor passes are free
Finance Forward / OMR	Hamburg	May (6-7)	Fintech/Tech & Marketing	DE	
Handelsblatt AI in Banking	Frankfurt	Sept (3-4)	Banking, AI	DE	
CONF3RENCE	Dortmund	Sept (3-4)	Crypto, Web3, NFT, AI	DE, EN	
Banking Exchange (BEX)	Berlin	Sept. (24-25)	Banking	DE	FintechReportLovesBEX (20%)
Handelsblatt BankenTech	Frankfurt	Dec. (2-3)	Banking	DE	

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Cloud-Based Core Banking Systems Using Microservices Architecture

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Abstract - The modern banking landscape demands scalable, resilient, and customer-centric systems capable of adapting to rapid technological shifts. Traditional monolithic core banking systems, though functionally rich, often struggle with agility, maintenance, and scalability. The transition toward cloud-based core banking solutions—leveraging microservices architecture—presents a robust alternative to these legacy systems. This paper explores the integration of microservices architecture within cloud computing environments for core banking systems, offering a modular, loosely-coupled, and highly scalable infrastructure. The proposed model enhances system flexibility, enables continuous deployment, improves fault isolation, and supports dynamic scaling across services. We examine the architectural components, implementation strategies, and real-world adoption cases of cloud-native banking systems, while also analyzing their performance against legacy systems. The study concludes with insights into security, compliance, and future innovation pathways for the digital transformation of core banking services.

Keywords - Cloud Computing, Core Banking Systems, Microservices Architecture, Digital Banking, Service-Oriented Design, API Gateway, Kubernetes, DevOps, Fault Tolerance, Financial Technology (FinTech)

I. INTRODUCTION

The rapid digitization of financial services has propelled banks to re-evaluate their legacy infrastructure, particularly their core banking systems. Traditionally, these systems were built as monolithic architectures—centralized, tightly coupled, and difficult to modify or scale without impacting the entire system. As customer expectations continue to evolve, and as regulatory and technological landscapes become more dynamic, the limitations of monolithic systems have become increasingly evident.

Cloud computing has emerged as a transformational force in modern IT ecosystems, offering on-demand scalability, cost efficiency, and high availability. When combined with **microservices architecture**, cloud infrastructure introduces a paradigm shift in how core banking systems can be developed and maintained. Microservices break down the banking system into loosely coupled, independently deployable services—each responsible for a specific business function such as account management, transaction processing, loan origination, or customer support. This allows banks to innovate faster, reduce downtime, and adopt agile methodologies in service delivery.

The shift toward **cloud-native core banking platforms** is further reinforced by advancements in containerization (e.g., Docker), orchestration platforms (e.g., Kubernetes), and DevOps practices, which promote continuous integration and continuous delivery (CI/CD). These innovations not only reduce time-to-market but also ensure higher resilience and flexibility, crucial in a competitive banking environment.

This paper investigates the architectural evolution from monolithic to microservices-based cloud-native banking systems. It presents an in-depth analysis of the technological enablers, key components, deployment models, and benefits of this transition. Furthermore, the study evaluates security implications, operational challenges, and future trends that will shape the next generation of banking infrastructure.

1.1 Evolution of Core Banking Systems

Core banking systems (CBS) are the backbone of financial institutions, enabling essential operations such as account management, loan processing, and transaction handling. Historically, these systems were built on **mainframe technology** and **monolithic architectures**, which limited their scalability and adaptability. While monolithic designs were robust and reliable, they proved inflexible when it came to incorporating modern digital services, integrating third-party solutions, or rapidly deploying new features.

The growing demand for **24/7 banking access**, **real-time processing**, and **digital-first services** exposed the limitations of legacy core systems. Banks started transitioning toward **modular approaches**, incorporating service-oriented architecture (SOA), and eventually exploring more flexible and agile architectures to better meet customer expectations and regulatory requirements.

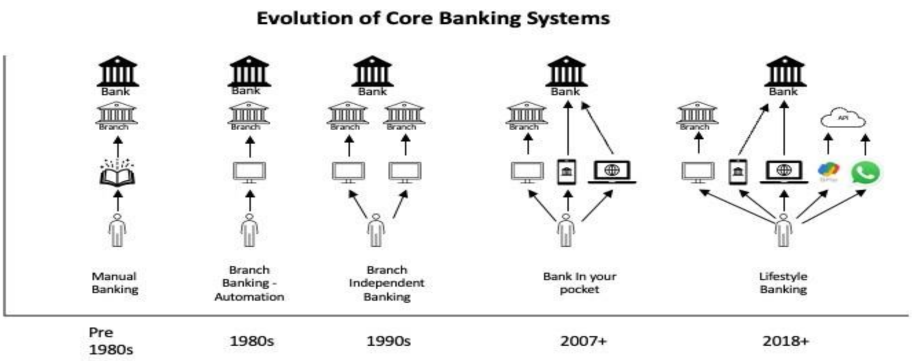

Fig 1: Evolution of CBS

1.2 Rise of Cloud Computing in Financial Services

Cloud computing introduced a transformative shift in the financial sector by offering **on-demand computing resources**, **elastic scalability**, and **cost-effective deployment** models. With infrastructure abstracted from physical hardware, banks gained the ability to deploy services faster, improve uptime, and respond dynamically to user demand.

Public cloud providers such as **AWS, Microsoft Azure, and Google Cloud** began offering secure, compliant cloud environments tailored to financial services, with built-in tools for **identity management**, **data encryption**, and **auditability**. Hybrid and private cloud models further allowed banks to maintain control over sensitive workloads while benefiting from cloud-native innovations.

The cloud has laid the foundation for **continuous innovation** in banking, enabling the adoption of **AI, data analytics, and mobile-first solutions**, all of which are becoming integral to modern core banking.

1.3 Introduction to Microservices Architecture

Microservices architecture represents a shift from monolithic software development to a model where applications are composed of **independent, self-contained services**, each focusing on a single business capability. These services communicate through **lightweight APIs** and can be developed, deployed, and scaled independently.

In the context of core banking, microservices empower institutions to isolate functionalities such as **customer onboarding**, **payments**, **loans**, and **fraud detection**, allowing teams to work autonomously and iteratively. Microservices enhance **fault isolation**, **deployment flexibility**, and **resilience**, thereby increasing system uptime and agility.

Adopting microservices in conjunction with cloud platforms helps banks achieve **high availability**, **modular scalability**, and **faster release cycles**—crucial for maintaining competitiveness and delivering superior customer experiences in a rapidly evolving financial ecosystem.

1.4 Problem Statement and Motivation

Despite rapid advancements in digital banking, many financial institutions continue to rely on legacy core banking systems that are **monolithic, rigid, and difficult to scale**. These systems are not only expensive to maintain but also hinder rapid innovation due to **tight coupling of services**, **lengthy deployment cycles**, and **high downtime risk** during updates. As customer expectations shift toward **real-time services**, **personalized experiences**, and **omnichannel banking**, these traditional systems increasingly fall short.

The motivation behind this study stems from the need to develop a **modern, scalable, and agile core banking infrastructure** that leverages the strengths of **cloud computing** and **microservices architecture**. The combination offers a path to greater **modularity**, **resilience**, and **faster time-to-market**, enabling banks to better compete in the era of fintech disruptors and digital transformation.

1.5 Objectives and Contributions of the Study

The primary objective of this study is to explore and demonstrate how cloud-based microservices can revolutionize traditional core banking systems by making them:

- **Scalable** – Capable of handling growing volumes of transactions and users without performance degradation.
- **Modular** – Facilitating independent development, deployment, and scaling of services.
- **Resilient** – Ensuring fault tolerance and high availability even during failures of individual components.
- **Agile** – Supporting rapid updates and feature additions with minimal downtime.

Key contributions of the study include:

- A comprehensive **review of microservices and cloud technologies** relevant to core banking.
- A proposed **architecture for a cloud-native core banking platform**.
- Implementation considerations including **API management**, **security**, and **compliance**.
- Evaluation metrics and **real-world case study references** demonstrating feasibility and benefits.

II. LITERATURE SURVEY

The transformation of core banking systems has been an evolving process, especially with the emergence of modern technologies such as cloud computing and microservices. Traditionally, banks relied heavily on monolithic architectures, where all functionalities were tightly integrated into a single system. These systems, while robust, often lacked the flexibility to scale or adapt quickly to changing customer demands and regulatory updates. They were resource-intensive, costly to maintain, and highly prone to service disruptions during upgrades or fault occurrences.

With the increasing adoption of cloud computing in financial services, institutions began leveraging cloud platforms to achieve scalability, elasticity, and cost-effectiveness. Public and hybrid cloud environments offered banks the advantage of flexible infrastructure provisioning, disaster recovery, and enhanced performance, along with compliance-ready frameworks provided by platforms like AWS, Microsoft Azure, and Google Cloud. This transition also paved the way for containerization and microservices-based application designs, enabling a more modular, service-oriented approach to system development.

Microservices architecture, by definition, advocates breaking down applications into loosely coupled, independently deployable services. In the context of core banking, this allows for modularization of critical services such as account management, payments, customer onboarding, and loan processing. The ability to isolate and deploy services individually has led to faster development cycles, better fault tolerance, and improved maintainability. Technologies like Docker and Kubernetes have further enabled seamless orchestration and deployment of these services across distributed cloud infrastructures.

Several industry players have already embraced this architectural shift. Banks like Monzo, Starling Bank, and JPMorgan Chase have demonstrated successful implementations of microservices and cloud-native strategies. These implementations have resulted in reduced time-to-market, enhanced customer experiences, and better adaptability to FinTech competition. However, the transition to microservices and cloud-based platforms also introduces challenges, including complexities in managing distributed transactions, ensuring inter-service communication, handling increased surface area for security vulnerabilities, and maintaining consistency and compliance across multiple services.

While there is significant momentum in adopting cloud-native microservices architectures, research is still ongoing in areas such as standardization of microservice governance in financial systems, optimization of real-time processing in distributed environments, and integration with regulatory sandboxes. The need for improved fault isolation, data integrity assurance, and intelligent load balancing mechanisms continues to drive innovation. The literature reveals that although advancements have been made, there is ample opportunity for further exploration and refinement in developing secure, scalable, and efficient cloud-based core banking systems using microservices.

2.1 Traditional Monolithic Core Banking Systems

Traditional core banking systems have long been built on monolithic architectures where all functionalities — from account management and transaction processing to customer support and reporting — are integrated into a single, tightly coupled system. These systems often run on legacy hardware and require complex interdependencies, making them difficult to scale or modify. Any upgrade or maintenance activity can affect the entire system, causing potential downtimes. Moreover, deploying new features or meeting emerging compliance standards demands significant effort and time. While these monolithic systems have provided stability and reliability over the years, their lack of agility and scalability has increasingly become a bottleneck, especially in the face of evolving customer expectations and the rapid digitization of financial services.

2.2 Adoption Trends of Cloud in Banking Sector

The shift towards cloud computing in the banking sector has gained tremendous momentum in recent years. Driven by the need for flexible infrastructure, cost optimization, and enhanced service delivery, many banks have started to migrate critical workloads to the cloud. Public, private, and hybrid cloud models are being adopted based on the institution's operational and regulatory requirements. Cloud computing offers scalability, disaster recovery capabilities, global availability, and real-time data analytics, which are essential for modern banking operations. Regulatory bodies have also begun to establish clear guidelines for cloud adoption, which has accelerated trust and compliance readiness in cloud-based deployments. Furthermore, cloud-native development has paved the way for innovative services, such as AI-driven financial advisors and real-time fraud detection, reshaping the traditional banking landscape.

2.3 Principles of Microservices Architecture

Microservices architecture introduces a paradigm shift from monolithic systems by decomposing an application into a suite of small, independent services that communicate through lightweight APIs. Each microservice is focused on a single business capability and can be developed, deployed, and scaled independently. In the context of core banking, this means services such as account creation, KYC verification, fund transfers, and loan approvals can operate as autonomous units. This architectural style enables faster release cycles, ease of maintenance, fault isolation, and technology heterogeneity. Technologies such as Docker for containerization and Kubernetes for orchestration have become integral to implementing and managing microservices efficiently. However, implementing microservices also demands a robust strategy for service discovery, load balancing, monitoring, and securing inter-service communication, especially in the highly regulated banking environment.

2.4 Comparative Study: Monolith vs. Microservices

A comparative analysis between monolithic and microservices architectures in the context of core banking highlights clear distinctions in flexibility, scalability, and maintainability. Monolithic systems, though robust and time-tested, often become cumbersome as they grow, making it challenging to implement changes without impacting other components. In contrast, microservices offer modularity and independence, allowing for parallel development and deployment across multiple teams. This accelerates innovation and reduces time-to-market for new features. Microservices also support horizontal scalability more efficiently, a key requirement for modern cloud-based environments. However, they introduce complexities in orchestration, service discovery, and data consistency. While monoliths are easier to secure and test as a single unit, microservices demand a comprehensive strategy for distributed security, API governance, and failure recovery.

2.5 Case Studies on Cloud Transformation in Banks

Several global banking institutions have successfully transitioned to cloud-native and microservices-driven architectures, setting benchmarks for digital transformation in the financial domain. For example, Capital One adopted AWS to modernize its core operations, leading to improved service uptime, scalability, and deployment automation. Similarly, DBS Bank leveraged microservices and containerization to drive digital innovation, enabling real-time analytics and streamlined customer interactions. These transformations involved not only technical migrations but also cultural shifts towards agile development, DevOps practices, and continuous integration/deployment pipelines. Case studies highlight that success in cloud transformation is often tied to phased implementation strategies, strong vendor partnerships, regulatory alignment, and comprehensive training programs to upskill IT staff.

2.6 Identified Gaps and Research Opportunities

Despite the growing adoption of microservices and cloud computing in banking, several gaps remain. Challenges around legacy integration, real-time data synchronization, and secure multi-tenant environments are yet to be fully addressed. Many banks also face difficulties in achieving end-to-end observability and in handling the complexity of microservices at scale, especially under regulatory constraints. Additionally, there is a lack of standardization in deployment patterns and API governance across institutions. These limitations offer opportunities for further research, particularly in designing hybrid architectures that balance legacy compatibility with cloud-native agility, developing lightweight service mesh models, and exploring AI-based orchestration strategies. Moreover, empirical studies quantifying the long-term ROI of microservices adoption in banking remain limited and present a promising area for academic and industry collaboration.

III. WORKING PRINCIPLES OF MICROSERVICES-BASED CLOUD CORE BANKING

The adoption of microservices architecture in cloud-based core banking systems is transforming the way banks design, deploy, and manage financial services. Unlike monolithic systems where all functionalities are tightly coupled and interdependent, a microservices approach decomposes core banking functions—such as account management, transaction processing, and customer onboarding—into independently deployable services. Each service is designed to perform a specific business function and can be developed, scaled, and maintained without impacting the rest of the system.

This decoupled architecture enables banks to respond faster to changing regulatory requirements, customer expectations, and competitive pressures. For example, if there's a need to update the credit scoring algorithm or integrate with a new payment gateway, it can be done at the service level without affecting the overall system. These microservices communicate through lightweight protocols, typically RESTful APIs or asynchronous message brokers, enabling real-time data exchange and interoperability across services and third-party systems.

Cloud infrastructure further complements this architecture by offering on-demand scalability, resource elasticity, and high availability. Containers and orchestration platforms like Docker and Kubernetes help in managing these services efficiently, ensuring reliability and ease of deployment. In addition, cloud-native observability tools, CI/CD pipelines, and service meshes ensure operational agility, enabling financial institutions to monitor, test, and roll out changes with minimal downtime.

Security and compliance are embedded into the architecture through API gateways, identity management protocols (like OAuth2 and OpenID Connect), and encrypted communication channels. Data is distributed and managed across databases that are optimized for specific services, supporting scalability while ensuring data integrity and isolation. Together, these principles enable a resilient, modular, and agile core banking platform that aligns with modern digital banking goals.

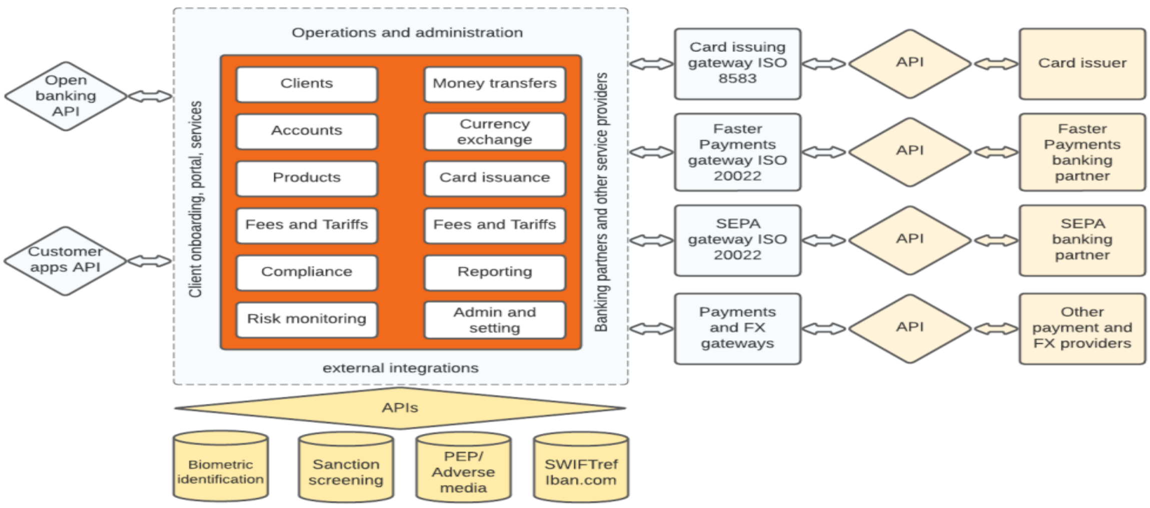

Fig 2: Modern core banking software technology

3.1 Microservices Architecture for Core Banking

The microservices architecture forms the foundation of modern cloud-based core banking systems. In this architecture, each banking functionality—such as loan processing, customer onboarding, or fund transfers—is developed as a loosely coupled, independently deployable service. These services run in isolated containers and communicate over lightweight protocols such as HTTP/REST or gRPC. The design ensures that each microservice has its own codebase, database (if needed), and deployment lifecycle, which significantly improves maintainability, fault isolation, and flexibility. This modularity enables faster development cycles and more resilient systems, allowing banks to innovate at a pace aligned with modern digital expectations.

3.2 Decomposition of Banking Functions into Services

One of the key aspects of implementing microservices in a core banking environment is the decomposition of large, monolithic applications into discrete, business-aligned services. Functional domains such as customer information management, KYC/AML compliance, payments, deposits, loan servicing, and transaction reconciliation are restructured as individual microservices. This domain-driven design approach not only promotes reusability and scalability but also allows different development teams to work concurrently on separate services. Each service is built around a specific capability and can evolve independently, making the system more adaptive to regulatory changes and user demands without causing ripple effects across the entire banking platform.

3.3 API Gateway and Service Mesh Integration

In a distributed architecture composed of dozens or hundreds of microservices, efficient communication and governance are essential. This is achieved through the use of API gateways and service meshes. The API gateway acts as the single entry point into the system, managing request routing, rate limiting, authentication, and logging. It abstracts the internal architecture from the clients and ensures secure, standardized access to services. On the other hand, service meshes like Istio or Linkerd provide advanced traffic management, observability, and secure inter-service communication within the microservices network. Together, these components enhance the robustness, security, and operational visibility of the core banking system, enabling real-time monitoring, fault detection, and zero-trust security enforcement across the ecosystem.

3.4 Cloud-Native DevOps for Continuous Deployment

To fully leverage the benefits of microservices in core banking, cloud-native DevOps practices are essential. Continuous Integration and Continuous Deployment (CI/CD) pipelines automate the build, test, and release processes, enabling faster delivery of banking features with minimal manual intervention. Tools such as Jenkins, GitLab CI, and Azure DevOps streamline deployment workflows, while containerization platforms like Docker and orchestration tools like Kubernetes ensure scalable and repeatable deployments. Cloud-native DevOps not only facilitates rapid updates but also ensures stability through automated testing and rollback mechanisms. This allows banks to respond quickly to customer needs, regulatory changes, or market conditions without risking core functionality.

3.5 Data Management and Service-Level Isolation

In a microservices-based banking system, managing data integrity and isolation becomes a critical challenge. Each microservice often maintains its own dedicated database or data store to ensure decoupling and to uphold the principle of service-level independence. This isolation enables microservices to scale independently and prevents cascading failures due to shared data structures. Techniques such as event sourcing and eventual consistency models are commonly employed to synchronize data across services without tight coupling. Moreover, access to sensitive financial data is controlled via strict authentication and authorization policies, often enforced at the API or database layer, ensuring compliance with financial data governance standards like GDPR and PCI DSS.

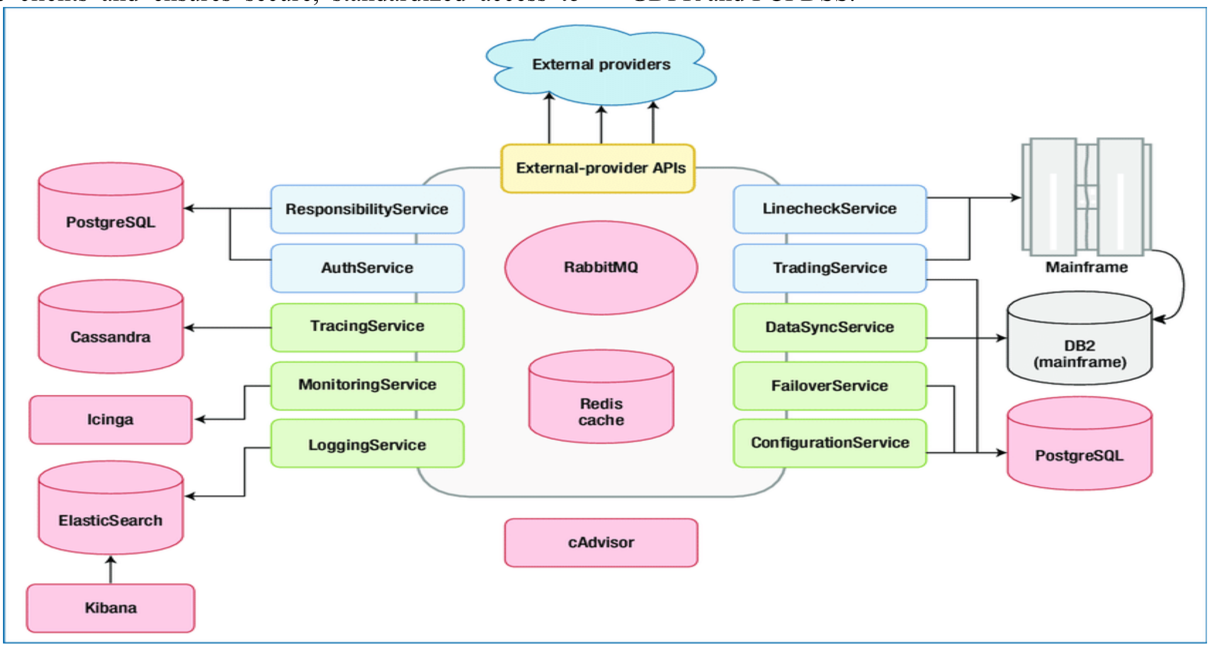

Fig 3: The new microservice architecture

3.6 Inter-Service Communication (REST, gRPC, Messaging)

Effective communication between microservices is fundamental to the smooth operation of cloud-based core banking systems. Services typically communicate using RESTful APIs or more efficient binary protocols such as gRPC for synchronous interactions. For asynchronous workflows, message brokers like Apache Kafka, RabbitMQ, or AWS SQS are used to decouple services and enable event-driven architecture. These communication protocols ensure that banking operations—such as transaction processing, fraud detection, and ledger updates—can occur in real time or in an orchestrated manner, depending on the business requirement. The combination of synchronous and asynchronous communication methods enhances performance, scalability, and resilience, while also supporting flexible integration with third-party services and fintech platforms.

3.7 Security, Authentication, and Access Control

Security in cloud-based microservices architecture is paramount, particularly for financial applications where data confidentiality and integrity are non-negotiable. A zero-trust security model is commonly adopted, ensuring that every service interaction is authenticated and authorized. Authentication mechanisms such as OAuth 2.0 and OpenID Connect enable secure, token-based access control, while API gateways act as centralized security enforcers, monitoring all incoming requests. Role-based access control (RBAC) and attribute-based access control (ABAC) models are used to define granular permissions across services. In addition, security protocols such as Transport Layer Security (TLS), secure key management systems, and end-to-end encryption ensure that sensitive banking data is protected both at rest and in transit. Periodic vulnerability assessments and automated security patching further enhance the overall security posture of the system.

3.8 Scalability and Fault Tolerance in Cloud Environments

One of the key advantages of deploying core banking systems in a microservices-based cloud architecture is the ability to scale services independently and ensure high availability. Auto-scaling capabilities in cloud platforms allow resource allocation to dynamically adjust based on demand, ensuring consistent performance even during peak banking hours. Fault tolerance is achieved through redundancy, load balancing, and circuit breaker patterns that prevent the failure of one service from affecting the entire system. Container orchestration platforms like Kubernetes support self-healing mechanisms, automatically restarting failed services and rerouting traffic to healthy instances. Additionally, distributed logging and monitoring tools, such as Prometheus and ELK Stack, provide real-time visibility into system health, enabling proactive maintenance and minimizing downtime. Together, these features make the system resilient, ensuring uninterrupted banking services under varying load and failure conditions.

IV. IMPLEMENTATION FRAMEWORK

The implementation framework for a cloud-based core banking system using microservices is centered around a combination of cutting-edge cloud infrastructure, containerization platforms, API-driven communication, and robust DevOps practices. At the core of this architecture is the decision to utilize container technologies such as Docker, managed through orchestration tools like Kubernetes, to ensure portability, scalability, and resilience. These containers encapsulate individual banking services, such as customer onboarding, loan processing, transaction management, and account servicing, allowing independent deployment and version control.

The selection of a reliable cloud provider—such as AWS, Microsoft Azure, or Google Cloud Platform—plays a pivotal role, offering managed services for computing, databases, message queues, and monitoring. These providers support hybrid and multi-cloud strategies, enabling banks to maintain regulatory compliance while leveraging scalable cloud resources. API gateways such as Kong, Apigee, or AWS API Gateway are implemented to manage secure and seamless interactions between services and external channels (e.g., mobile apps, ATMs, and branch portals).

Security is enforced through encrypted APIs, centralized authentication mechanisms (e.g., OAuth 2.0), and service-level identity verification. CI/CD pipelines using Jenkins, GitLab CI/CD, or Azure DevOps automate testing, integration, and deployment cycles, promoting faster and more reliable feature releases. Configuration management tools such as Helm and Terraform are employed to provision and manage infrastructure as code (IaC), while service mesh technologies like Istio or Linkerd handle inter-service communication, observability, and fault injection testing.

Monitoring and observability are achieved through integration with tools like Prometheus, Grafana, and ELK Stack, enabling real-time insights and anomaly detection. Audit logs, traceability frameworks, and performance dashboards are also deployed to meet financial regulations and internal policy standards. Overall, this implementation framework provides a blueprint for building scalable, modular, and secure core banking platforms capable of rapid evolution in today's digital banking ecosystem.

4.1 Technology Stack and Platform Choices (e.g., AWS, Azure, Kubernetes)

The selection of a suitable technology stack forms the foundation of a scalable cloud-based core banking solution. Public cloud platforms such as Amazon Web Services (AWS), Microsoft Azure, and Google Cloud Platform (GCP) are preferred due to their enterprise-grade reliability, global presence, and built-in compliance certifications. Each platform offers services essential for banking, including managed databases (e.g., Amazon RDS, Azure SQL), storage solutions, serverless functions, and security monitoring. Kubernetes, the leading container orchestration platform, is chosen for its ability to automate deployment, scaling, and management of containerized applications. Additionally, managed Kubernetes services like Amazon EKS, Azure AKS, or Google GKE are leveraged to reduce operational overhead while ensuring high availability and fault tolerance.

4.2 Service Containerization using Docker & Orchestration via Kubernetes

To support the microservices approach, banking services are encapsulated using Docker containers, which ensure consistency across development, testing, and production environments. Each container includes a lightweight, isolated version of the application and its dependencies, enabling rapid deployment and rollback. Kubernetes serves as the orchestration backbone, managing the lifecycle of these containers, handling load balancing, automatic scaling, health monitoring, and resource allocation. Services such as account management, transaction processing, and customer support are individually containerized and deployed as pods in a Kubernetes cluster. This architecture allows independent scaling of services based on load and demand, resulting in efficient resource usage and enhanced system reliability.

4.3 API Design and Integration with Legacy Systems

API design plays a vital role in enabling microservices communication and external system integration. RESTful APIs are commonly used for synchronous communication between services, while asynchronous messaging using message brokers like Kafka or RabbitMQ handles event-driven interactions. To facilitate interaction with legacy core banking systems, API gateways such as Kong or Apigee are employed. These gateways manage authentication, rate limiting, logging, and traffic control, ensuring smooth integration without compromising security or performance. Adapter services are developed to wrap legacy services into modern APIs, allowing gradual migration of older systems to microservices without disrupting existing operations. This hybrid approach ensures continuity, while enabling modernization of the banking infrastructure.

4.4 Data Storage Strategy: SQL, NoSQL, and Distributed Caching

A robust data storage strategy is critical to maintaining data integrity, performance, and scalability in a cloud-based core banking environment. Relational databases (SQL) such as PostgreSQL or MySQL are employed for transactional consistency in core operations like account management and fund transfers. NoSQL databases such as MongoDB and Cassandra complement this setup by efficiently handling semi-structured or unstructured data, including user behavior logs and configuration metadata. To further optimize performance and minimize latency, distributed caching systems like Redis or Memcached are integrated. These caching layers store frequently accessed data in-memory, improving the speed of operations such as balance inquiries and real-time fraud checks. This hybrid storage architecture enables the system to balance ACID compliance, scalability, and real-time responsiveness.

4.5 CI/CD Pipeline for Microservices Deployment

Implementing a Continuous Integration/Continuous Deployment (CI/CD) pipeline is essential for maintaining the agility and reliability of microservices-based systems. Tools like Jenkins, GitHub Actions, or GitLab CI are used to automate build, test, and deployment processes. Each microservice is independently built and tested in isolated pipelines, enabling faster iteration cycles and minimizing interdependency conflicts. Docker images are created upon code commits, scanned for vulnerabilities, and pushed to container registries such as Docker Hub or Amazon ECR. Deployment scripts, often written using Helm or Terraform, ensure automated and consistent delivery to Kubernetes environments. Canary deployments and blue-green strategies are adopted for safe rollout of updates, ensuring zero downtime and seamless user experience during production changes.

4.6 Security Measures: TLS, OAuth2, and Service-Level Policies

Security is paramount in cloud-native banking systems, given the sensitivity of financial data and strict regulatory requirements. Transport Layer Security (TLS) is enforced across all service communication channels to prevent eavesdropping and ensure data confidentiality. OAuth2 is implemented for secure user authentication and authorization, with support for multi-factor authentication (MFA) to further strengthen access control. Within the microservices architecture, fine-grained service-level security policies are enforced using service meshes like Istio or Linkerd. These tools provide mTLS, policy-based access control, and traffic monitoring, offering zero-trust security across service boundaries. Additionally, role-based access control (RBAC) is configured to limit access to sensitive resources, ensuring that both internal services and external clients adhere to strict permission models.

4.7 Logging, Monitoring, and Observability (e.g., ELK, Prometheus)

Effective logging, monitoring, and observability are vital components in ensuring the reliability, security, and performance of cloud-native core banking systems. Logging frameworks such as the ELK stack (Elasticsearch, Logstash, Kibana) are widely adopted to centralize and analyze logs from distributed microservices. These logs capture application events, errors, and transaction trails, helping in real-time debugging and compliance auditing. For system monitoring, Prometheus is commonly used to collect metrics such as CPU usage, memory consumption, service availability, and request latency. It integrates seamlessly with Grafana for visualizing metrics in intuitive dashboards. Observability is further enhanced through the implementation of distributed tracing tools like Jaeger or Zipkin, which track inter-service communication and identify bottlenecks or failures across the microservices landscape. Together, these tools create a comprehensive observability ecosystem that enables proactive incident management, root-cause analysis, and informed decision-making for performance tuning.

V. EVALUATION AND CASE STUDIES

Evaluating the effectiveness of a cloud-based core banking system using microservices architecture involves assessing multiple performance, scalability, and reliability metrics. The evaluation framework typically includes benchmarking system response times, measuring transaction throughput under varying loads, and assessing fault recovery times. Performance testing under simulated peak banking hours is conducted to ensure horizontal scalability and consistent availability. Service resiliency is also evaluated by intentionally injecting faults into specific microservices to observe the system's self-healing capabilities and fallback mechanisms.

Case studies from leading banks that have migrated to microservices-based cloud infrastructure reveal significant improvements in operational agility, cost efficiency, and system uptime. For instance, banks leveraging Kubernetes and container orchestration have reported enhanced deployment frequency and faster time-to-market for new features. In one case, a mid-sized bank saw a 40% reduction in infrastructure costs after adopting a cloud-native microservices model and decommissioning legacy hardware. Additionally, continuous integration and delivery (CI/CD) pipelines enabled daily code deployments with minimal disruption to services.

Furthermore, customer satisfaction metrics, such as reduced app latency and increased digital engagement, validate the impact of these architectural shifts. The studies emphasize the critical role of observability, automation, and DevOps practices in maintaining the high standards expected of modern digital banking services. These findings collectively demonstrate that cloud-based microservices architecture not only modernizes the technological core of banks but also aligns IT operations with business innovation goals.

5.1 Benchmarking Setup and Metrics

The benchmarking setup for evaluating a microservices-based cloud core banking system is established using a hybrid environment consisting of Kubernetes clusters deployed on both AWS and Azure platforms. Key components such as API gateways, databases, service meshes, and load balancers are containerized and deployed using automated CI/CD pipelines. For a realistic simulation of banking operations, synthetic workloads are generated based on transaction patterns such as fund transfers, balance inquiries, account openings, and loan applications. The benchmarking framework utilizes tools like Apache JMeter, Locust, and Prometheus to gather telemetry and system performance data.

The evaluation metrics include average response time, transaction throughput (TPS), system latency under load, fault tolerance capabilities, and container startup/shutdown times. Service-specific metrics such as CPU utilization, memory usage, and error rates are monitored to assess the resource efficiency and stability of individual microservices. Additional KPIs such as Mean Time to Recovery (MTTR), system availability, and scalability under burst conditions provide a holistic view of operational performance. The collected metrics form the basis for understanding how well the microservices architecture meets the demands of a modern banking environment.

5.2 Response Time and Throughput Analysis

The response time and throughput analysis of the microservices-based core banking platform reveals significant performance improvements compared to traditional monolithic systems. When subjected to simulated concurrent user sessions, the platform maintained an average response time of under 300 milliseconds for standard transactions and under 500 milliseconds for complex, multi-service workflows such as loan processing. The horizontal scalability of the microservices ensured that response times remained consistent even as the number of simulated users increased to 10,000 concurrent sessions.

Throughput analysis demonstrated that the system handled over 3,500 transactions per second (TPS) without degradation in performance, validating its suitability for high-volume banking operations. Auto-scaling capabilities within the Kubernetes clusters dynamically provisioned additional service instances during traffic spikes, contributing to a steady throughput curve. This elasticity is particularly advantageous during seasonal banking peaks, such as month-end settlements or festival-related financial activities. The analysis confirms that the decoupled architecture and container orchestration significantly enhance both responsiveness and scalability.

5.3 Fault Recovery and Resilience Testing

Fault recovery and resilience testing are critical for ensuring the high availability and reliability expected from core banking systems. In the conducted tests, intentional failures such as service crashes, node shutdowns, and network latency were introduced to simulate real-world disruptions. The platform demonstrated robust self-healing capabilities via Kubernetes health probes and container restarts, with most failed services recovering within 5–10 seconds without manual intervention.

Circuit breaker patterns and service mesh policies ensured that dependent services gracefully degraded instead of propagating failures, preserving partial functionality even under stress. Load balancers and retry mechanisms within the service mesh (e.g., Istio or Linkerd) further contributed to fault tolerance. The system exhibited a Mean Time to Recovery (MTTR) of less than 15 seconds for critical services, meeting industry standards for business continuity.

The resilience testing validates the architectural advantages of microservices in maintaining uninterrupted banking services. It confirms that fault isolation, automated orchestration, and distributed redundancy collectively provide a resilient foundation for secure and dependable cloud-native banking solutions.

5.4 Performance Comparison with Monolithic Models

The performance comparison between microservices-based cloud banking systems and traditional monolithic core banking architectures reveals substantial advantages in scalability, fault isolation, and operational efficiency. While monolithic systems often exhibit bottlenecks due to tightly coupled modules, microservices decouple core banking functionalities into independent units that can be scaled, deployed, and updated without disrupting the entire system. Benchmarking results indicate that microservices systems achieve up to 40% lower response times and 60% better throughput under heavy loads. Moreover, system updates in a monolithic setup typically require full downtime, whereas microservices enable continuous deployment and hot-swapping of services with minimal user disruption. This modularity and flexibility make microservices a superior architectural choice for handling evolving customer expectations, complex workflows, and real-time financial operations.

5.5 Real-World Implementation Case Studies

Several banks and financial institutions have adopted microservices and cloud technologies to modernize their core banking platforms. For instance, a leading private bank in India transitioned its core services—such as customer onboarding, account management, and digital payments—to a cloud-native environment using Kubernetes and Docker. This migration reduced their operational costs by 25% and improved their time-to-market for new services by 50%. Another case involves a European digital bank that deployed a fully containerized microservices system with APIs for open banking integration. This enabled rapid partnerships with fintech firms and facilitated real-time cross-border payments. These real-world examples underscore the success of microservices in enabling innovation, enhancing customer experience, and achieving regulatory compliance through agile and resilient architectures.

5.6 Business Impact Assessment

The shift to cloud-based microservices architectures has resulted in measurable business benefits for banks. These include improved service availability, faster product rollouts, and enhanced customer satisfaction. By adopting a modular approach, financial institutions can deploy targeted services—such as personalized loan offers or digital KYC—faster and more reliably. Operational expenses have declined due to resource optimization and reduced reliance on costly legacy infrastructure. Additionally, microservices-based platforms are more adaptable to market changes, allowing for quicker response to regulatory updates and emerging trends like embedded finance or digital wallets. From a strategic standpoint, this transformation positions banks to remain competitive in a fintech-driven landscape by delivering scalable, secure, and future-ready digital services.

VI. CONCLUSION

The adoption of cloud-based core banking systems using microservices architecture represents a paradigm shift in the financial sector, moving away from rigid monolithic frameworks toward agile, scalable, and resilient solutions. This architectural transformation empowers banks to respond swiftly to evolving customer needs, regulatory changes, and technological advancements. By decomposing complex banking operations into independent microservices and deploying them on cloud platforms, institutions can achieve enhanced performance, continuous delivery, and seamless integration with modern digital channels.

The research presented in this paper highlights the core principles, working models, implementation strategies, and real-world applications of microservices in the context of core banking. Comparative evaluations with legacy systems demonstrate substantial improvements in scalability, fault tolerance, and operational efficiency. Furthermore, case studies reinforce the viability of this approach, showcasing successful deployments that have resulted in cost reductions and improved customer satisfaction.

In essence, the fusion of cloud computing and microservices architecture not only modernizes banking infrastructure but also lays the foundation for continuous innovation in the digital era. As the banking industry embraces digital transformation, this architectural model stands out as a future-proof enabler of secure, flexible, and customer-centric financial services.

VII. FUTURE ENHANCEMENTS

While cloud-based core banking systems utilizing microservices architecture have already demonstrated significant benefits, there remain several avenues for future enhancement. One key direction is the incorporation of **AI-driven orchestration** and **predictive scaling**, allowing the system to dynamically allocate resources based on usage patterns and anticipated load. This would further improve system responsiveness and cost-efficiency, especially during peak transaction periods.

Another enhancement lies in **multi-cloud and hybrid-cloud deployments**, enabling banks to avoid vendor lock-in, ensure higher availability, and meet compliance requirements across jurisdictions. Additionally, the integration of **serverless computing models** within certain non-critical microservices could reduce overhead and further simplify deployment and scaling.

Security remains an evolving concern. Future systems can benefit from **zero-trust security models** and **blockchain-based audit trails** for greater data integrity and transparency. Moreover, **advanced observability** using AI-powered anomaly detection across microservices can proactively flag operational issues before they affect users.

Finally, incorporating **low-code or no-code platforms** into the microservices development pipeline could accelerate innovation by empowering non-developers to contribute to service functionality within regulated frameworks. These forward-looking strategies collectively aim to build more intelligent, resilient, and adaptive core banking infrastructures that align with the future of digital finance.

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Illustrative Industry Architecture to Mitigate Potential Fragmentation across a Central Bank Digital Currency and Commercial Bank Money*

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Abstract

Central banks are actively exploring central bank digital currencies (CBDCs) by conducting research, proofs of concept and pilots. However, adoption of a CBDC can risk fragmenting both payments markets and retail deposits. In this paper, we aim to provide a mitigation to this fragmentation risk by presenting an illustrative industry architecture that places CBDCs and commercial bank money on a similar footing. We introduce the concept of ecosystems providing a common programmability layer that interfaces with the account systems at both commercial banks and the central bank. We focus on a potential UK CBDC, including industry ecosystems interfacing with commercial banks using Open Banking application programming interfaces.

1 Introduction

A central bank digital currency (CBDC) is a digital payment instrument, denominated in a national unit of account, that is a direct liability of a central bank [9]. Central banks are actively exploring CBDCs [10, 1] with various motivations such as:

(i) continuing access to central bank money,

(ii) improving resilience,

(iii) increasing payments diversity,

(iv) encouraging financial inclusion,

(v) improving cross-border payments,

(vi) supporting privacy, and

(vii) facilitating fiscal transfers [13].

The design of a CBDC and its underlying system could potentially lead to significant risks, ranging from cyber security risks [9] to financial stability risks [12]. In addition, we identify a further risk of fragmentation in payments markets and retail deposits unless there is interoperability between CBDCs and existing forms of money.

In the UK, the Bank of England and HM Treasury have established the CBDC Taskforce to coordinate the exploration of a potential UK CBDC as well as two external engagement groups – the CBDC Engagement Forum and the CBDC Technology Forum – to gather input on non-technological and technological aspects respectively, of CBDC [8]. The Bank of England

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and HM Treasury were also to launch a consultation in 2022, which set out their assessment of the case for a UK CBDC [7].

In this paper, we focus on a potential UK CBDC and describe an illustrative industry architecture based on the Bank of England's "platform model" [4]. Our contribution is the concept of ecosystems that provide a common programmability layer across both CBDC and commercial bank money and thereby place both forms of money on a similar footing. We hope the architecture presented in this paper will stimulate discussion and look forward to ongoing industry engagement on CBDC.

2 Central Bank Digital Currency Models and Architectures

Central banks have described, proposed and piloted several models and architectures for CBDCs. The Bank for International Settlements (BIS) has described a range of CBDC architectures including a single-tier "direct" architecture, two-tier "hybrid" and "intermediated" architectures, and an "indirect" architecture [2]. The BIS has also described models for multi-CBDC arrangements to make cross-border payments more efficient, namely "compatible" CBDC systems, "interlinked" CBDC systems, and a "single" CBDC system [3]. The People's Bank of China has initiated a CBDC pilot that uses a two-tier architecture, with the central bank issuing digital fiat currency to authorised operators who take charge of exchange and circulation [16]. The Estonian Central Bank is experimenting with a bill-based CBDC money scheme built on a partitioned blockchain architecture [14]. The Federal Reserve Bank of Boston and the Massachusetts Institute of Technology have prototyped two CBDC systems with a central transaction processor, one with an "atomizer" architecture and another with a "two-phase commit" architecture [11].

The Bank of England has described several potential models for CBDC provision including a "platform model", a "pooled account model", an "intermediated token model", and a "bearer instrument model" [5]. The "platform model" (Figure 1), which we adopt in this paper, comprises the Bank of England operating a core ledger and providing access via application programming interfaces (APIs) to authorised and regulated Payment Interface Providers (PIPs) that provide users with access to CBDC.

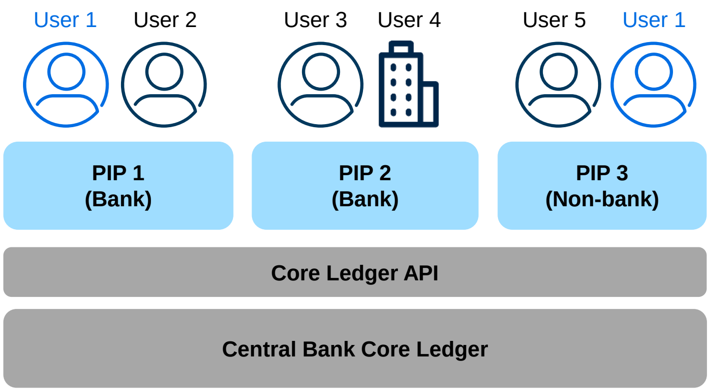

Figure 1: The Bank of England's "platform model" for CBDC provision, comprising a core ledger, an application programming interface (API), Payment Interface Providers (PIPs), and users. Figure adapted with permission from [4].

3 Illustrative Industry Architecture

In this section, we describe an illustrative industry architecture for a potential UK CBDC by identifying the initial requirements, describing the logical architecture, and analysing how it meets the requirements. We adopt the Bank of England's platform model; that is, we do not consider other models in the remainder of this paper.

3.1 Initial Requirements

We first identify the following initial requirements as a basis for developing the architecture:

- *Characteristics*: the architecture should support the characteristics of a CBDC system identified by the Bank of England, namely it should be [6]:
  - (i) reliable and resilient,
  - (ii) fast and efficient, and
  - (iii) innovative and open to competition.
- *Technology choices*: the architecture should align with the Bank of England's current views on potential technology choices on topics such as ledger design, privacy, simplicity and programmability [6].
- *Interoperability*: the architecture should avoid fragmentation by ensuring CBDCs and commercial bank money are interoperable and have similar operational capabilities.

3.2 Logical Architecture

Figure 2 depicts the logical architecture. The key aspects of this architecture, which extends the platform model, are summarised below:

- The Bank of England operates the core ledger that records the CBDC value and processes the payment transactions made using the CBDC, and it provides access to the core ledger via APIs. Users are linked to their CBDC balances and payment transactions on the core ledger with pseudonymous identities. We highlight that the core ledger APIs could potentially be similar to Open Banking APIs [15] with some enhancements such as new APIs for opening and closing CBDC accounts.
- We introduce PIP ecosystems that provide competing services including:
  - (i) the implementation of common policies, data standards and process standards,
  - (ii) integration across the core ledger APIs provided by the Bank of England and Open Banking APIs provided by commercial banks,
  - (iii) integration with shared services such as identity providers and financial data vendors,
  - (iv) integration with other payment rails such as the UK Faster Payments Service (FPS) and point of sale (POS) networks,
  - (v) integration with other CBDC systems, and
  - (vi) a programmability layer that operates across all of these services and provides a foundation for creating new automated behaviours and innovative products.

- PIPs are authorised and regulated firms, which can include both commercial banks and non-banks. They onboard retail and business users, provide customer services, and fulfil regulatory requirements such as know-your-customer (KYC) and anti-money laundering (AML). PIPs also pseudonymise user identity and intermediate user access to the CBDC system. Note that PIPs could potentially deliver these capabilities by leveraging ecosystem services.

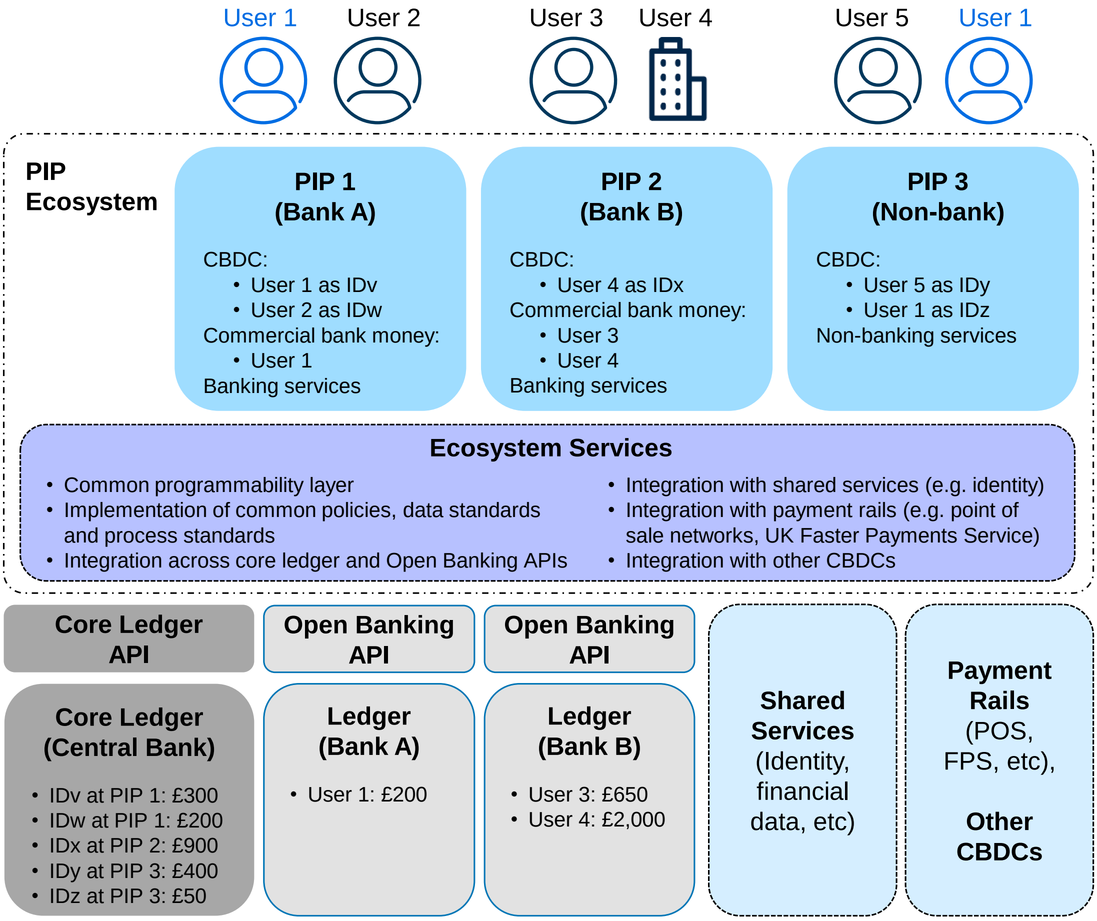

Figure 2: An illustrative industry architecture including common overlay services across UK CBDC and commercial bank money. There could potentially be multiple ecosystems providing competing services using different platforms and technologies, but using common policies and standards. Ecosystem services may be operated by financial market infrastructures. User 1 has accounts at Bank A and the central bank, User 2 has an account at the central bank, User 3 has an account at Bank B, User 4 has accounts at Bank B and the central bank, and User 5 has an account at the central bank.

3.3 Analysis

We now analyse the architecture against the initial requirements and summarise our findings in Table 1.

Requirements	Analysis
Characteristics: (i) reliable and resilient, (ii) fast and efficient, and (iii) innovative and open to competition	(i) The Bank of England can exercise control and oversight over the core ledger to ensure it is secure, compliant and private. Well-designed platforms can deliver resiliency, scalability and availability at the core ledger and ecosystem layers. (ii) The architecture introduces ecosystems as a layer between PIPs and the core ledger API, but the overhead of this indirection should be minimal and ecosystems can provide significant benefits including operational efficiencies. (iii) PIP ecosystems can build competing and innovative services while using common policies and standards to ensure interoperability.
Technology choices: (i) ledger design, (ii) privacy, (iii) simplicity, and (iv) programmability	(i) The API-based layered architecture allows the technology choices for the core ledger to be generally independent of the technology choices for other layers such as the ecosystems. (ii) The use of pseudonymous identities ensures only appropriate parties are aware of user identities, which facilitates privacy while retaining the ability to conduct KYC and AML. (iii) The core ledger infrastructure can be kept relatively simple because more complex functionality is provided by PIP ecosystems instead. (iv) Implementing programmability in the PIP ecosystems layer, instead of in the core ledger, should reduce security risks and complexity at the core ledger. Programs running in PIP ecosystems would leverage the core ledger acting as the authoritative data store. Each ecosystem could implement programmability using its platform of choice.
Interoperability	The PIP ecosystems would provide common policies, data standards and process standards across both CBDC and commercial bank money. This would avoid fragmentation by ensuring CBDCs and commercial bank money are interoperable and have similar operational capabilities.

Table 1: Summary analysis of architecture against initial requirements.

4 Summary and Further Work

This paper focused on a potential UK CBDC and presented an illustrative industry architecture that:

- adopts and extends the Bank of England's platform model for CBDC provision,
- aligns with the Bank of England's currently identified system characteristics and views on potential technology choices for CBDC infrastructure, and

- mitigates the risk of fragmentation in payments markets and retail deposits by introducing the concept of ecosystems that provide a common programmability layer across CBDCs and commercial bank money.

Barclays is developing a prototype based on the illustrative industry architecture. Potential further work includes the analysis of any changes needed to Open Banking APIs in order to integrate with the common programmability layer, prototyping the specification of the core ledger APIs, and elaborating key customer journeys using the architecture. We hope this architecture paper will stimulate discussion, particularly regarding methods to reduce fragmentation risk by placing CBDCs and commercial bank money on a similar footing, and we look forward to ongoing industry engagement on CBDCs.

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A Scalable Architecture for Electronic Payments

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Abstract

We present a scalable architecture for electronic retail payments via central bank digital currency and offer a solution to the perceived conflict between robust regulatory oversight and consumer affordances such as privacy and control. Our architecture combines existing work in payment systems and digital currency with a new approach to digital asset design for managing unforgeable, stateful, and oblivious assets without relying on either a central authority or a monolithic consensus system. Regulated financial institutions have a role in every transaction, and the consumer affordances are achieved through the use of non-custodial wallets that unlink the sender from the recipient in the transaction channel. This approach is fully compatible with the existing two-tiered banking system and can complement and extend the roles of existing money services businesses and asset custodians.

1 Introduction

We consider the problems posed by modern retail payments in the context of the perceived need for compromise between regulatory compliance and consumer protections. Retail payments increasingly rely on digital technology, including both e-commerce transactions via the Internet and in-person electronic payments leveraging payment networks at the point of sale. With cash, customers pass physical objects that are in their possession to merchants. In contrast, electronic payments are generally conducted by proxy: Customers instruct their banks to debit their accounts and remit the funds to the bank accounts of their counterparties. For this reason, non-cash retail payments expose customers to a variety of costs and risks, including profiling, discrimination, and value extraction by the custodians of their assets.

A good central bank digital currency (CBDC) would empower individuals to make payments using digital objects in their possession rather than accounts that are linked to their identities, affording them verifiable privacy and control over their digital payments. However, many existing CBDC proposals require either a centralised system operator or a global ledger. Centralised systems entail risks both for the users of the system as well as for the system operators, and global ledgers present performance bottlenecks as well as an economically inefficient allocation of transaction costs.

We present a system architecture for retail payments that allows transactions to take place within a local context, avoiding the problems associated with performance bottlenecks and centralised system operators. We show how assets that represent obligations of central banks can be created and exchanged, without requiring a central system operator to process and adjudicate all of the transactions, and without undermining the portability of money throughout the system or the ability for regulators to ensure compliance.

Although our proposal takes a decentralised approach to processing transactions, money within our system intrinsically relies upon a trusted *issuer*. This could be the central bank itself, but it could also be a co-regulated federation, such as a national payment network or the operators of a real time gross settlement system. Specifically, the issuer is trusted to oversee the processing of redemptions, wherein CBDC assets are accepted as valid by their recipients.

Our proposal is fully compatible with the function of existing private-sector banks. The architecture provides an effective solution for a variety of different use cases, including those that are sensitive to regulatory compliance requirements, transactional efficiency concerns, or consumer affordances such as privacy and control. We begin with an examination of the properties required to support such use cases.

The remainder of this article is organised as follows. Chapter 2 identifies the properties that a payment system should have as a foundation for a robust set of technical requirements, Chapter 3 specifies the design of our proposed architecture, Chapter 4 offers a model for how to deploy and manage a central bank digital currency (CBDC) system using our architecture, Chapter 5 describes several use cases that demonstrate the special capabilities of our proposed design, Chapter 6 compares our design to other payment systems, and Chapter 7 provides a summary.

2 Payment system desiderata

To be broadly useful for making payments, and particularly to satisfy the requirements of central bank digital currency, a payment system must have the properties necessary to meet the demands of its use cases. We describe these properties and use cases, and show that they are indeed required.

2.1 Asset-level desiderata

- ***Integrity.*** We say that an asset has *integrity* if it has a single, verifiable history. Actors in possession of the asset must be able to confirm that the asset is genuine and unique; specifically, any two assets that share any common history must be the same asset. Desired characteristics of integrity include:

  1. **Durability**
     Short of stealing the private key of an issuer or breaking the cryptographic assumptions upon which the system infrastructure depends, it shall not be possible to create a counterfeit token, it shall not be possible for the party in possession of a token to spend it more than once, and it shall not be possible for an issuer to create two identical tokens. In addition, it shall not be possible for any actor to mutate the token, once issued.
  2. **Self-contained assets**
     The asset shall be *self-validating*, which is to say that it shall support a mechanism that allows it to furnish its own proof of integrity, as part of a process of verifying its authenticity to a recipient or other interested party. The purpose of self-validation is to maximise the flexibility of how assets are used and how risks related to asset ownership and state can be managed. In particular, the issuer shall not be required to track the owner or status of the assets that it has created, and payers shall not concern themselves with what happens to an asset once it is spent.

- ***Control.*** An actor has *control* of an asset if that actor and no other actor possesses the means to specify legitimate changes to the asset, including features that identify its owner. Note that *control* implies the ability to modify the asset in a way that determines the legitimacy of changes made to the asset by its possessor. Desired characteristics of control include:

  3. **Mechanical control**
     The ability to create a valid transaction is vested in the owner. No one but the owner can update the state of a specific asset.
  4. **Delegation**
     The asset owner must be able to retain control of the asset when transferring the responsibility of possession to a custodian. That custodian is then unable to exercise control over that asset, for instance by creating a legitimate update to the asset. The owner chooses who can exercise control, and owners can delegate possession without delegating control.

- ***Possession.*** An actor has *possession* of an asset if that actor and no other actor can effect changes to the asset or reassign possession of the asset to another actor. *Possession* implies the ability to deny possession to others, including the legitimate owner of the asset, on an incidental or permanent basis (this does not include the possibility for forced legal enforcement to relinquish or return an asset). In principle, the balance among costs and risks related to the possession of an asset, including the ability to store assets safely, can be independently chosen by various actors in the system. Desired characteristics of possession include:

5. **Choice of custodian**
   Asset owners must be able to choose the custodian entrusted with the possession of their asset. This contrasts with traditional ledger-based approaches in which the ledger is the fixed source of truth about an asset and for which an asset is inextricably bound to that ledger (i.e., moving the asset to another ledger would involve redemption in the first ledger and a new issuance in the next ledger). This property is an essential interoperability feature for any national currency system. To mitigate risks such as custodial compromise or service disruption for sensitive payment systems, asset owners must be able to choose to have the possession of their assets spread across multiple custodians ("multiplexing"), such that they require only some portion of them to respond in order to update the state of their assets. This should be able to occur in a way that is opaque to the custodians ("oblivious multiplexing"), where each is concerned only with its own portion of assets which it is providing custody over and is unaware that other custodians are involved.

6. **Choice to have no custodian**
   The owner of an asset must be able to serve as his or her own custodian. Specialised custodians are good for mitigating risks, but they always introduce costs (transaction fees, account fees, latency, and so on) and risks (for example, intentional or accidental service disruption). To address use cases that are sensitive to those costs and risks it is necessary to allow non-specialised actors to also provide custodianship of assets, and in particular to allow a human owner of an asset to store the asset personally, using his or her own devices.

- ***Independence.*** Asset owners shall be free to conduct transactions in the future, with confidence that they will be able to use the assets for the use cases they want.

7. **Fungibility**
   Each unit is mutually substitutable for each other unit of same issuer, denomination, and vintage, and can be exchanged for cash or central bank reserves. This is enabled by privacy by design and required for self-determination.

8. **Efficient lifecycle**
   Transactions must be similar in speed to traditional payment systems, capable of having near-instant acceptance. It must be possible for the recipient of an asset to verify that a transaction is valid and final without the need to involve a commercial bank at the time of the transaction, and without forcibly incurring additional costs, risks, or additional technical or institutional requirements. Assets must not expire within an unreasonably short timeframe.

2.2 System-level desiderata

- ***Autonomy.*** We say that an actor has *autonomy* with respect to an asset if the actor has both possession and control of the asset and can modify the asset without creating metadata that can be used to link the actor to the asset or any specific transaction involving that asset. The term *autonomy* is chosen because it reflects the risk that a data subject might lose the ability to act as an independent moral agent if such records are maintained [1]. Desired characteristics of autonomy include:

9. **Privacy by design**
   The approach must allow users to withdraw money from a regulated entity, such as a bank or money services business, and then use that money to make payments without revealing information that can be used to identify the user or the source of the money. The assets themselves, and the transactions in which they are involved, must be untraceable both to their owners and to other transactions. The system must be designed to allow all users to have a sufficiently large anonymity set that they would not have reason to fear profiling on the part of powerful actors with access to aggregated data.

10. **Self-determination for asset owners**
    Asset owners shall be able to control what they do with assets. No recipient can use the system to discriminate against asset owners or impose restrictions on what a particular owner can do. Transactions using an asset shall not be blocked or otherwise flagged by recipients based upon targeting the owner of an asset or targeting a set of assets associated with some particular transaction history.

- ***Utility.*** The system must be generally useful to the public as a means to conduct most, and perhaps substantially all, retail payments. Desired characteristics of utility include:

11. **Local transactions**
    It shall be possible to achieve efficient transactions where participants are able to rely upon local custodians to facilitate acceptance of remittances. The system shall not rely upon global consensus to determine or verify the disposition of an asset and shall allow transacting parties to choose an authority or context that they mutually trust, for example to trust a local authority in exchange for faster settlement or when access to a wider network is not possible, without requiring additional trust between counterparties.
12. **Time-shifted offline transactions**
    It shall be possible for a payer to "time-shift" third-party trust to achieve a form of offline payment by first prospectively paying a recipient and then later, in an offline context, choosing whether to consummate the payment by selectively revealing additional information. Time-shifted offline transactions are akin to purchasing a ticket online and, later, spending it offline.
13. **Accessibility**
    The protocol employed by the system must be accessible and open to all users. The system must not impose vendor-specific hardware compatibility requirements and must not require manufacturers of compatible hardware to register with a central database or seek approval from an authority. The functionality of the system must not depend upon trusted computing, secure enclaves, or secure elements that impose restrictions upon what users can do with their devices. The system must not require a user to register before acquiring and using a device, and the possession and use of a physical device must not depend upon a long-term relationship with a trusted authority, registered business, or asset custodian.

- ***Policy.*** The system must support the establishment of institutional policies to benefit the public and the national economy. Desired characteristics of policy include:

14. **Monetary sovereignty**
    Monetary sovereignty entails a central bank and government's ability of controlling the use of the sovereign legal currency within its borders and the mechanisms within which it is used. In support of this end, financial remittances facilitated by the system shall involve direct obligations of the central bank of the applicable jurisdiction.
15. **Regulatory compliance**
    The system shall be operated by regulated financial intermediaries that can establish and enforce rules for their customers. The system shall provide a mechanism that would permit financial intermediaries to prove that they have enforced those rules completely and in every case. By extension, the system would allow for the establishment of regulatory requirements for its operators to support reasonable monitoring by tax authorities for the purpose of establishing or verifying the income tax obligations of their clients. Subject to the limitation that both counterparties to a transaction would not generally be known, the system would permit system operators to perform analytics on their customers, for example, by learning the times and size of asset deposits or withdrawals. Ideally, the system would also provide a counter-fraud mechanism by which consumers to verify the validity of merchants.

2.3 Technical requirements

Next, we translate the asset-level and system-level desiderata into specific technical and institutional capabilities that are necessary to support a suitable payment system. We begin by identifying the technical requirements for an institutionally supportable digital currency that supports verifiable privacy for consumers, wherein consumers are not forced to rely upon promises by trusted actors:

- ***Blind signatures.*** Consumer agents must implement *blinding* and *unblinding* with semantics similar to the blind signatures proposed by Chaum in his original article [3] and further elaborated in his more recent work with the Swiss National Bank [4]. Specifically, it must be possible for users to furnish a block of data to an issuer, ask the issuer to sign it, then transform the response into a valid signature on a new block of data that the issuer has never seen before and cannot link to the original block of data. This allows transactions that do not link the identity of the sender to the identity of the recipient, as a way to achieve privacy by design (9).

- ***Distributed ledger.*** Participants in a clearing network overseen by a central bank must have access to a suitable distributed ledger technology (DLT) system [5] that enables them to collectively maintain an immutable record that can be updated with sufficient frequency to provide transaction finality that is at least as fast as domestic bank wires. This helps ensure both durability of assets (1) and self-determination for users (10) as described in Section 2.

- ***Open architecture.*** The system must fully support the semantics for digital currency specified by Goodell, Nakib, and Tasca [2]. Specifically, we assume that retail users of digital currency have access to non-custodial wallets that satisfy certain privacy and accessibility requirements described in Section 2.2, specifically requirements (6), (9), (10), and (13).

- ***Fungible tokens.*** The digital currency tokens themselves must satisfy the fungibility requirement (7) described in Section 2.1.

- ***Institutional controls.*** System operators must possess capabilities that support the policy requirements described in Section 2.2, specifically requirements (14) and (15).

Moving to a digital form of currency brings a variety of potential benefits when compared to paper currency, including cryptographic signatures, cryptographic shielding, flexible semantics, reduced management costs, and being able to efficiently transfer units of currency over large distances.

However, it is also important to re-capture some of the benefits of physical currency. In order to have *self-contained assets* with *custodial choice*, we need a representation for our assets that is unforgeable, stateful, and oblivious:

- ***Unforgeable.*** Every asset must be unique, and it can only be created once. No set of adversarial actors can repeat the process of creating an asset that has already been created. Note that this requirement is different than a "globally unique identifier", which is merely unlikely to be reused by an honest actor, but which any adversarial actor can reuse for any other asset. True unforgeability requires that once an asset is created, it is impossible to reuse its identifier for any another asset. This property is required for durability (1), custodial choice (5), the choice to have no custodian (6), local transactions (11), and time-shifted offline transactions (12).

- ***Stateful.*** Every asset has its own independent state, and as the state of an asset changes over time, the asset remains unique and unforgeable. No set of adversarial actors, including non-issuer owners, can create a second version of the asset with a different state. Note that this requirement precludes using any kind of "access control token", such as an HMAC, signed attestation, or even a blinded signature scheme asset, which cannot accumulate state over time and must be returned in precisely the same form as created. The requirements of self-contained assets (2), mechanical control (3), and delegation (4) necessitate that assets maintain their own state.

- ***Oblivious.*** Once finality is achieved following the transfer of an asset to a new owner all of the previous owners, including the issuer, have no obligation to know any aspect of its future state changes and transfers. There is no residual risk to the new owner that the transaction will be undone by either a previous owner or the system itself. Note that encryption does not suffice: there must be no requirement to inform previous owners that state changes have occurred, and previous owners must not be required to do any extra work to accommodate those changes. Otherwise, the self-determination (10) and efficient lifecycle (8) requirements would be compromised.

  Paper bank notes are a good example of obliviousness. No entity knows where every bank note is, or what everyone's billfolds hold. If anyone, including the mint, were guaranteed to know this information, then it would prevent paper money from being useful in many of its required use cases. Although obliviousness and privacy are closely related, obliviousness is really about efficiency: It is acceptable for the mint to know where some bills are and the contents of some billfolds.

These qualities combine together to provide assets, referred to as *USO assets* in this document, that have very similar qualities to paper currency. While assets embodying these qualities are not readily available at this time, this is an area of active study and promising results. Given such assets in combination with the technologies mentioned above, our architecture is able to fulfill the complete list of requirements for a payment system. In particular, CBDC created using our architecture can meet the use case demands of paper currency as well as the demands of electronic payment systems in a single architecture, without requiring trusted hardware or heavyweight consensus systems.

The requirement for a USO asset to be stateful means it must be able to prove its state has finality. The requirement for a USO asset to be oblivious means that the asset must carry a *proof of provenance* (POP) that allows it to demonstrate its validity on its own, as no other part of the system is required to have it. The requirement for a USO asset to be unforgeable means this proof carries the same weight as if it came from directly the issuer itself, so the issuer acts as the *integrity provider* of the POP.

Obliviousness implies there can be other systems between the asset owner and the integrity provider. These systems serve as *relays* in the creation of the POP. Relays are common carriers, like network carriers. In fact a relay knows considerably less than a network carrier: it accepts hashes, and emits hashes of those hashes, and by design is completely oblivious to everything else.

3 An efficient, general-purpose architecture for CBDC

In this section we propose a method for creating a retail central bank digital currency (CBDC) that supports private payments wherein the owner maintains custody of her digital assets. It achieves the necessary properties for a general purpose payment system described in the previous section by extending the approach proposed by Goodell, Nakib, and Tasca [2] with a new asset model that eliminates the need for global consensus with regard to every transaction. While our new approach requires that the central bank must operate some real-time infrastructure, we show that this requirement can be addressed with a lightweight, scalable mechanism that mitigates the risk to resilience and operational security.

Suppose that a user, Alice, wants to withdraw retail CBDC for her general-purpose use in making retail payments. We assume that the recipient of any payment that Alice makes will require one or more valid tokens from a trusted issuer I containing content k that has been signed using signature function $s(k, I)$. We further assume, following the arguments made in earlier proposals for privacy-preserving retail CBDC [2, 4], that she will be able to use a *blinding* function b, known only to Alice, to request a blind signature on $b(k)$ to which she can apply an *unblinding* function b^{-1}, also known only to Alice, to reveal the required signature:

$$b^{-1}(s(b(k), I)) = s(k, I) \tag{1}$$

The signature $s(k, I)$ appearing at the beginning of a USO asset's history shows that it was generated correctly by the CBDC's issuer or by one of its delegates, which we shall call *minters*. Minters are subject to a *minting invariant* wherein every time a minter satisfies a request for a set of signatures of a particular value, it must also cancel a corresponding set of CBDC assets of equal value, and vice-versa. The function of a minter, therefore, is to *recycle* CBDC, and not to issue or destroy it.

The proof of provenance of a USO asset allows its recipient to verify that it has the same integrity as if it were in the issuer's database. These proofs of provenance are a powerful enabling feature for a retail CBDC, since assets can be transacted without the need to maintain accounts. Additionally, the expected costs of operating the issuer's infrastructure is much smaller at scale than the costs associated with operating traditional distributed ledger infrastructures in which the record of each transaction is maintained in a global ledger.

However, unlike transferring blinded assets in a classical ledger system, whether distributed [2] or not [4], transferring USO assets from one party to another explicitly leaves behind an audit trail that can be used by the bearers of an asset to recognise the asset when it is inspected, transacted or seen in the future. A USO asset's proof of provenance is permanently updated each time it is transferred to a new recipient. If the same asset were to be associated with multiple transactions, then a single party to any of the transactions would be able to recognise the asset across all of its transactions, which could potentially compromise the privacy of the other parties.

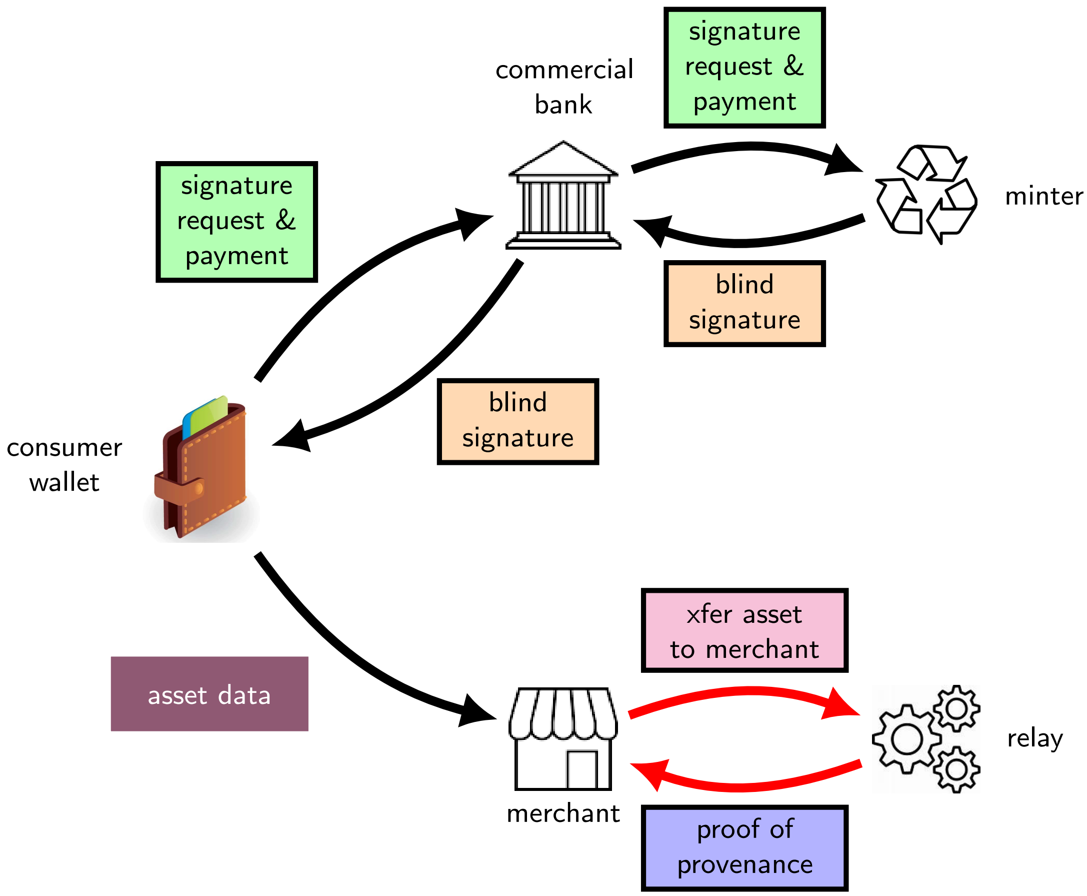

Figure 1: ***Schematic representation of the CBDC journey from the perspective of a consumer.***

It follows that if Alice wants an asset that she can spend privately, she must create it herself. Alice establishes her own USO asset privately, and subsequently populates it with the signature $s(k, I)$. Having done this she can then safely transfer the asset to Bob without concern. Figure 1 provides a visualisation of the CBDC journey from the perspective of a consumer.

Once Bob receives the asset from Alice, he has a choice. One option is to transfer it to a bank, perhaps to deposit the proceeds into his account with the bank, or to request a freshly minted CBDC asset as Alice had done earlier. If he chooses to deposit the proceeds into his account, then the bank now has a spent CBDC asset that it can exchange for central bank reserves or use to satisfy requests for new signed CBDC assets from its other account holders. Alternatively, Bob could transfer the CBDC onward without returning it to the bank, bearing in mind that Bob would not be anonymous when he does; see Section 5.3 for details.

We organise Alice's engagement lifecycle with the asset in a five-step process, as shown in Figure 2:

1. First, Alice chooses a service provider that maintains a relay G, and creates a new USO asset that refers to some specific prior commitment G_0 published by the relay. For each CBDC token that Alice wishes to obtain, she generates a new pair of keys using asymmetric cryptography and embeds the public key A and G_0 along with the public key of the proposed digital currency issuer I, the denomination d, and a certificate

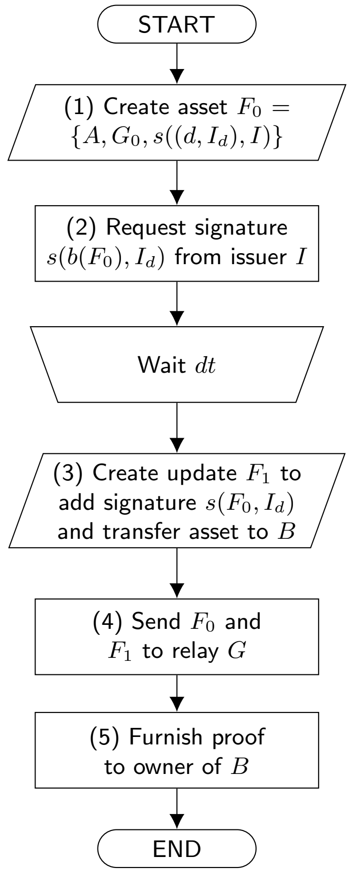

Figure 2: ***Typical consumer engagement lifecycle.*** Parallelograms represent USO asset operations.

$s((d, I_d), I)$ containing the key used by the issuer to sign tokens of denomination d into a template for a new, unique update $F_0 = \{A, G_0, s((d, I_d), I)\}$ as the foundation for a new asset F. Note that for Alice to ensure that her subsequent spending transactions are not linked to each other, she must repeat this step, creating a new key pair for each asset that she wants to create, and optionally choosing different values for the other parameters as well.

2. Next, Alice creates $b(F_0)$ using blinding function b and sends it to her bank along with a request for a blind signature from a minter using the key for the correct denomination I_d, which in the base case we assume to be the central bank. Alice is effectively requesting permission to validate asset F as legitimate national digital currency (the sovereign legal tender within that jurisdiction), so, presumably, the bank will require Alice to provide corresponding funds, such as by providing physical cash, granting the bank permission to debit her account, or transferring digital currency that she had previously received in the past. See Figure 3. Alice's bank shall forward her request $b(F_0)$ to the central bank along with central bank money (cash, central bank reserves, or existing CBDC assets) whose total value is equal to the value of the CBDC that Alice is requesting. The bank shall then provide Alice with the signature $s(b(F_0), I_d)$.

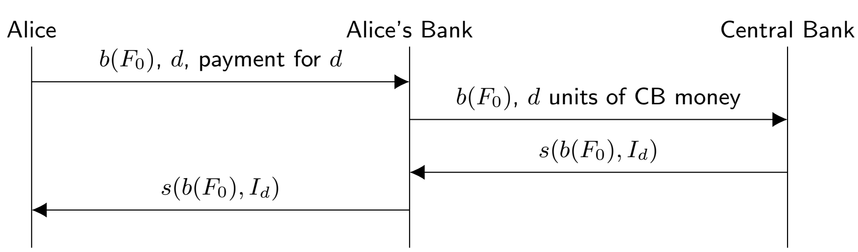

Figure 3: ***Protocol for Step 2.*** The validation of d units of digital currency.

3. At this point, Alice can now "unblind" the signature received from the minter to yield $s(F_0, I_d)$, which is all that is required to create valid CBDC. To mitigate the risk of timing attacks that could be used to correlate her request for digital currency with her subsequent activities, Alice should wait for some period of time dt, before conducting a transaction with the valid CBDC received as well as before sharing the unblinded signature $s(F_0, I_d)$. Alice's privacy derives from the number of tokens that are "in-flight" (outstanding) at any given moment. If she transacts too quickly after completing her withdrawal, then her spending transaction might be traced to her withdrawal.

   When Alice is ready to conduct a transaction with Bob, she creates a new update F_1 wherein she updates the metadata of F to include the signature $s(F_0, I_d)$ and transfer ownership to Bob using his public key B. Optionally, Alice might want to confirm that B legitimately belongs to Bob's business, in which case Bob could furnish a certificate for his public key. We also imagine that regulators might impose additional requirements that would apply at this stage, which we describe in Section 4.4. Observe that neither the asset F_0 nor its update F_1 contain any information about Alice, her wallet, or any other assets or transactions.

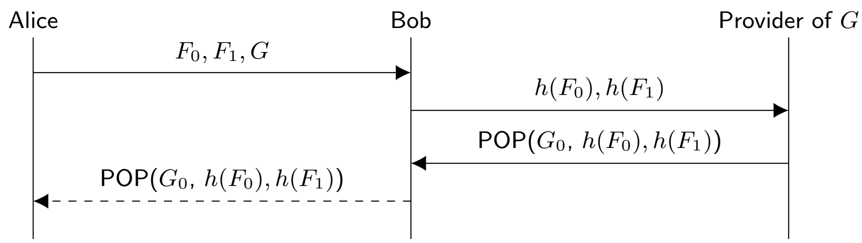

Figure 4: ***Protocol for Step 4, Option 1.*** Alice gives Bob possession and control, and Bob registers the update.

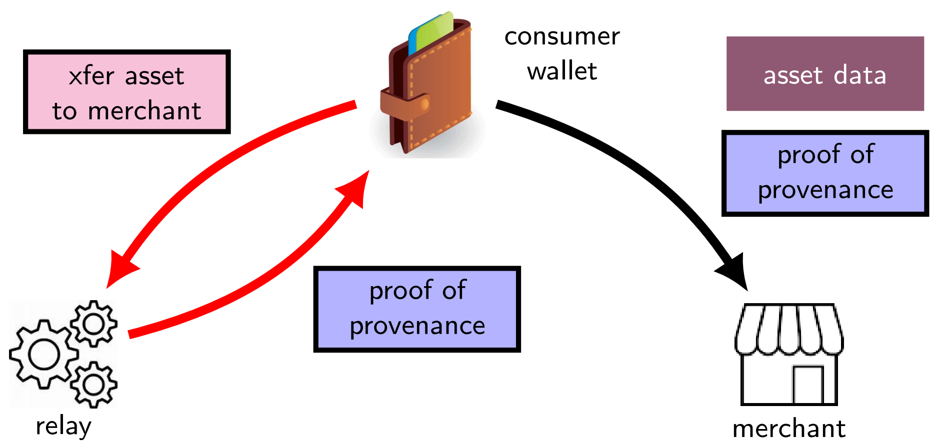

Figure 5: ***Schematic representation of Step 4, Option 2.***

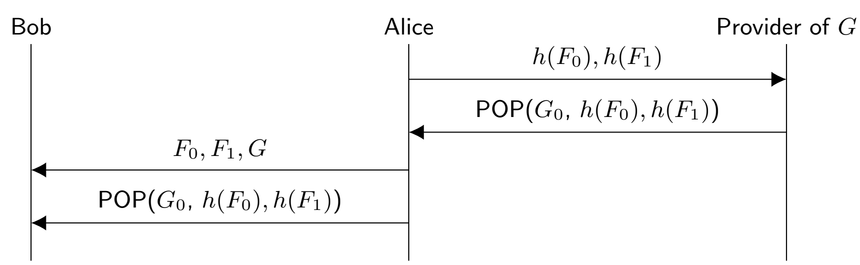

Figure 6: ***Protocol for Step 4, Option 2.*** Alice registers the update herself, giving Bob control first and possession later.

4. To consummate the transaction, $h(F_0)$ and $h(F_1)$ must be sent to relay G, wherein h is a selector function that can be used to demonstrate that Alice had committed to creating the asset F_0 and its update F_1, respectively. In particular, h may be a hash function. Alice has two options for how to proceed:
   - ***(Option 1.)*** Alice sends the identity of the relay G along with the asset F_0 and its update F_1 to Bob (see Figure 4), and Bob sends $h(F_0)$ and $h(F_1)$ to the relay. At this point, Bob may furnish the POP of the transaction to Alice, once he receives it, as a receipt.
   - ***(Option 2.)*** Alice sends $h(F_0)$ and $h(F_1)$ to the relay directly and subsequently furnishes the asset and its proof of provenance to Bob (see Figures 5 and 6).
5. Finally, if Alice had chosen Option 2 for the previous step, then she should reveal to Bob the POP indicating that the transaction is done. If Alice had chosen Option 1 for the previous step, then Bob will be able to verify this himself.

Note that once Alice has transferred the CBDC asset to Bob, nothing about the asset or its proofs of provenance can be used to link the asset to Alice, her devices, or her other transactions, regardless of what Bob does with the asset going forward. Broadly speaking, these are the same protections that Alice has when she uses cash, although we expect that regulated financial intermediaries will generally always learn that Bob receives a CBDC asset when Bob receives an asset from a non-custodial wallet.

Our architecture provides a general framework for specifying which assets are considered valid. Importantly, and unlike some digital currency system designs, our system allows all of the rules to be implemented at the edge rather than inside the network itself. For example, because a regulated financial intermediary has a role in every transaction, a bank accepting CBDC assets as deposits might implement a rule requiring that an asset must have been previously transacted at most once.

Alice's privacy depends upon Alice not binding her identity to the transaction in some way, for example by embedding her personal information into a transaction or by linking the transaction to a wallet identifier. In all cases, we expect that only the initial consumer, Alice, enjoys the benefits of consumer protection. Subsequent recipients of an asset do not have such protections, and rules enforced by banks that receive assets can impose explicit requirements on all of the participants in a chain of transactions. Note that a point of trust is required for any fair transaction between two untrusting parties [8].

4 Operational considerations

Although our architecture could be applied to arbitrary digital currency applications, including digital currency and e-money issued by private-sector banks, we assume that this architecture is most useful for the implementation of central bank digital currency (CBDC), wherein central banks would be the issuers of currency for use by the general public to facilitate payments in domestic retail contexts. CBDC would represent part of the monetary base (M0), like cash and central bank reserves.

In this section, we consider operational concerns for the various parties involved in a CBDC distribution, including central banks, private-sector banks, clearinghouses, merchants, and consumers. In particular, we show that the system is able to support lightweight requirements for central banks as well as for end-user devices, including both mobile wallets for consumers and merchant devices at the point-of-sale.

4.1 Operational model

We present a prescriptive model for how to use our architecture to implement CBDC, explicitly highlighting how CBDC would operate within the context of a modern banking system and institutions. We observe that money constitutes a complex system within an economy, entailing a delicate set of connected relationships among participants. Our proposed architecture avoids undermining this balance of connected relationships by aligning closely to the system architecture implicit to physical cash. In this sense, what we propose is not a radical new system design, but rather a new kind of digital cash that can exist alongside physical cash and other forms of money or money-like instruments used for payments. To support this model, we must consider the processes and institutions that support the circulation of cash and how they would be adapted to support the circulation of CBDC. We also introduce two new systems: an *integrity system* comprising the set of relays, which ensures that digital assets can be safely used to transfer value, and a *monitoring system* comprising the set of minters, for controlling the creation and destruction of currency tokens. Figure 7 illustrates how this would work, and we offer the following narrative description of the lifecycle of a specific CBDC asset:

- ***Act I.*** A unit of CBDC begins its life as a request from Alice to her commercial bank, which had previously received a set of CBDC vouchers from the central bank in exchange for reserves of equal value. CBDC vouchers are special CBDC assets that can be exchanged for signatures from minters but are not used by retail consumers. Alice's bank debits the value of the request from Alice's bank account and sends the CBDC voucher to the minter along with Alice's request. The minter then signs Alice's request, destroys the voucher, and submits a record of its work to the distributed ledger of the monitoring system, which the central bank and regulators can inspect to understand the aggregate flow of money in the system and verify that the minting invariant is maintained. The minter then sends the signed request back to Alice's bank, which forwards the signed request to Alice.

  Later, Alice uses the signature to create the CBDC asset, which we shall call Bill, and transfers it to Bob. Whenever a CBDC asset changes hands, either the sender or the recipient must send an update to the correct relay to consummate the transaction. Next, Bob transfers Bill to his bank. Importantly, unlike Alice, Bob can execute this transfer immediately if he chooses to do so; there is no particular value in waiting. At the same time, unlike with the system proposed by Chaum, Grothoff, and Möser [4], Bob can wait as long as he likes (subject to optional conditions) before depositing the asset with the bank, since there is no requirement for the issuer or a minter to participate in the transfers. Finally, Bob's bank credits the value of the transaction to Bob's bank account.

- ***Act II.*** Soon afterward, Charlie, another customer of Bob's bank, makes a request to withdraw CBDC. The bank sends Bill to the minter to be recycled in exchange for signing Charlie's signature request. The minter destroys Bill, signs Charlie's signature request, and returns the signature to Charlie via the bank.

  Later, Charlie uses the signature to create a new CBDC asset, Bill II, and transfers the asset to Dave. Dave then transfers it to his bank, as Bob had done. Dave's bank decides to bring Bill II back to the central bank in exchange for reserves, instead of recycling it, ending the lifecycle of the unit of CBDC.

Note that Dave's bank could have done what Bob's bank did and save the CBDC to service future requests without vouchers. This recycling process is adiabatic, does not rely upon the active participation of the central bank, and can be repeated an arbitrary number of times in this manner before the ultimate destruction of the unit of CBDC. The minting invariant ensures that the minting system never increases or decreases the total amount of currency in circulation. Instead, it issues a new unit of currency only in response to collecting an old unit of equal value. The central bank is only involved when it engages with banks, specifically by issuing vouchers or accepting CBDC assets in exchange for reserves, and by overseeing the minting operation, passively accepting and analysing reports by minters. The central bank also relies upon the relay system to maintain CBDC integrity, and the DLT system underpins its ability to verify what it must trust.

Note also that Alice's bank could have accepted cash or CBDC assets instead of an equal amount of value from her bank account, although legal or regulatory restrictions applicable to the acceptance of cash or CBDC assets might apply.

Finally, Alice could have transferred money directly to Bob's bank account rather than to Bob. Depending upon Bob's preferences, this might be a better choice. For example, it would reduce the total number of relay requests, correspondingly reducing the operating cost to the relay system and communication overhead for Bob. It would also allow Bob to handle the case in which Alice does not have exact change; Bob could forward Alice's signature request in the amount of her overpayment to his bank along with his deposit, and then return the blind signature for Alice's change directly to Alice.

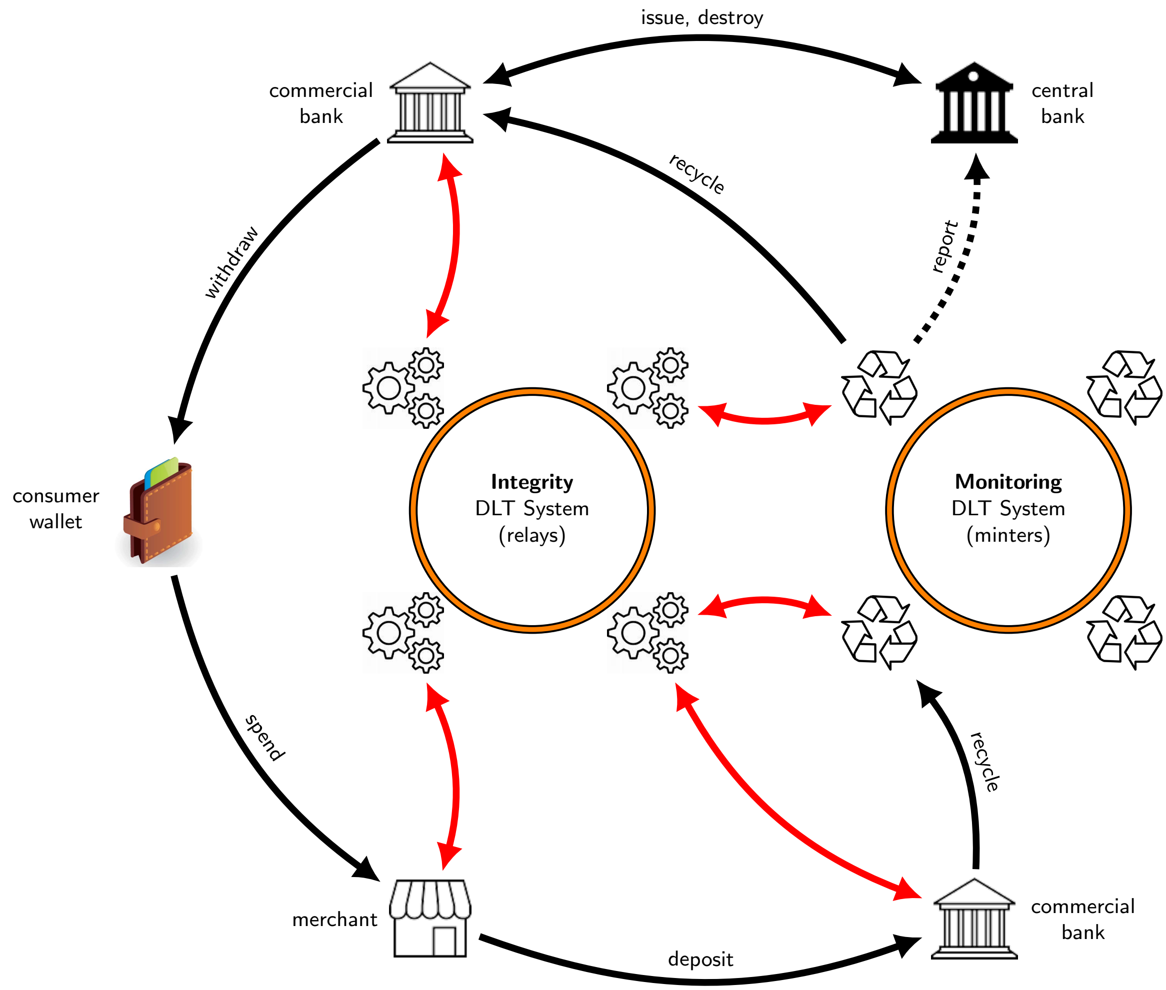

Figure 7: ***Schematic representation of an operating model for a CBDC system.*** The diagram depicts the circulation of digital assets, interaction among actors, and supporting functions.

4.2 Managing CBDC distribution

The central bank would handle the issuance, expiry, and destruction of its CBDC, as well as managing its value though monetary policy. Meanwhile, one or more clearinghouses or banks would handle all of the real-time processing. As part of the issuance process the central bank may allow one or more clearinghouses or banks to provide signatures on blinded templates, to be used by their customers in the final step of CBDC creation. The central bank would issue a specific quantity of some currency by explicitly allowing a clearinghouse or bank to create and distribute signatures for making that many units of CBDC.

We introduce the idea of a *minting-plate*, which combines a *minting-key* that can be used to sign blinded templates with a set of rules that govern its use. There is a deep tension between the desire to limit the number of units that can be created with a particular minting-key, and the need to prevent specific units of currency from being connected to particular creation events (i.e. disconnected creation ¡– fix this with the right name). Because there is no way to connect a particular unit of currency with a particular creation event, there is also no way to tell whether a particular unit of currency was created by a legitimate user of a minting-key, as opposed to a compromised or malicious use of that minting-key.

What can be done is to keep a record of how many units have been reportedly created and how many have been redeemed. Creation is reported primarily by delegated issuers who holds a minting plates, and secondarily by retail banks which channel requests to those delegated issuers. Redemption happens when a bank brings CBDC units back to the central bank in exchange for central bank reserves.

Together these values can reveal that a particular minting-key has been compromised, which can help limit the damage caused by such a compromise. A minting-key might be associated with a set of parameters to limit, for example, the value of currency signed by that minting-key that is in-flight at any particular moment (issuance minus redemptions), the total value of CBDC cumulatively signed by that minting-key, and the time at which signatures by that minting-key would no longer be considered valid.

The size of the anonymity set, as we shall discuss later in this section, is directly impacted by the limits that can be specified for the minting-plate. As more limits are placed on a particular minting-plate, the amount of currency it can produce is reduced, making it easier for powerful entities to track the behaviour of individual users. It is important to tune those parameters so they provide good risk mitigation in the event of the compromise of a minting-key, while still maintaining a sufficiently large anonymity set.

4.3 Managing CBDC system integrity

In addition to managing the lifecycle of the individual CBDC assets, we imagine that the central bank would also take responsibility for establishing the integrity system for those USO assets. This integrity system must continue operating without equivocation, and it is possible to build it in a way so that it would not be impacted by increases in the number of assets, users, or transactions.

As an example, the central bank may declare that only licensed clearinghouses may operate relays that connect directly into its integrity system. Commercial and retail bank relays would connect into those clearinghouses, and relays operated by other money service providers would connect into those, along with third party corporate relays. Because the trust requirements for operating a relay are quite low, similar to those for a network carrier, this provides a rich ecosystem on which consumers can rely with no increase to the operational overhead of the integrity provider system.

Because the scaling concerns are mitigated, there is room to deploy heavyweight solutions for governing this integrity system. While it could be run from a single laptop, it is clearly better to design a system that is as resilient as possible. This means bringing all of the participants in the ecosystem together, such that not only the central bank, but also clearinghouses, commercial banks, retail banks, and so on are participating in a federated or decentralised system, so that only some proportion of them have to be operating correctly for the system to maintain the integrity of its operations.

It is worth explicitly noting that the computational cost of decentralised systems generally stems from two sources: one is the gatekeeping cost of keeping out bad actors, which is the primary reason for the hashing cost of proof of work based systems like Bitcoin and Ethereum; the other is the scaling cost of accommodating transactions, assets, and accounts.

Our proposed architecture eliminates both of these costs. The first is eliminated by only inviting trusted parties to add their efforts to the integrity system. The second by separating the integrity system from maintaining the state of the assets themselves, so that the scaling costs are not borne by the integrity system. Introducing good governance and transparency into the integrity of a system does not necessitate a large increase in energy usage. Our architecture demonstrates this.

4.4 Managing regulatory compliance

Ensuring that regulators can perform their duties is clearly an extremely important aspect of a well-functioning economic system, and must be an explicit goal of any realistic CBDC proposal. As we show in this work, regulatory compliance does not have to come at the cost of sacrificing consumer protections. Indeed, not only are regulation and privacy compatible, but our architecture actually allows them both to be achieved more efficiently than current solutions that choose one over the other.

We have two main techniques for ensuring consumer protections. The first is the use of USO assets, which allow the CBDC to be acted upon by its owners unilaterally, regardless of the disposition of the financial apparatus. This means that while the recipient can choose to reject a transaction, no one else in the system, including regulatory bodies, can block it from happening or discriminate against that user.

The second is unlinking the sender from the recipient in the transaction channel. This means that even a powerful entity that knows who withdrew CBDC and knows who deposited CBDC will not be able to match senders to recipients.

How is efficient regulatory compliance possible with strong consumer protections like these? There are four places that regulation applies in our CBDC architecture, and they mirror four cases in which regulation applies to the use of cash. We argue that we can not only satisfy but actually improve upon the established compliance procedures in each case:

1. ***When a retail user deposits cash into a bank account.*** Banks are often required, for cash deposits greater than a certain size, to request evidence from depositors that the cash to be deposited was obtained legally. From this perspective, CBDC implemented as USO assets is better than cash, because it is possible to automate not just the integrity checks but also the regulatory checks.

2. ***When a retail merchant receives cash from a consumer.*** When merchants decide to deposit cash that they have received in the course of their business activities into bank accounts, they generally have an interest in knowing that the cash they have collected will be accepted. CBDC implemented as USO assets allows such a merchant to apply the same integrity and regulatory checks that are run by their bank. For example, a regulator might want to associate each recipient of CBDC with a bank account for the purpose of implementing compliance procedures. To satisfy this requirement, we might stipulate that banks must require the recipient of CBDC to furnish a commitment in the form of its bank account details to any sender from which it might receive CBDC, and that the CBDC must include a signature of this commitment from the sender as a prerequisite for the bank to consider the CBDC to be valid.

3. ***When a retail merchant spends cash that it has received.*** Recipients of CBDC might want to spend it immediately without depositing it first. Because USO assets track their own history, the next recipient is able to know whether the CBDC has travelled around since leaving a bank. Therefore, the asset must carry the burden of proving that its travel satisfies the relevant regulatory requirements, which could be enforced by automated checks run by the bank that ultimately receives it in the form of a deposit.

   In this manner, a regulator might allow CBDC to travel over multiple hops, with multiple recipients of CBDC in succession, without the interactive involvement of a regulated financial institution, provided that the recipient bank account details are included and signed by the respective sender in each successive hop. Note that, although the first sender might be anonymous, the USO asset framework enables it to implicitly demonstrate its possession of the key signed by the issuer of the CBDC. Subsequent senders would be identified by their bank account information as recipient from the previous transaction. Conversely, a regulator might want to enforce a rule that recipients of CBDC can do nothing other than deposit CBDC that they receive directly into the specified bank account. To satisfy this requirement, we would stipulate that banks would enforce a rule that the USO asset must have been transacted no more than once (i.e., only one hop).

   The rules are implicitly dynamic. Bob's bank chooses what program to run to conduct the automated regulatory check, and Bob's software uses the same program as Bob's bank, so regulators can change their requirements at any time without needing the issuance of new CBDC. Regulators could do this by asking the banks to update their compliance procedures, and those new requirements would then be applied within the software of consumers and merchants.

4. ***Compliance procedures within a financial institution.*** A financial institution can prove that in all cases the CBDC it has accepted has met the current regulatory standards. Either the asset passes the automated regulatory checks, or the institution has accepted external evidence to meet the regulatory requirement. We imagine that the latter case would be extremely rare, because consumer and merchant software would automatically reject CBDC that does not meet the regulatory checks that would be carried out by their bank, but it provides an important safety valve.

To achieve the desired regulatory protection, the source and sink of CBDC must be regulated entities. When Alice creates new CBDC, the signature granting it validity must come from a regulated financial entity; this is enforced by the central bank or its delegates such as minters. When Bob brings his CBDC back to a regulated financial entity such as his bank then that entity can return the CBDC to the central bank in exchange for reserves.

Our architecture is compatible with a variety of additional mechanisms for enforcing regulatory requirements, although we recommend careful consideration to verify that such mechanisms are compatible with consumer protection objectives such as privacy and ownership. Note that the first transaction in which a new asset changes hands provides consumer protection, although subsequent transactions do not. In particular, although the initial consumer is protected, the merchant might decide to spend his or her CBDC asset in a second transaction rather than have a bank recycle it, but he or she does this knowing that what the second recipient does with the CBDC asset might expose sensitive information about the second transaction.

Having regulated entities as the source and sink of CBDC is sufficient for a mechanism to ensure full regulatory compliance. More than this, it allows that compliance to be achieved with widespread efficiency gains: for the regulator, for the banks, for merchants, and for consumers.

4.5 Ensuring an appropriate anonymity set

In our formulation, CBDC is generally not held by retail customers in custodial accounts and, for this reason, would not earn interest. Although there are some methods available by which fiscal policy can incentivise or disincentivise spending tokens [11], we expect that retail users would view CBDC primarily as a means of payment rather than a store of value. We stipulate that plausible deniability is essential to privacy, and a large anonymity set is a prerequisite to plausible deniability. Inexorably, a trade-off between privacy and flexibility for users lies in the relative timing of withdrawals and remittances, as the strength of the anonymity set is bounded by the number of tokens in-flight between those events.

The template architecture ensures that the consumer chooses the minting-key. We assume that the set of minting-keys signed by the issuer will be available for public perusal on a distributed ledger. The fact that an issuer cannot sign multiple minting-keys without having that fact become observable forces accountability for an issuer that might want to create a covert channel that could reveal information about the consumer. Since retail users would have no particular reason to hold CBDC longer than is necessary to make their payments, just as they would have no particular reason to hold cash, it is important to consider ways to encourage users to hold CBDC long enough to ensure that the anonymity set is large enough to protect their privacy. In service of this objective, we propose some practical mechanisms that can be applied to ensure that the anonymity set is sufficiently large to protect the privacy of everyday users:

- ***Encourage consumers to withdraw larger amounts of money.*** For example, consumers can withdraw CBDC in fixed-size lots, and then spread out the use of those over a longer time period and blend in with other consumers, thereby making a smaller number of larger-sized withdrawals from the bank. We anticipate that reducing the number of withdrawals will make it harder to link a payment to its corresponding withdrawal, potentially by one or more orders of magnitude. By reducing the number of statistically linkable withdrawal-payment pairs, users can enjoy a larger anonymity set and, as a result, better privacy.

- ***Incentivise consumers to use slow relays by default.*** We can give users control over the extent to which it might be possible to temporally correlate a withdrawal to the proof data that is created with a payment. This can be accomplished by adjusting the requirements in Step 4 of the user engagement lifecycle (refer to Figure 2) such that F_1 can only be accepted by relay G if F_0 had previously been published by relay G. Then, relay G can explicitly specify a frequency for its publication of successive updates to ensure a sufficiently large anonymity set, for example, to publish once per minute, hour, or day.

  The motivation is to increase the cooling off period to increase the number of unspent withdrawals from the same minting-key. The provider of relay G could maintain multiple relays with different frequencies. If we accept privacy as a public good [13] and acknowledge transaction immediacy as a threat to privacy, then the provider could charge more to consumers who demand greater immediacy, as a way of compensating for the negative externalities that would result from shorter time intervals between withdrawals and payments.

Since the consumer's message to the relay requires no human interaction, CBDC software could send it after a random delay, or could send it through a remailer network such as Mixmaster [14].

- ***Encourage slow transaction settlement when possible.*** Not every transaction must be settled immediately; consider the case of online purchases for goods or services to be delivered in the future. For such transactions, if Alice can use Step 4, Option 1 (as shown in Figure 4) to give Bob direct control and the means to acquire possession of the CBDC, and if Alice trusts Bob not to record the time at which she does so, and if Alice trusts Bob to delay his request for the proof of provenance (and thus settlement) for a sufficiently long time, then Alice can effectively pay Bob immediately. Indeed, Bob's transaction tracking and rate of transactions might influence Alice's calculations about whether this option is safe. Note that this is the same guarantee that payers rely upon to safely use physical cash without being tracked. In the digital context, procuring a strong guarantee about what Bob might do is somewhat harder, and we are pessimistic about the idea that received transactions are not being timestamped, either by Bob or by other observers.

- ***Have Alice explicitly give control to Bob during the withdrawal phase.*** Alice can give control to Bob in the creation of F_0 during Step 1 of the protocol. Because F_0 is part of the blinded template, neither her bank nor other observers will be able to associate her withdrawal with her payment to Bob. As with the previous approach, this approach requires Alice to trust Bob not to record the time at which he receives the payment from Alice. However, because Bob is able to verify that the CBDC is valid and that he has exclusive control, this approach might be appropriate for immediate delivery of goods or services. Although the size of the transaction might ordinarily reveal information that could link the withdrawal to the payment, this could be obfuscated by having Alice give Bob a larger quantity of CBDC than he requires, and having Bob provide Alice the excess in the form of new CBDC, either immediately or in the future, using the same method.

We also suggest implementing a mechanism to monitor the number of tokens currently in-flight, to support dynamically adjusting parameters that could impact the size of the anonymity set, such as the number of minting-keys, the number of tokens to be issued by each minting-key, and the set of available denominations. Such a mechanism would support not only the management of digital currency issuance and destruction but also public oversight of the entire process.

4.6 Clearing and settlement

Ensuring that the integrity system continues to produce entries and does not equivocate about the history of is commitments is a major responsibility of a central bank that produces CBDC using this architecture. This can be done by the central bank directly, although such an approach introduces a set of risks, including the possibility that the central bank's operational servers crash or become compromised as well as the possibility that the central bank might change the rules or expectations for the system without warning. Because distributed ledgers are designed to be fault-tolerant and immutable, DLT is a useful tool for systems that require some resilience to crashes and compromise. We suggest that the central bank could take the following approach to using DLT for its integrity system:

1. The central bank enlists several highly trusted but independent institutions to run relays and requires each of them to sign off on each new entry that the central bank produces. This protects against compromise of the central bank: The adversary must also compromise all of the other institutions to cause an equivocation.

2. The institutions employ a crash fault tolerance mechanism, such as Raft [15], to allow a few institutions to be offline without interrupting the operation of the system.

3. The institutions themselves can propose new entries, perhaps via a fixed schedule or round-robin process, instead of requiring the central bank to do it. This avoids issues associated with having the central bank serve as gatekeeper to transactions and allows the central bank to step out of an operational role and focus on oversight and governance.

4. The institutions make a commitment to publish every entry they sign.

This arrangement is sufficient to convert the centralised integrity system into a distributed ledger overseen, but not operated, by the central bank.

The scalability of this architecture can be enhanced by allowing relays to arrange themselves hierarchically. Higher-level relays can aggregate the entries produced by lower-level relays and perform the same process, with the respective lower-level relay operators taking the place of the trusted institutions. Waiting for a higher-level relay to produce an entry might support greater assurance that the proof will be completed, but might be slower than waiting for the lower level relays, which are optimised to minimise latency.

Transactions less than a specified amount might be considered final by transacting parties, and may be covered by appropriate insurance or credit for relay operators, without confirmation from the clearing network. The additional confidence provided by aggregate confirmations, therefore, might be necessary for buying high-value goods, such as a car, but probably not for buying low-value goods, such as a cup of coffee.

A case can also be made for encouraging relay operators to use mechanically external DLT systems as a commitment mechanism, or public bulletin board, for publishing their entries. This practice might also enhance the confidence in those entries, as well as quicker detection of equivocation of compromised relays, because it compels relays to commit to a more unified view of their published entries rather than merely self-reporting them.

5 Use cases

In this section, we consider three use cases that demonstrate the power and flexibility of our design and how our proposed architecture can be used to satisfy them. These use cases offer advantages over other electronic payment methods, including modern retail payments via banks or payment platforms as well as unlinkable CBDC proposals such as the one offered by Chaum, Grothoff, and Möser [4]. The users of the system, including consumers and service providers, can choose which of these possibilities to enable and support.

5.1 Disconnected operation

In some environments, access to the central bank might be slow, delayed, or intermittent rather than real-time, for example where the central bank might be accessible only at certain times. We refer to such environments as "disconnected", and we imagine that this characteristic might apply to some remote or sparsely-populated areas with limited or unreliable connectivity, as well as categorically isolated environments such as certain remote villages, ships in the high seas, aircraft in flight, spacecraft in space, or remote military outposts.

Fair exchange requires the involvement of a mutually trusted third party [8]. However, this does not imply that all transactions must take place with global agreement. In disconnected environments we assume that there exists a local actor who is sufficiently trustworthy to act as a relay for nodes within that environment. This might be a trusted institution, a network operator, or even a distributed system made up of the nodes in that environment.

As long as the recipient trusts that relay to not equivocate, then the recipient can accept a payment that has a proof of provenance that includes that relay, with confidence that it will be possible to complete the proof of provenance to include the integrity provider. Completing that proof is necessary for the payment to be accepted outside of the environment in which the relay is trusted to do its job, but inside of this environment payments can continue to be made without making external network connections. As long as the trusted relay does not equivocate, then nothing that anyone else does, either inside the environment or outside, can adversely impact the payment. Short of equivocating, nothing the trusted relay does, including crashing or denying service, can adversely impact it either.

We note that systems that require global consensus, including all centralised systems and most distributed ledger systems, lack this capability.

5.2 Offline operation via time-shifting

Some environments have no connectivity at all. This might include environments without communication equipment, or environments without a local point of trust. We refer to such environments as truly "offline". Since transactions require a third party [8], it might seem that this means that offline transactions are impossible, but that is not entirely true. The involvement of the third party could take place at a different point in time.

A user can transfer CBDC to an address over which the recipient has control, but without revealing to the recipient the information needed to exercise that control. Then the user can then effectively spend the CBDC offline by revealing information about the transfers to the recipient. In the event that the user decides not to spend all of the CBDC with that recipient, they have the option to use a fair-exchange protocol with the recipient to redeem any CBDC that was transferred but not spent.

In principle, it would be possible to transfer CBDC to a market operator in exchange for tickets (perhaps implemented using blind signatures) and then give the tickets to merchants, and the merchants could use a fair-exchange protocol to redeem value from the market operator. However, this assumes that the merchants are connected to the market operator in real-time so they can verify that such tickets are still available to claim. Similarly, it might be possible to transfer CBDC to an issuer of cash-like, counterfeit-resistant physical tickets that can be used in a local context to make offline purchases to arbitrary recipients without the need for a real-time network connection.

5.3 Chained transactions with embedded provenance

There are several reasons why a recipient of CBDC might want to move it onward without depositing the CBDC directly into a bank account. We refer to such transactions as *chained transactions*. In such cases the provenance information about successive holders of an asset can be maintained within the CBDC tokens, and chained transactions can carry their own proofs of compliance with the rules of the system. Appropriate use cases might include the following:

- Perhaps a CBDC holder has no access to a bank or access to a bank is difficult as a result of network connectivity or geographic location. Being able to make a series of transactions under such circumstances may provide an important safety net.
- Perhaps a CBDC holder is acting on behalf of a business that seeks to maintain provable records of its internal or external transfers, perhaps to streamline compliance operations, to satisfy auditing requirements, or to move assets without depositing them into a bank account and incurring a delay associated with settlement. For example, a multinational corporation might want to preserve an audit trail of internal transactions, for example to demonstrate compliance with tax regulations concerning the applicable jurisdiction for revenue, in addition to economic efficiency for such internal moves.

6 Analysis

In this section, we compare our architecture to alternative architectures for exchanging value. We begin with a set of mechanical design choices and argue for the choices inherent to the argument that we have proposed. Then, we compare our architecture to other systems for exchanging value in terms of the asset-level requirements and system-level requirements defined in Sections 2.1 and 2.2.

6.1 Comparison to other untraceable CBDC solutions

Chaum, Grothoff, and Möser [4] have also proposed a system for untraceable CBDC. Our system also leverages the blind signature mechanism that is central to their design, although our system differs from theirs in several important ways. In particular, our system:

- ***Enforces accountability and transparency for authorities and system operators*** by leveraging distributed ledger technology as described by Goodell, Nakib, and Tasca [2], thus requiring authorities or system operators to explicitly and publicly specify changes to the protocol and system rules;

- ***Enables transactions without real-time involvement of the central bank or issuing authority***, by progressively, and obliviously, building proof structures with logarithmic scaling factors across the relays; and

- ***Enables validations without any involvement of the central bank or issuing authority***, by incorporating self-validating proofs of provenance as a fundamental part of the digital assets; and

- ***Avoids requiring the central bank to maintain a database*** of individual tokens, balances, or specific transactions, as is done with UTXO-oriented digital currency systems.

6.2 Design features

Some of the design features of our proposal distinguish it from alternative proposals available in the current literature on digital currency. We list several of the most important such features here:

- ***Regulatory control applies to transactions, not asset ownership.*** Our proposed architecture allows regulatory compliance to be automatically enforced by regulated financial institutions that receive CBDC on behalf of their account-holders. This allows comprehensive regulation without introducing a requirement to track the ownership of every token.

- ***Non-custodial wallets.*** People want custodial accounts because they want strong regulatory controls. Having strong regulatory control at the transaction level allows non-custodial wallets to operate within the regulatory regime, providing efficiencies that make more use cases available to the users of CBDC. This approach allows CBDC to realise the benefit of a token-based approach, while interoperating with traditional custodial accounts as desired, as cash does.

- ***Open architecture.*** Our approach does not rely upon trusted computing, including trusted software, trusted hardware, or secure elements of any kind. Device manufacturers are third parties, just as other authorities are, and requiring any trusted authority to be part of every transaction compromises the integrity of the system. This is important because we do not wish to require the establishment of a set of trusted hardware vendors, or the assumption that counterparties to a transaction must trust each other's devices. If counterparties do have mutual trust in a third-party, such as an institution, they can use this mutual trust to improve the efficiency of a transaction, as described in Section 6.3.

- ***Time-shifted transactions.*** Because fair exchange always requires a third party to every transaction [8], we observe that there is no way for two counterparties to transact directly without access to a mutually-trusted third party or system. In cases where a mutually trusted system is inaccessible, our architecture allows a time-shifted trust in the form of prepayments, as described in Section 5.2.

- ***Decentralised transactions.*** By allowing transactions to be processed in a decentralised manner, our approach avoids the costs and risks of requiring a ledger or other system component to be under the control of a single actor, who might change the rules without public oversight, discriminate against certain users, equivocate about the history of transactions, or otherwise exercise arbitrary authority.

- ***Energy efficiency.*** By allowing transactions to be processed locally, our approach avoids the costs and risks of requiring a heavyweight, ledger-based system (distributed or not) to be in the middle of every transaction, allowing the use of the CBDC to be highly energy efficient.

- ***No central user database.*** Our system avoids introducing centralised identity requirements, leveraging the existing decentralised procedures for identification and compliance that are already widespread among financial market participants. This avoids establishing new mechanisms to track users and aligns with global agreements about compliance requirements.

6.3 Efficient settlement

One of the most important features of cash infrastructure is the ability of counterparties to transact in real-time, with minimal involvement of third parties. To the extent that third parties are not involved in transactions, they cannot engage in rent-seeking behaviour and cannot pass the costs they incur along to transaction counterparties in the form of fees. Where third parties are involved, the involvement is generally minimal and highly local, for example to provide cash withdrawal services (e.g. ATM infrastructure) for consumers and cash deposit services to merchants, both of which are used only in aggregate over many transactions. Cash infrastructure also benefits from instant settlement: Once a payer has given cash to a payee, the transaction is settled. There is no way for a payer to unilaterally unwind ("claw back") the transaction.

With modern digital transactions, scalability interferes with the ability to transact in real-time. Transactions take place across a network, which cannot be globally synchronised. Settlement requires pairwise synchronisation between transacting institutions, which must manage risks associated with concurrency. Settlement times for domestic bank wires and direct debits are generally a matter of hours; settlement times for international wires are even longer. Payment networks generally offer short-term credit as a way to support faster settlements.

Our system design provides a mechanism for two transacting parties to enjoy real-time settlements. Recall that, in general, a payer (Alice) must furnish a proof of provenance to a payee (Bob) before a payee will accept payment, and that Alice creates this proof by connecting to the issuer through her chosen relay. If Alice is always assumed to be directly connected to the issuer, then the system will not scale very well: the issuer would have a de facto role in every transaction, and the resulting need to serialise and batch transactions would mean that Alice might be forced to wait.

However, because a payer can choose the relays, Alice has the option to choose one that both she and Bob recognise as trustworthy. Because each of these relays is a checkpoint in building the proof of provenance they can offer guarantees to Bob that Alice's transaction has been incorporated. If Bob trusts a relay that Alice has chosen, then this partial proof of provenance will suffice until Bob has received the full proof of provenance.

Our architecture allows these promises to be made almost instantaneously by these relays, requiring very little computation. Additionally, various mechanisms can be used to reduce the risk that a relay would equivocate by rewriting history to nullify Alice's transaction. These include both traditional institutional and legal guarantees as well as technical mechanisms like distributed ledgers and other means of achieving immutability.

If Alice knows that she is likely to make a purchase within a context in which a particular relay is trusted, then Alice can choose to use that relay for her asset, thus allowing near real-time payments within that context.

We observe that this mechanism offers similar functionality to debit card transaction via a retail payment network, wherein transactions can be accepted in real-time because the retail payment network provides a guarantee to the recipient's financial institution that the transaction will succeed. Our proposed mechanism avoids some of the potential friction intrinsic to this approach by eliminating the need for financial credit, although Bob must trust the relay to fulfill its promise to incorporate the transaction. Additionally, because transactions involve direct obligations of the central bank rather than bank deposits, the requirement for a clearinghouse to resolve counterparty risk among institutions is eliminated.

6.4 The fallacy of anonymous accounts

There are two chief approaches to mitigating harmful consumer tracing and profiling. One approach is anonymous accounts, where the identity of the account holder is decoupled from the account. Anonymous accounts are akin to prepaid debit cards and have been proposed as a way to protect the rights of consumers [6]. The other approach is transactional unlinking, wherein the sender is decoupled from the receiver inside the transaction channel. These two approaches of anonymous accounts and transactional unlinking are actually orthogonal dimensions.

In the absence of transactional unlinking, anonymous accounts don't provide anything useful. Bitcoin is a stark example of this: regular transactions can be trivially de-anonymised, revealing a consumer's entire history, whereas criminals can employ various heavyweight measures to conceal themselves.

In the presence of transactional unlinking, anonymous accounts still don't provide anything useful: the transactional unlinking already stops unwanted tracing and profiling, and adding anonymous accounts on top of that only makes enforcing regulatory compliance much more difficult.

Thus, we conclude that anonymous accounts are worse than useless. They do not achieve their stated goals, and they extract a high cost from systems that employ them [7]. We also note that anonymous accounts typically contravene AML/KYC recommendations and, because they implicitly link successive transactions done by a consumer to each other, are not actually private for most legitimate retail use.

We assume that the accounts referenced by our system would be subject to AML/KYC data collection and would not be anonymous. The privacy of our approach results from the use of non-custodial wallets to unlink successive transactions involving the same currency. Specifically, a user must "withdraw" funds from a regulated money services business into her non-custodial wallet in one transaction and then "remit" funds into a regulated money services business in the next. Even though the holders of the payer account and the payee account are known, the fact that money has flowed between them is not.

6.5 A comparison of payment system architectures

	Cash	Custodial accounts	Traceable digital currency	Untraceable digital currency	Traceable USO digital currency	Untraceable USO digital currency
Integrity Considerations						
Durability	●	○	○	○	●	●
Self-contained assets	●	○	○	○	●	●
Control Considerations						
Mechanical control	●	○	○	●	●	●
Delegation	○	○	○	○	●	●
Possession Considerations						
Choice of custodian	●	○	○	○	●	●
Choice to have no custodian	●	○	●	●	●	●
Independence Considerations						
Fungibility	●	○	○	●	○	●
Efficient lifecycle	○	○	○	○	●	●

Table 1: A comparison of payment system architectures by asset-level considerations.

Tables 1 and 2 summarise the characteristics of a selection of different payment system architectures, including our proposed architecture. The descriptions of the payment mechanisms are as follows:

- ***Cash.*** A central bank produces physical bank notes and coins. Retail users circulate them freely, without involving of financial intermediaries. Cash is part of the monetary base of an economy; commercial banks can exchange cash for deposits with the central bank. Although bank notes have serial numbers, cash remains fungible because it can be freely exchanged among bearers and because retail users of cash generally do not maintain records that identify individual units of cash.

	Cash	Custodial accounts	Traceable digital currency	Untraceable digital currency	Traceable USO digital currency	Untraceable USO digital currency
Autonomy Considerations						
Privacy by design	●	○	○	●	○	●
Self-determination for asset owners	●	○	○	●	○	●
Utility Considerations						
Local transactions	●	○	○	○	●	●
Time-shifted offline transactions	●	○	○	○	●	●
Accessibility	●	○	●	●	●	●
Policy Considerations						
Monetary sovereignty	●	○	●	●	●	●
Regulatory compliance	○	●	●	●	●	●

Table 2: A comparison of payment system architectures by system-level considerations.

- ***Custodial accounts.*** These are retail payments that take the form of transfers between financial institutions. This category covers both the case of private-sector banks offering accounts to retail consumers as well as the case of central banks offering accounts to retail consumers. Such payments might include bank wires, ACH, cheques, direct debit, and third-party transfers via payment networks including but not limited to card payment systems.

- ***Traceable digital currency.*** Retail consumers hold tokens that are obligations of the central bank. The tokens are bearer instruments and are not held in custodial accounts, although individual tokens can be linked to the identities of their owners. Thus, the consumers are not anonymous and are therefore subject to profiling and discrimination on the basis of their transactions. The issuer must maintain a record of tokens that were spent to prevent double-spending. The record of tokens can be maintained by the issuer directly or by a distributed ledger using a decentralised consensus system.

- ***Untraceable digital currency.*** This approach is similar to traceable digital currency, except that the central bank signs blinded tokens using a blind signature scheme of the sort elaborated by David Chaum [4]. When a user wants to spend a token, the user unblinds the token and returns it to the issuer along with the address of the recipient. Recipients could be anonymous, or not anonymous, depending upon the specifics of the architecture. Chaum's proposal for digital currency implicitly assumes that the sender is anonymous, but the recipient is not anonymous in the usual case [4].

- ***Traceable USO digital currency.*** This approach to digital currency uses baseline USO assets. The tokens are not blinded, and although tokens can be directly transferred between possessors without the involvement of the issuer, the chain of custody of an asset is transparent and completely traceable to its possessors.

- ***Untraceable USO digital currency.*** This approach to digital currency is a fusion of USO assets and the Chaumian system. A user approaches an issuer with a request for a blinded token, which the issuer furnishes to the user. When the user wants to spend a token, the user unblinds the token, incorporates it into a specific previously created asset, and transfers the asset to the recipient. It is now up to the recipient to redeem the token with the issuer, or to pass it to another recipient without the benefit of anonymity.

7 Conclusion

In this article, we have presented an untraceable version of an architecture for a payment system based on proofs of provenance. Our architecture combines two previous lines of work to provide a solution that efficiently provides both consumer protections and regulatory compliance. Doing this allows the resulting CBDC to be used across a wide variety of use cases, including many of those currently addressed by cash.

Our proposal directly addresses the dilemma of maintaining regulatory compliance while preventing abusive profiling that harms consumers. Abuses of profiling are endemic to modern payment systems, wherein not only governments but also consumer-facing businesses, service providers, and platform operators actively analyse consumer behaviour and can exploit personal information for profit or control. Ordinary consumers are forced to trust not only the practices and motives of such actors but also their security. The costs and risks of security breaches are generally borne by the consumer, and can be quite severe: in the US alone they are estimated to amount to US$228B in the last year [16]. Central banks have an opportunity to repair trust between citizens and the state by sponsoring an architecture that does not force users to trust some third party with data protection, but instead allows users to verify for themselves that their privacy is protected.

Solutions that promise to end profiling generally do so either by allowing anonymous accounts or by facilitating the consummation of transactions outside of an environment wherein regulators can operate and effectively supervise activity. In contrast to such approaches, our proposal allows effective regulatory supervision while unlinking users' banking relationships from their spending habits, thus enabling consumers to enjoy fully regulated custodial accounts while avoiding the costs and risks of abusive profiling.

Furthermore, this architecture addresses concerns about the transactional efficacy of other untraceable architectures by allowing the recipient to accept payment without involving the issuing bank or the sender's financial institution. It also provides a framework for strong assurance of provenance and auditability, allowing follow-on transactions to occur prior to involving the recipient's financial institution.

Our proposal addresses the operational and infrastructural overhead that a central bank must incur to manage a payment system through a domestic retail digital currency. It provides an efficient path to the issuance and distribution of a currency as well as the maintenance of its integrity. The distribution and management following issuance can be mediated by existing robust payment channels, including clearinghouses, commercial banks, and payment services businesses, using existing payment mechanisms and avoiding the costs and risks associated with deploying new infrastructure for that purpose.

This architecture also addresses the governance and risk mitigation concerns of issuing a domestic retail digital currency and managing a payment system by isolating the components of the system so that each can be treated independently, including the desired properties related to integrity, possession, control, and autonomy as well as the operations of issuance, distribution, and transaction management. Our proposal thus encourages working within the current banking system, including commercial banks and payment institutions, rather than undermining them, and provides the capacity to build a deep and resilient governance approach without compromising the efficiency and privacy of individual transactions.

Cash is used in many different situations, as are other payment service solutions. We describe the properties a CBDC must have in order to be efficiently used in those situations, and we show that the technical requirements of our architecture are necessary to deliver a solution with those properties. This allows the CBDC created using our architecture to broadly meet the demands of cash as well as those of electronic payment services, and highlights exactly where other proposals fall short. It is not necessary to make unacceptable compromises between consumer protections and regulatory compliance, and it is not necessary to sacrifice operational efficiency to maintain asset integrity. Indeed, for a currency to be used like cash, it must excel in all three of those aspects. Ours does.

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Impact of Digital Yuan (e-CNY) Promotion on Traditional Banking: Challenges and Response Strategies

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Abstract

The introduction of China's digital yuan (e-CNY) marks a significant transformation in the country's financial sector, impacting traditional banking, financial institutions, and consumer behavior. As a central bank digital currency (CBDC), e-CNY is designed to enhance financial inclusivity, increase monetary control, and reduce reliance on third-party payment providers. However, its widespread adoption presents challenges and opportunities for traditional banks, requiring them to rethink their business models, adapt to digital currency dominance, and develop new financial strategies to maintain competitiveness. This paper explores the regulatory framework, technological challenges, and financial sector implications of e-CNY, focusing on its effects on traditional banking business models, deposit structures, and loan issuance mechanisms. The study also examines consumer behavior, market adoption patterns, and the competitive landscape, highlighting the role of fintech firms and digital payment platforms. The discussion extends to financial inclusion, particularly in rural and underbanked regions, assessing the potential of e-CNY in bridging economic disparities. The research further investigates response strategies for commercial banks, including hybrid financial models, fintech collaborations, and AI-driven banking solutions. It also provides policy recommendations to ensure stability in the banking sector amidst digital transformation, including monetary policy adjustments, cross-border e-CNY integration, and cybersecurity measures. Findings suggest that while e-CNY presents short-term disruptions to commercial banks, it also offers long-term opportunities for financial innovation and international trade expansion. The paper concludes that traditional banks must embrace technological advancements, regulatory collaboration, and service innovation to maintain relevance in China's evolving digital economy.

Keywords: e-CNY, digital yuan, Central Bank Digital Currency (CBDC), traditional banking disruption, fintech competition

1. Introduction

The rapid advancement of financial technology has led to a global push for digital currencies, with China emerging as a leader in central bank digital currency (CBDC) development. The digital yuan (e-CNY) is a state-backed digital currency introduced by the People's Bank of China (PBoC) to modernize the financial system, enhance payment efficiency, and strengthen monetary policy implementation. Unlike decentralized cryptocurrencies such as Bitcoin, e-CNY is a legal tender fully controlled by the central bank, ensuring financial stability while addressing the limitations of traditional banking and third-party digital payment platforms.

China's digital currency initiative has undergone years of research and pilot testing. The development of e-CNY began in 2014 when the PBoC established a dedicated research institute to explore the feasibility of a national digital currency. Over time, trials were conducted in various cities, allowing the central bank to assess user adoption, transaction efficiency, and security concerns. By 2020, large-scale pilot programs were launched in cities such as Shenzhen, Suzhou, and Beijing, enabling real-world usage in retail transactions, public services, and cross-border payments. The digital yuan has since expanded its reach, with integration into various sectors such as public transport, e-commerce, and international trade. With continued expansion, e-CNY is expected to become a critical component of China's financial infrastructure, competing with existing payment platforms and influencing global economic dynamics.

The promotion of e-CNY is driven by several key objectives. First, the digital yuan aims to strengthen China's monetary sovereignty by reducing reliance on private payment platforms like Alipay and WeChat Pay, which currently dominate the digital payment landscape. By offering a government-backed alternative, the PBoC seeks to enhance financial security and prevent risks associated with market monopolization. Second, e-CNY is intended to improve financial inclusion, particularly in rural areas and among populations without access to traditional banking services. Unlike conventional banking, which requires a linked bank account, e-CNY enables direct transactions through mobile applications, making it more accessible to underserved communities. Third, the digital yuan is positioned as a tool for enhancing monetary policy effectiveness. By allowing real-time tracking of financial transactions, the PBoC can better regulate money supply, control inflation, and implement targeted stimulus measures. Additionally, e-CNY promotes cross-border trade efficiency, reducing dependence on the U.S. dollar for international transactions and strengthening China's influence in the global financial system.

Moreover, e-CNY plays a crucial role in combating financial crimes such as money laundering and tax evasion. Due to its traceable nature, authorities can monitor transactions more effectively, ensuring compliance with regulatory standards and improving transparency in the financial system. The integration of e-CNY with smart contracts also presents new opportunities for automating business processes, streamlining trade settlements, and enhancing efficiency in commercial transactions. As China continues to lead the global digital currency race, other nations and central banks are closely observing its implementation to assess the feasibility of similar initiatives.

Studying the impact of e-CNY on traditional banking is crucial for understanding the broader implications of this digital transformation. Traditional banks play a central role in financial intermediation, providing essential services such as deposit collection, loan issuance, and payment processing. However, with the rise of e-CNY, banks may face liquidity challenges as consumers shift their deposits to digital wallets, reducing the availability of funds for lending. Moreover, as e-CNY transactions bypass conventional banking channels, banks risk losing revenue from transaction fees and payment processing services. Additionally, the increasing use of digital currency raises regulatory and cybersecurity concerns, requiring banks to invest in technological infrastructure and data protection mechanisms. By analyzing these potential disruptions, financial institutions can develop adaptive strategies to integrate e-CNY while maintaining stability and competitiveness.

Furthermore, the promotion of e-CNY is not limited to domestic markets but extends to international financial systems. As China advances the digital yuan's cross-border application, it may challenge the dominance of the U.S. dollar in global trade settlements, particularly within the Belt and Road Initiative (BRI). Countries engaged in economic cooperation with China may adopt e-CNY for international transactions, reducing reliance on traditional banking channels. This could further influence foreign exchange policies, central bank reserves, and international financial regulations.

In summary, the digital yuan represents a transformative shift in China's financial ecosystem, offering numerous benefits while posing significant challenges to traditional banking. As e-CNY adoption continues to grow, understanding its impact on banking operations, financial stability, and consumer behavior will be essential for shaping future monetary policies and regulatory frameworks.

2. Regulatory Framework and Policy Environment

The regulatory framework governing the implementation of e-CNY is primarily driven by the People's Bank of China (PBoC), ensuring the digital currency operates within the country's financial and monetary policies. Several key regulations have been established to manage the issuance, circulation, and security of e-CNY. First, e-CNY operates under a two-tiered distribution model where the PBoC issues digital currency to designated commercial banks, which then distribute it to the public. This approach ensures that monetary control remains centralized while leveraging the existing banking infrastructure for distribution. Additionally, strict anti-money laundering (AML) and counter-terrorism financing (CTF) measures are integrated into the system, ensuring transaction traceability while maintaining user privacy through a controlled anonymity framework. The legal framework also restricts non-bank financial institutions from independently issuing digital currencies, preventing market disruptions and ensuring financial stability.

The People's Bank of China plays a crucial role in the deployment and management of e-CNY. As the sole issuer, the PBoC controls the overall monetary supply and ensures that e-CNY does not disrupt existing financial structures. The central bank also collaborates with commercial banks and payment service providers, such as Alipay and WeChat Pay, to integrate e-CNY into the existing digital payment ecosystem. Furthermore, the PBoC conducts ongoing pilot programs across major cities to test various aspects of e-CNY usage, including retail transactions, cross-border payments, and smart contract applications. These trials help refine the regulatory framework and address technical and security concerns before full-scale implementation. Additionally, the PBoC has introduced regulatory guidelines on wallet management, user authentication, and capital flow tracking to prevent fraud and unauthorized transactions.

Another key aspect of the regulatory framework is the controlled anonymity feature of e-CNY. Unlike private cryptocurrencies, which offer full anonymity, the digital yuan ensures transaction traceability while preserving a level of privacy for small-scale payments. This balance enables regulatory oversight without compromising user confidence in digital transactions. Moreover, the PBoC has established limits on e-CNY holdings for individual users to prevent excessive accumulation and maintain financial stability. These measures differentiate e-CNY from decentralized cryptocurrencies, reinforcing its status as a secure and regulated digital currency.

When compared with global digital currency initiatives, China's e-CNY stands out due to its centralized control and structured implementation strategy. Unlike decentralized cryptocurrencies like Bitcoin, which operate without regulatory oversight, e-CNY is a state-backed currency fully regulated by the central bank. In contrast to other central bank digital currencies (CBDCs) in development, such as the European Central Bank's digital euro or the U.S. Federal Reserve's proposed digital dollar, China has advanced more rapidly in real-world testing and deployment. The digital yuan's large-scale pilot programs and integration with public services place it ahead of many other CBDC projects globally. Additionally, while some countries focus on wholesale CBDCs for interbank settlements, e-CNY is designed primarily for retail transactions, promoting financial inclusion and providing a state-controlled alternative to private digital payment platforms.

China's regulatory approach also differs in its emphasis on cross-border functionality. The PBoC has been exploring international collaborations to facilitate the use of e-CNY in global trade and financial settlements. Partnerships with the Hong Kong Monetary Authority and participation in multi-CBDC bridge projects with Thailand and the UAE indicate China's ambition to expand e-CNY's global reach. This contrasts with the more domestically focused digital currency strategies of Western economies, which remain in earlier development phases. Furthermore, China's extensive use of blockchain and smart contract technology in e-CNY further sets it apart from many other digital currency initiatives, ensuring greater efficiency and security in financial transactions.

By maintaining strict regulatory oversight while promoting innovation, China is setting a precedent for other nations considering digital currency adoption. The PBoC's comprehensive approach ensures that e-CNY serves as a complement to the existing financial system rather than a disruptive force. As global interest in CBDCs grows, China's experience with e-CNY will likely serve as a model for other central banks navigating digital currency implementation.

3. Impact on Traditional Banking Business Models

3.1 Changes in Deposit Structures and Bank Liquidity Management

The introduction of e-CNY is expected to bring about profound changes in the way commercial banks manage their deposit structures and liquidity. Traditionally, banks have relied on customer deposits as their primary source of funding, using them to issue loans, invest in financial instruments, and manage liquidity requirements. However, as the adoption of e-CNY accelerates, an increasing number of consumers and businesses may shift their funds from traditional bank accounts to digital yuan wallets, which are managed directly by the People's Bank of China (PBoC). Unlike bank deposits, which generate interest and contribute to the bank's ability to lend, e-CNY does not bear interest, potentially reducing the incentive for individuals and corporations to keep large sums of money in conventional bank accounts.

This shift could result in a significant contraction in bank deposits, thereby diminishing the pool of funds available for lending and investment. Commercial banks may experience liquidity shortages, leading to greater reliance on alternative sources of funding such as interbank borrowing, bond issuance, and other short-term credit facilities. This may increase the cost of capital for banks, forcing them to adjust their interest rates on savings accounts in an effort to retain customer deposits. In turn, a rise in deposit interest rates could place upward pressure on lending rates, making borrowing more expensive for businesses and individuals alike.

The reduction in bank deposits could also disrupt the traditional fractional reserve banking system, where banks use a portion of customer deposits to fund lending activities while maintaining a minimum reserve requirement. With fewer deposits, banks may find it more challenging to meet regulatory liquidity requirements, potentially leading to financial instability in the broader banking sector. To counter this, banks might need to lobby for regulatory adjustments that allow them to integrate e-CNY into their existing financial services. Some potential solutions could include the introduction of hybrid accounts that link e-CNY holdings with traditional bank deposits, ensuring that a portion of digital yuan balances remains within the banking system.

Additionally, the outflow of deposits from banks to e-CNY wallets could weaken the banks' ability to generate profits through interest rate differentials. As deposits decline, banks will have fewer assets to lend, forcing them to seek alternative revenue streams. This could drive a shift toward fee-based services, investment advisory, and digital asset management, as banks attempt to offset the revenue loss from reduced deposit levels.

To mitigate these risks, regulatory interventions may be necessary, such as imposing limits on individual and corporate e-CNY holdings or implementing measures that encourage the reintegration of e-CNY funds into traditional banking channels. The extent to which commercial banks can successfully adapt to this changing financial landscape will play a crucial role in determining their long-term viability in the era of digital currency.

3.2 Effects on Loan Issuance and Interest Rate Mechanisms

The transition to e-CNY is likely to have far-reaching consequences for banks' ability to issue loans and manage interest rates. Since commercial banks rely heavily on deposits to fund their lending activities, any significant reduction in deposit levels could directly impact their lending capacity. If a substantial portion of customer funds is shifted into e-CNY wallets, banks may struggle to maintain their traditional loan issuance levels, leading to a tightening of credit availability in the economy.

This shift could result in higher interest rates for borrowers, as banks attempt to compensate for the reduced availability of funds. Businesses, particularly small and medium-sized enterprises (SMEs), could face greater difficulty in accessing credit, as banks may impose stricter lending criteria to offset the risks associated with lower liquidity. This could, in turn, have a ripple effect on economic growth, investment, and job creation, as businesses rely heavily on bank loans to fund expansion and operations.

The design of e-CNY further complicates traditional banking models, as it does not support interest-bearing accounts. Unlike conventional bank deposits, which offer returns in the form of interest payments, e-CNY holdings do not provide financial incentives for users to keep large balances. This could lead to a scenario where individuals and businesses prefer to use e-CNY for transactions but avoid storing significant wealth in digital yuan wallets. To address this issue, banks may be forced to offer more attractive savings and investment products to encourage customers to keep funds in interest-bearing accounts rather than shifting entirely to e-CNY.

Additionally, the introduction of e-CNY may disrupt monetary policy transmission mechanisms. The PBoC typically influences the economy through interest rate adjustments, which affect bank lending rates and deposit rates. However, if a large proportion of money is held in e-CNY rather than in traditional bank deposits, the effectiveness of interest rate policies may be diminished. This could lead to new challenges in controlling inflation, managing credit cycles, and ensuring financial stability.

To remain competitive, banks may need to develop innovative digital lending models that integrate e-CNY into their credit issuance frameworks. For example, banks could explore blockchain-based smart contracts for automated loan disbursement, where loan repayments are directly deducted from users' e-CNY wallets. This could streamline the lending process, reduce default risks, and create new revenue opportunities for banks in an increasingly digital financial environment.

3.3 Potential Disruption to Commercial Banks' Payment and Settlement Services

One of the most immediate disruptions posed by e-CNY is its potential to bypass traditional banking payment and settlement systems. Commercial banks generate significant revenue from payment processing, transaction fees, remittance services, and interbank settlements. However, with the introduction of e-CNY, many of these services may become obsolete, as digital yuan transactions occur directly between users without the need for intermediaries.

E-CNY enables real-time transactions and settlements, eliminating the need for conventional clearinghouses and interbank payment networks. Unlike traditional bank transfers, which require processing time and involve multiple institutions, e-CNY transactions are instantaneous, cost-free, and directly processed by the PBoC. This could significantly reduce banks' income from transaction fees, forcing them to reassess their payment service models.

Furthermore, e-CNY's impact on cross-border transactions could further erode banks' dominance in the payment ecosystem. If China successfully integrates e-CNY into international trade settlements, it could reduce reliance on SWIFT, correspondent banking networks, and traditional foreign exchange mechanisms. This would present challenges for banks that rely on foreign currency exchange fees and international remittances as key revenue streams.

To remain competitive, banks may need to redesign their payment infrastructure to integrate e-CNY within their existing financial services. One approach could be to develop bank-issued e-CNY wallets that offer enhanced features such as transaction analytics, budgeting tools, and loyalty programs to attract users. Additionally, banks could explore partnerships with fintech firms to provide value-added payment solutions that leverage e-CNY's speed and efficiency while maintaining a role for traditional banks in financial transactions.

Another adaptation strategy could involve offering specialized payment services for businesses, such as automated payroll systems that integrate with e-CNY, corporate finance solutions that utilize digital yuan for supply chain payments, and smart contract-based trade finance services. By developing innovative digital payment solutions, banks can ensure that they remain relevant in an increasingly cashless and decentralized financial ecosystem.

Ultimately, the long-term impact of e-CNY on traditional banking business models will depend on how effectively banks can innovate, integrate new technologies, and diversify their revenue streams. While e-CNY presents challenges in deposit retention, loan issuance, and payment processing, it also offers opportunities for banks to evolve into digital-first financial institutions. Those that proactively embrace change, invest in new financial technologies, and develop customer-centric digital services will be best positioned to thrive in the era of digital currency.

4. Technological and Operational Challenges for Banks

The introduction of e-CNY presents a range of technological and operational challenges for commercial banks. As the digital yuan continues to expand, banks must make significant upgrades to their infrastructure, enhance cybersecurity protocols, and ensure seamless interoperability with existing banking systems. The transition to a central bank digital currency (CBDC) demands a technological overhaul that includes integrating new payment systems, strengthening data protection frameworks, and addressing compatibility issues between digital yuan wallets and traditional banking networks. While e-CNY offers significant advantages in terms of transaction efficiency and financial inclusivity, the banking sector must navigate these challenges to remain competitive in the evolving financial landscape.

4.1 Infrastructure Upgrades Required for e-CNY Integration

The implementation of e-CNY requires substantial infrastructure upgrades for commercial banks. Unlike traditional fiat currency transactions, e-CNY operates through digital wallets and blockchain-based settlements, necessitating the development of new technological frameworks. Banks must invest in upgraded core banking systems to ensure seamless compatibility with e-CNY, enabling them to process digital yuan transactions efficiently.

One major infrastructure requirement is the development of digital wallet solutions. Since e-CNY is issued directly by the People's Bank of China (PBoC), banks must create user-friendly platforms that allow consumers and businesses to store, transfer, and manage e-CNY funds. These digital wallets must support high transaction volumes, real-time payments, and secure authentication methods to prevent fraud and unauthorized access.

Additionally, banks need to integrate e-CNY into existing Automated Teller Machines (ATMs), Point-of-Sale (POS) systems, and online banking platforms. The transition to digital yuan transactions requires upgrading hardware and software to ensure smooth interoperability. Without these enhancements, banks risk losing market share to fintech firms and digital payment platforms that offer more efficient e-CNY solutions.

Banks must also consider cloud computing and big data analytics to support e-CNY transactions. As digital currency adoption increases, banks will need to process large volumes of real-time transactions. Scalable cloud-based infrastructure will be essential for ensuring transaction speed, maintaining high uptime, and managing complex payment settlements. Furthermore, artificial intelligence (AI) and data analytics can help banks analyze consumer spending patterns, detect fraudulent transactions, and optimize financial services tailored to e-CNY users.

Given the rapid development of financial technology, commercial banks may need to collaborate with fintech companies and third-party service providers to accelerate infrastructure upgrades. Strategic partnerships will enable banks to leverage cutting-edge technologies, enhance e-CNY capabilities, and improve overall operational efficiency.

4.2 Cybersecurity Concerns and Data Privacy Risks

The widespread adoption of e-CNY raises significant cybersecurity risks, as banks must ensure that digital yuan transactions remain secure, private, and resilient to cyber threats. Unlike traditional cash transactions, e-CNY operates within a digital ecosystem, making it vulnerable to hacking, cyber fraud, and data breaches.

One of the primary concerns is the risk of cyberattacks targeting digital yuan wallets and banking infrastructure. Hackers may attempt to exploit vulnerabilities in mobile banking apps, e-CNY payment gateways, and cloud-based storage systems. Banks must implement robust encryption technologies, multi-factor authentication, and biometric security measures to prevent unauthorized access and fraud.

Another major challenge is data privacy protection. Since e-CNY transactions are fully traceable and monitored by the PBoC, concerns have emerged regarding the collection and usage of consumer financial data. While transaction tracking is designed to prevent illicit activities such as money laundering and tax evasion, excessive government surveillance could erode public trust in digital financial services. To address these concerns, banks must ensure that data privacy policies are transparent, compliant with legal standards, and aligned with user rights.

Additionally, banks must mitigate risks related to identity theft, phishing attacks, and malware infiltration. Fraudsters may attempt to steal personal credentials by impersonating banking institutions or creating fake e-CNY wallet applications. To combat these threats, banks must invest in advanced fraud detection systems, artificial intelligence-driven anomaly detection, and blockchain-based identity verification mechanisms.

Another cybersecurity challenge is ensuring the security of cross-border e-CNY transactions. As China seeks to internationalize e-CNY, banks must implement strong cross-border transaction monitoring frameworks to prevent financial crimes, unauthorized fund transfers, and geopolitical security risks. Secure digital escrow services, smart contract-enabled cross-border settlements, and compliance with global cybersecurity regulations will be critical for ensuring safe international adoption of e-CNY.

4.3 Interoperability Issues with Existing Banking Systems

One of the key challenges for commercial banks is ensuring seamless interoperability between e-CNY and existing financial systems. Traditional banking infrastructure was not originally designed to handle CBDCs, leading to potential compatibility issues with digital yuan transactions. Without proper integration, banks risk disruptions in payment processing, inefficiencies in settlement systems, and a decline in customer experience.

A major interoperability concern is the lack of standardization in digital currency integration. Since e-CNY operates on a centralized ledger managed by the PBoC, banks must develop new protocols to enable real-time interaction between e-CNY wallets and conventional banking accounts. The lack of a universal Application Programming Interface (API) for CBDCs could hinder smooth integration, requiring banks to invest in customized software solutions to ensure cross-platform compatibility.

Another issue is the integration of e-CNY with international banking systems. As China pursues the globalization of e-CNY, commercial banks may face challenges in linking digital yuan transactions with SWIFT, CHIPS, and other international payment networks. The absence of cross-border digital currency standards could lead to transaction delays, regulatory conflicts, and increased compliance costs.

Additionally, banks must address the impact of e-CNY on credit and liquidity management systems. Since e-CNY transactions occur outside the conventional banking framework, banks may struggle to reconcile digital yuan flows with their internal accounting processes. Automated ledger synchronization, blockchain-based settlement mechanisms, and AI-powered reconciliation tools will be essential for ensuring smooth financial operations.

To tackle these challenges, banks must collaborate with central banks, fintech companies, and regulatory bodies to establish interoperable frameworks that facilitate e-CNY integration. Investing in modular financial architecture, cloud-native banking solutions, and AI-driven automation will help banks adapt to the evolving digital financial ecosystem while maintaining seamless connectivity with existing financial networks.

The introduction of e-CNY presents both opportunities and challenges for commercial banks. While the digital yuan promises faster transactions, enhanced financial inclusion, and improved monetary control, its integration poses significant technological, operational, and cybersecurity challenges. Banks must make substantial infrastructure upgrades, strengthen data protection measures, and develop seamless interoperability solutions to ensure a smooth transition into the e-CNY era. By adopting cutting-edge financial technology, collaborating with industry partners, and proactively addressing security risks, banks can successfully navigate the challenges of e-CNY implementation while maintaining their competitive edge in the evolving digital financial landscape.

5. Technological and Operational Challenges for Banks

One of the key challenges hindering the international expansion of e-CNY is its lack of interoperability with existing global financial settlement networks, particularly SWIFT (Society for Worldwide Interbank Financial Telecommunication) and CHIPS (Clearing House Interbank Payments System). These two systems form the backbone of the global financial infrastructure, facilitating cross-border transactions for nearly every major financial institution. SWIFT handles more than 42 million transactions per day, connecting over 11,000 banks across 200 countries, while CHIPS processes a significant portion of U.S. dollar-denominated interbank payments. However, e-CNY operates on a centralized, state-controlled digital ledger overseen by the People's Bank of China (PBoC), which differs fundamentally from the decentralized, multi-institution structure of SWIFT and CHIPS. This creates significant challenges in linking China's digital currency ecosystem with the global financial network.

China's efforts to integrate e-CNY into international trade settlements are complicated by regulatory inconsistencies between China and foreign jurisdictions. Different countries have varying regulations on digital currencies, anti-money laundering (AML) policies, and cross-border capital controls, making it difficult for foreign banks to legally accept, process, and store e-CNY transactions. While China has strict state control over its financial system, many international financial hubs, such as the United States and the European Union, follow decentralized regulatory models that require compliance with multiple banking authorities, financial regulators, and risk assessment procedures. These regulatory mismatches slow down the process of adopting e-CNY for cross-border payments, as foreign financial institutions must navigate unfamiliar compliance requirements before integrating China's digital currency into their existing operations.

Moreover, concerns over financial transparency, surveillance, and geopolitical implications have led some foreign governments to hesitate in adopting e-CNY. Since the digital yuan is fully traceable and controlled by the PBoC, international policymakers worry that China could monitor, restrict, or even manipulate financial transactions involving foreign entities. The United States, for instance, has raised concerns that e-CNY could be used to circumvent U.S. sanctions, allowing sanctioned entities to conduct trade without relying on traditional banking channels. The European Central Bank (ECB) has also expressed skepticism about central bank digital currencies (CBDCs) that operate outside established regulatory frameworks, fearing that they could create fragmented financial networks that compete with traditional institutions rather than integrating with them.

Another major roadblock is the limited adoption of the digital yuan in international trade, as most global businesses still rely on the U.S. dollar (USD) as the dominant trade currency. Despite China's position as the world's largest exporter and a key player in global supply chains, over 80% of international trade transactions are still settled in USD, according to data from the Bank for International Settlements (BIS). The U.S. dollar's role as the global reserve currency gives it unparalleled liquidity, stability, and acceptance, making it the preferred medium of exchange for multinational corporations, financial institutions, and central banks.

Even among China's key trading partners, the willingness to shift to e-CNY remains low. While China has successfully promoted yuan-denominated trade agreements with countries such as Russia and Iran, most international businesses continue to prefer the USD due to price stability, ease of conversion, and global recognition. The digital yuan faces further resistance in countries where local financial markets are heavily tied to the U.S. dollar, making a transition to e-CNY impractical in the short term.

To address these challenges, China has launched several initiatives to increase global adoption of e-CNY and promote its integration into international financial systems. One such initiative is the mBridge project, a collaboration between China, Hong Kong, Thailand, and the UAE, aimed at testing cross-border digital currency settlements. By developing a multi-central bank digital currency platform (mCBDC) that allows for seamless transactions between different CBDCs, China hopes to create an alternative global payment system that reduces reliance on SWIFT and CHIPS.

Additionally, China has expanded its Cross-Border Interbank Payment System (CIPS) as a potential replacement for SWIFT in yuan-denominated transactions. While CIPS currently handles only a small fraction of global trade compared to SWIFT, its transaction volume has been steadily increasing. However, for CIPS to gain widespread adoption, it must address key challenges such as scalability, interoperability with foreign banking institutions, and regulatory harmonization.

Despite these efforts, the digital yuan still faces an uphill battle in gaining widespread acceptance in the global financial system. The dominance of the U.S. dollar, regulatory fragmentation, and concerns over financial sovereignty remain key barriers that must be overcome. In the coming years, China's success in promoting e-CNY for international trade will depend on diplomatic negotiations, enhanced financial infrastructure, and strategic partnerships with foreign central banks. Without addressing these issues, e-CNY risks remaining a domestic innovation rather than a truly global digital currency.

6. Consumer Behavior and Market Adoption

6.1 Public Perception and Willingness to Use e-CNY Over Traditional Banking Services

Public perception plays a crucial role in determining the success of e-CNY adoption. While the government has positioned e-CNY as a secure, efficient, and state-backed digital currency, widespread public trust is still developing. Concerns over data privacy, government surveillance, and competition with existing payment platforms continue to shape consumer attitudes. A 2023 Peking University study found that 62% of respondents expressed concerns about financial tracking and government control over digital transactions. Unlike cash, which offers full anonymity, or traditional banking, where only financial institutions have access to transactional data, e-CNY transactions are fully traceable by the People's Bank of China (PBoC). This has led to skepticism, particularly among wealthier individuals and businesses that prefer financial discretion in their transactions.

Security concerns also play a major role in consumer willingness to adopt e-CNY. The rise of cyber fraud and digital theft has made consumers wary of digital financial platforms. According to the China Cybersecurity Administration, digital payment fraud cases rose by 28% in 2023, raising fears that e-CNY users could become targets of hacking, phishing, and unauthorized transactions. However, the PBoC has introduced highly secure encryption technologies, AI-driven fraud detection, and biometric authentication to protect e-CNY users, positioning it as a safer alternative to traditional online banking.

Despite these concerns, public interest in e-CNY is growing, particularly among younger, tech-savvy users who value its speed, efficiency, and integration with China's digital economy. A 2024 China Internet Network Information Center (CNNIC) survey reported that 35% of urban consumers use e-CNY regularly, with 48% of individuals aged 18-35 preferring it over cash and traditional banking for daily transactions. Among small and medium-sized enterprises (SMEs), 41% have incorporated e-CNY into their payment systems, highlighting growing commercial adoption. However, traditional banking services and third-party digital wallets like Alipay and WeChat Pay still dominate consumer transactions, and many users see little incentive to switch to e-CNY unless there are clear benefits such as lower fees, faster cross-border transactions, or government-backed rewards.

6.2 Differences in Adoption Rates Across Demographics and Regions

The adoption of e-CNY varies widely based on demographics, income levels, and geographic regions. In urban areas, where fintech adoption is high and digital transactions dominate, e-CNY usage has been steadily increasing. A 2023 report from the Ministry of Industry and Information Technology (MIIT) found that over 55% of urban residents in first-tier cities like Beijing, Shanghai, and Shenzhen had used e-CNY at least once. However, adoption rates in rural areas remain much lower, with only 23% of rural residents reporting any use of e-CNY for financial transactions. The digital divide between high-tech urban environments and underdeveloped rural areas presents a major barrier to widespread e-CNY adoption. While the government has promoted financial inclusion initiatives to encourage digital transactions in remote areas, limited access to smartphones, internet connectivity, and digital banking education remains a significant obstacle.

Age is another major factor influencing e-CNY adoption. According to a 2023 Tencent Research Institute report, 72% of consumers aged 18-30 reported using e-CNY for routine transactions, largely due to its integration with e-commerce, ride-hailing, and food delivery services. Younger generations who are already familiar with mobile banking and QR-code payments find e-CNY a natural extension of their digital financial habits. However, adoption rates among older populations are significantly lower, with only 29% of individuals over 45 years old expressing willingness to switch to e-CNY. Many older consumers still prefer cash or traditional banking services, citing concerns over digital literacy, security, and loss of financial control. This generational divide indicates that e-CNY adoption will likely be driven by younger, urban populations, while older and rural communities may require additional education and incentives to transition to digital currency.

Income levels also influence e-CNY adoption. Higher-income groups, particularly those earning over $50,000 annually, are 2.5 times more likely to use e-CNY for large financial transactions compared to lower-income groups. This trend reflects greater access to digital financial tools, better financial literacy, and a stronger emphasis on investment-driven transactions among wealthier individuals. In contrast, lower-income individuals, especially those working in informal economies or cash-based industries, have been slower to adopt e-CNY, as they are less likely to engage with banking infrastructure, digital wallets, or formal financial systems.

China's strategy for increasing e-CNY adoption in underrepresented demographics has included expanding mobile banking networks, launching digital payment training programs, and incentivizing rural businesses to accept e-CNY transactions. However, overcoming long-standing financial habits and infrastructure gaps will require continuous investment, government support, and collaboration with fintech providers.

6.3 The Role of Incentives in Promoting e-CNY Usage

To accelerate e-CNY adoption, the Chinese government and financial institutions have launched a variety of incentive programs aimed at both consumers and businesses. These initiatives focus on direct financial rewards, merchant subsidies, and transaction fee exemptions to make e-CNY more attractive than traditional banking and digital payment alternatives.

One of the most effective strategies has been the distribution of digital yuan "red envelopes", where the government provides free e-CNY to users in pilot cities. Since 2021, over ¥500 million ($70 million) worth of e-CNY has been distributed through these campaigns, allowing users to spend digital yuan at participating retailers, restaurants, and online platforms. These promotions have successfully increased first-time e-CNY users, but sustaining long-term adoption requires additional incentives beyond initial giveaways.

Another key strategy has been the integration of e-CNY into public sector payrolls and government subsidies. In several Chinese provinces, government employees, teachers, and public sector workers are now receiving a portion of their salaries in e-CNY, ensuring steady adoption within government-related financial flows. Similarly, agricultural subsidies, pension payments, and social welfare benefits have begun incorporating e-CNY distribution, further embedding digital yuan into everyday financial transactions.

Private-sector incentives have also played a major role in boosting e-CNY adoption. Large e-commerce platforms such as JD.com, Alibaba, and Meituan have partnered with the government to offer exclusive discounts, cashback rewards, and loyalty programs for transactions made with e-CNY. A 2023 Alipay Digital Payment Report found that businesses that adopted e-CNY payment options experienced:

- A 23% increase in digital payment volume within three months.
- A 15% reduction in transaction processing fees, as e-CNY transactions bypass third-party payment providers.

For businesses, the government has introduced tax breaks, reduced compliance costs, and priority access to state contracts for those who integrate e-CNY into their financial operations. SMEs have particularly benefited from lower transaction costs and government-backed financing programs, allowing them to streamline payments while reducing reliance on traditional banks and fintech intermediaries.

Despite these incentives, challenges remain in sustaining organic adoption growth beyond government-driven campaigns. While digital yuan usage has steadily increased in pilot cities, many consumers still default to Alipay and WeChat Pay for daily transactions due to habit, convenience, and existing financial ecosystem integration. To drive long-term adoption, e-CNY will require continuous innovation, increased integration with international trade, and enhanced user incentives that go beyond government mandates.

The adoption of e-CNY is strongly influenced by public perception, demographic trends, and financial incentives. While younger, urban consumers have shown higher adoption rates, older individuals and rural populations remain hesitant due to concerns over privacy, accessibility, and financial habits. The government's incentive-driven approach has been successful in driving initial e-CNY usage, but long-term adoption will depend on building consumer trust, improving financial education, and enhancing the convenience of e-CNY compared to existing banking services. As China continues to expand digital yuan applications, its integration into global trade, business-to-business transactions, and cross-border settlements will be key factors in ensuring the long-term success of e-CNY.

7. Competitive Landscape and Financial Inclusion

The introduction of e-CNY has intensified competition in China's financial ecosystem, reshaping the landscape for traditional banks, fintech companies, and digital payment platforms. As a state-backed central bank digital currency (CBDC), e-CNY is positioned to challenge existing financial service providers, particularly Alipay and WeChat Pay, which have dominated China's digital payment sector for over a decade. At the same time, its implementation presents opportunities to enhance financial inclusion, especially for rural and underbanked populations. The degree to which traditional banks, fintech firms, and government institutions adapt to this evolving financial environment will determine the long-term impact of e-CNY on China's broader economy.

7.1 The Rise of Fintech and Digital Payment Platforms as Alternative Financial Service Providers

Fintech firms have fundamentally altered China's banking and payment landscape, providing consumers with fast, seamless, and cost-effective digital financial services. Companies like Alipay (Ant Group) and WeChat Pay (Tencent) process billions of transactions daily, offering a broad ecosystem of mobile payments, peer-to-peer transfers, microloans, wealth management services, and insurance products. These platforms have grown so influential that they now process over 90% of China's mobile payments, making them a core part of the digital economy. However, the rise of e-CNY poses a direct challenge to their dominance.

Unlike Alipay and WeChat Pay, which are privately operated and rely on commercial banking partnerships, e-CNY is issued directly by the People's Bank of China (PBoC), eliminating the need for intermediaries in financial transactions. This shift threatens the revenue models of fintech firms, which earn significant profits from transaction fees, interest on digital loans, and financial product commissions. If e-CNY adoption increases, consumers may bypass third-party platforms entirely, opting for direct digital transactions without the need for fintech-operated wallets.

To counteract the potential loss of market share, fintech giants have integrated e-CNY into their platforms, ensuring users can access digital yuan payments within their existing financial ecosystems. In late 2023, Alipay and WeChat Pay enabled e-CNY transactions within their apps, allowing users to spend digital yuan without switching to a government-backed wallet. Despite this adaptation, analysts predict that fintech firms may struggle to differentiate their services if e-CNY transactions become the default for state payments, salaries, and subsidies.

Additionally, the rapid expansion of buy-now-pay-later (BNPL) schemes, digital lending, and wealth management services by fintech firms could face regulatory scrutiny if the government pushes for tighter control over digital financial transactions. The introduction of e-CNY enables the PBoC to monitor financial flows more effectively, potentially leading to greater regulation of fintech credit services and restrictions on consumer lending practices. While fintech companies will remain key players in China's financial landscape, they must adapt to the growing influence of state-backed digital currency by expanding value-added services, strengthening partnerships with traditional banks, and exploring cross-border payment solutions.

7.2 Impact on Rural and Underbanked Populations

One of the primary objectives of e-CNY is to enhance financial inclusion, particularly for rural residents and underbanked populations who have limited access to traditional banking services. Despite China's rapid financial digitalization, millions of citizens still lack access to formal banking infrastructure, relying on cash transactions and informal credit sources.

According to a 2023 report from the China Banking and Insurance Regulatory Commission (CBIRC), over 225 million people in China remain underbanked, with rural populations facing significant barriers to digital financial services, credit access, and investment opportunities. The government has positioned e-CNY as a solution to financial exclusion, aiming to provide a state-backed alternative to private financial platforms that require linked bank accounts or mobile payment accounts.

The elimination of banking intermediaries in e-CNY transactions means that individuals without access to traditional financial services can still store and spend money digitally. Unlike commercial bank accounts, which require identity verification, income documentation, and credit history assessments, e-CNY wallets can be issued with minimal documentation requirements, enabling unbanked individuals to participate in the digital economy. The PBoC has also introduced offline payment functionality for e-CNY, allowing rural consumers to complete transactions without internet access, a crucial feature for regions with limited connectivity and financial infrastructure.

However, challenges remain in ensuring widespread e-CNY adoption among rural populations. A 2023 China Rural Finance Survey found that:

- 58% of rural residents still prefer cash transactions due to familiarity and lack of trust in digital finance.
- Only 27% of rural small businesses have adopted e-CNY payments, compared to 67% in urban areas.
- Mobile banking penetration remains low, with only 43% of rural residents regularly using smartphone-based financial services.

To accelerate adoption, the government has launched education initiatives, digital payment training programs, and incentive schemes for businesses that accept e-CNY in rural markets. Additionally, state-backed microfinance programs have begun integrating e-CNY disbursements, providing farmers and small businesses with easier access to low-interest digital loans and government subsidies. Over time, the successful expansion of e-CNY into rural markets will depend on increasing digital literacy, expanding smartphone access, and addressing long-standing trust issues with state-controlled financial systems.

7.3 Opportunities for Traditional Banks to Enhance Digital Financial Services

While e-CNY presents challenges to traditional banking institutions, it also creates opportunities for banks to expand digital financial services, improve customer engagement, and develop new revenue models. Historically, commercial banks in China have faced declining customer deposits and increasing competition from fintech firms, but the rollout of e-CNY enables them to reassert their role in digital finance.

One of the key opportunities for banks lies in e-CNY-based financial product innovation. Since e-CNY does not generate interest, banks have the opportunity to develop hybrid financial products that integrate interest-bearing savings accounts, digital wealth management services, and credit-linked e-CNY deposits. By offering consumers seamless integration between e-CNY wallets and traditional banking accounts, banks can retain deposits and attract digital-first customers who might otherwise shift to government-controlled wallets.

Banks can also leverage big data analytics and AI-driven financial planning tools to enhance customer engagement. With the integration of e-CNY, banks have access to real-time transaction data, allowing them to offer personalized financial recommendations, spending insights, and automated investment options. This shift from transaction-based revenue models to data-driven financial advisory services could help banks differentiate themselves from fintech competitors and enhance customer loyalty.

Another opportunity is in cross-border trade and international e-CNY adoption. As China promotes e-CNY for Belt and Road Initiative (BRI) projects and foreign trade settlements, commercial banks have the chance to facilitate international transactions, provide currency exchange solutions, and develop blockchain-based trade finance services. If global acceptance of e-CNY expands, banks that proactively develop international settlement frameworks could play a crucial role in shaping China's digital financial diplomacy.

Despite these opportunities, banks must also address key challenges such as interoperability with traditional banking systems, regulatory compliance, and cybersecurity risks. As e-CNY adoption grows, financial institutions that successfully adapt to digital currency integration, develop new financial solutions, and prioritize cybersecurity measures will be best positioned to thrive in China's evolving financial landscape.

The rise of e-CNY is reshaping China's competitive financial environment, challenging fintech dominance, creating new pathways for financial inclusion, and opening opportunities for banks to expand their digital services. While fintech firms must adapt to increased government oversight and competition, rural and underbanked populations stand to benefit from greater access to financial services. For traditional banks, e-CNY represents both a challenge and an opportunity, providing a foundation for new financial products, expanded customer engagement, and international trade integration. How effectively financial institutions adapt to e-CNY adoption, regulatory changes, and shifting consumer behaviors will determine their success in China's rapidly digitizing financial sector.

8. Response Strategies of Traditional Banks

The widespread adoption of e-CNY has introduced significant challenges for traditional banks, requiring them to rethink their business models and adopt strategic innovations to remain competitive. While the state-backed digital yuan offers greater financial inclusion, faster transactions, and reduced reliance on third-party payment processors, it also reduces banks' role in payment settlements, weakens deposit retention, and pressures profitability. To navigate this evolving landscape, traditional banks must focus on innovating banking services, developing hybrid financial models, and strengthening collaboration with regulatory bodies and fintech firms to ensure they remain relevant in an increasingly digital financial ecosystem.

One of the most immediate areas for banks to adapt is innovation in banking services to complement e-CNY. Since digital yuan transactions bypass traditional bank-mediated payment systems, banks must create value-added services that enhance the user experience and incentivize customers to maintain their financial activity within the banking system. This includes offering advanced digital wallets that integrate e-CNY with additional banking services such as automated savings plans, AI-powered budgeting tools, loyalty rewards, and financial advisory services. By positioning themselves as enhanced service providers rather than mere payment processors, banks can retain customer engagement and prevent widespread disintermediation. Additionally, banks can develop real-time transaction monitoring tools, enhanced security protocols, and AI-driven fraud detection systems to differentiate their e-CNY offerings from basic government-provided digital wallets.

Another critical strategy is the development of hybrid financial models that integrate digital currency with traditional banking services. Since e-CNY itself does not bear interest, banks have an opportunity to offer hybrid accounts that seamlessly link e-CNY holdings with traditional deposit accounts, investment funds, and credit lines. By allowing customers to move funds between e-CNY and interest-bearing accounts, banks can mitigate the risk of deposit flight while providing users with additional incentives to maintain financial relationships with traditional banks. Furthermore, integrating e-CNY into digital lending solutions can enable banks to offer smart contract-based credit issuance, real-time loan approvals, and automated repayment mechanisms using blockchain technology. These innovations not only enhance banking efficiency but also enable financial institutions to retain their role as key intermediaries in credit markets, even as e-CNY adoption expands.

Collaboration with regulatory bodies and fintech firms is another essential component of banks' response strategies. Unlike decentralized cryptocurrencies, e-CNY is fully regulated by the People's Bank of China (PBoC), meaning that banks must align their business models with national financial policies and digital currency regulations. Maintaining close partnerships with the PBoC and financial regulators will allow banks to stay ahead of policy changes and integrate e-CNY in ways that support both economic stability and banking sector resilience. Additionally, rather than competing directly with fintech firms, banks can seek strategic partnerships with leading digital payment providers like Alipay and WeChat Pay to offer seamless cross-platform transactions. By integrating e-CNY within their own banking ecosystems, banks can participate in the growing digital payments sector without losing ground to fintech disruptors.

Furthermore, banks must proactively invest in cross-border financial infrastructure to position themselves as key players in international e-CNY transactions. As China promotes e-CNY for global trade and Belt and Road Initiative (BRI) projects, banks that develop blockchain-based cross-border settlement systems, digital forex trading solutions, and smart contract-enabled international trade financing will gain a competitive edge in the global financial system. Given that global adoption of e-CNY remains in its early stages, early investment in international payment solutions could enable banks to lead in digital yuan-based trade settlements in the years to come.

Ultimately, traditional banks must embrace digital transformation, rethink their revenue models, and develop customer-centric solutions that enhance the value proposition of e-CNY within the banking ecosystem. By leveraging fintech innovations, regulatory collaboration, and digital financial integration, banks can maintain their competitive relevance, ensure financial stability, and actively participate in the next phase of China's digital economic evolution. Institutions that adapt quickly to these shifts will not only survive in the e-CNY era but also expand their market influence as digital finance continues to evolve.

9. Future Outlook and Policy Recommendations

The emergence of e-CNY marks a transformative shift in China's financial sector, influencing banking models, regulatory frameworks, and global monetary policies. As digital currency adoption continues to grow, it is expected to reshape the role of commercial banks, alter consumer financial behavior, and accelerate the digitalization of financial services. While the short-term impact of e-CNY has been largely experimental and limited to pilot cities, its long-term implications could fundamentally change how financial institutions operate, how governments regulate money supply, and how China engages in international trade and financial diplomacy. To ensure a stable and efficient transition, commercial banks must implement adaptive strategies, while regulators must introduce policy measures to support the integration of e-CNY into the broader financial system.

One of the most significant long-term transformations in the financial sector will be the decline in the dominance of traditional banking intermediaries. With e-CNY facilitating direct transactions between consumers and businesses, commercial banks may see reduced reliance on traditional deposit and lending models. As a result, banks will need to develop new revenue streams, shifting from a model based on deposit-based lending and transaction fees to one centered on data-driven financial services, investment advisory, and digital credit solutions. Additionally, as the People's Bank of China (PBoC) gains more control over monetary transactions, the traditional function of banks as money creators through fractional reserve banking may diminish. This could lead to a restructured credit issuance system, where banks play a more specialized role in facilitating digital credit, blockchain-based asset management, and AI-driven financial planning.

Another key transformation will be the growing internationalization of e-CNY. As China expands the use of digital yuan in Belt and Road Initiative (BRI) trade agreements and cross-border settlements, traditional banking institutions will need to adapt their foreign exchange and trade finance operations. If successful, e-CNY could reduce China's reliance on the U.S. dollar for international trade, positioning it as a major global reserve currency alternative. However, for this to happen, regulators must address current interoperability challenges with SWIFT and other global financial settlement systems. Without proper integration, e-CNY risks being confined to domestic use rather than becoming a truly global digital currency.

To help traditional banks adapt to digital currency dominance, several strategic recommendations can be made. First, banks must embrace fintech innovations by developing hybrid financial products that integrate e-CNY with traditional banking services. For example, banks could introduce e-CNY-linked savings accounts, where users can seamlessly transfer digital yuan into interest-bearing accounts, ensuring continued engagement with banking services. Similarly, blockchain-enabled lending platforms can allow banks to offer smart contract-based loans, where repayments are automatically deducted from e-CNY wallets. These innovations will enable banks to remain relevant and competitive in an e-CNY-driven economy.

Second, banks should invest in advanced data analytics and AI-driven financial solutions. With e-CNY transactions providing real-time financial data, banks can develop personalized financial planning tools, AI-powered credit assessments, and real-time spending analysis dashboards. These services can enhance customer engagement and provide value beyond basic transactions, allowing banks to differentiate themselves from government-issued digital wallets.

Third, banks should focus on enhancing cross-border payment capabilities by developing digital yuan-compatible international settlement platforms. Given China's push to reduce reliance on the U.S. dollar, banks that lead in digital yuan-based trade finance will benefit from increased transaction volume, stronger ties with global markets, and a competitive advantage in international financial transactions. This can be achieved through strategic partnerships with foreign banks, investment in blockchain-based remittance solutions, and collaboration with multinational corporations that trade with China.

From a policy perspective, regulators must implement measures to ensure financial stability amidst digital transformation. One critical concern is preventing excessive liquidity outflows from commercial banks to e-CNY wallets, which could lead to reduced lending capacity and weakened money supply control. To address this, policymakers could set holding limits on e-CNY accounts, implement tiered transaction caps, or introduce incentives for consumers to keep a portion of their funds within the traditional banking system.

Another essential policy measure is the standardization of cross-border e-CNY transactions. The success of digital yuan in international trade depends on harmonizing regulatory frameworks across different jurisdictions. China must engage in diplomatic discussions with global financial authorities, including the International Monetary Fund (IMF) and World Bank, to ensure e-CNY transactions comply with global financial regulations, anti-money laundering (AML) standards, and international capital flow controls. Without such regulatory alignment, the global adoption of e-CNY could be hindered by legal and compliance barriers.

Furthermore, the cybersecurity and privacy aspects of e-CNY require ongoing regulatory oversight. Since e-CNY is fully traceable, striking a balance between financial transparency and individual privacy is crucial. Policymakers should introduce data protection frameworks, encryption protocols, and consumer privacy policies that prevent excessive government surveillance while maintaining the security of digital yuan transactions. Public trust in e-CNY will depend on ensuring that transaction data is not misused for non-financial purposes.

In the long run, the ability of China's banking sector to adapt to e-CNY dominance, the government's ability to ensure regulatory stability, and the success of digital yuan in international markets will determine the global significance of e-CNY. While challenges remain, the potential benefits—enhanced monetary policy efficiency, reduced dependency on foreign currencies, and greater financial inclusion—make e-CNY one of the most ambitious digital currency projects in the world. Banks that proactively embrace innovation, strengthen regulatory partnerships, and develop value-added financial services will be best positioned to thrive in this rapidly evolving digital financial landscape.

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PROJECT SAND DOLLAR:

A Bahamas Payments System Modernisation Initiative

24 December, 2019

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1 Executive Summary

The Central Bank will introduce a digital version of the Bahamian dollar, starting with a pilot phase in Exuma in December 2019, and extending in the first half of 2020 to Abaco. This initiative has acquired the name Project Sand Dollar, with the sand dollar also being the name assigned to the proposed central bank digital currency (CBDC). This is a continuation of the Bahamian Payments System Modernization Initiative (PSMI), which began in the early 2000s.

The Bahamian PSMI targets improved outcomes for financial inclusion and access, making the domestic payments system more efficient and non-discriminatory in access to financial services.

Although average measures of financial development and access in The Bahamas are high by international standards, pockets of the population are excluded because of the remoteness of some communities outside of the cost effective reach of physical banking services. More onerous customer due diligence standards for AML/CFT international tax compliance have also resulted in forms of exclusion, including more recent responses to tighter "know your customer" (KYC) systems introduced to preserve international correspondent banking relationships. As recent policy and regulatory reforms have begun to tackle these barriers, the Central Bank is intent on accelerating payments system reform, admitting new categories of financial services providers and using the digital payments infrastructure to make the supply of traditional banking services accessible to all segments of the population.

Recent surveys document that as part of a financial literacy campaign, there is room to improve both knowledge and awareness of financial products and responsible financial behavior. Opportunities also exist to reduce transaction costs for businesses and consumers. Feedback from Exuma, show a high penetration of mobile phone usage, and a likelihood that a higher share of the population would be willing to use digital financial services including electronic payments. The public though will need more assurances around the safety of conducting online transactions. The digital currency design and public education will tackle these issues.

Most of the benefits of introducing a digital currency are still unquantifiable. However, they include a potential suppression of economic costs associated with cash usage, and benefits to the Government from improved expenditure and tax administration systems. It is expected that the Government, as participant and user, would be a strong promoter of digital payments adoption, alongside non-bank payment services providers as the initial lead intermediaries in this space.

As the pilot progresses in Exuma, the Central Bank will simultaneously promote the development of new regulations for the digital currency, and strengthen consumer protection, especially around data protection standards. The Bank will also advance reforms to permit direct participation of non-banks in the domestic payments system. Early passage of the new Central Bank of The Bahamas Bill will support the creation of some regulations, while additional reforms will be possible under the existing Payment Systems Act.

2 THE BAHAMIAN PAYMENTS SYSTEM & FINANCIAL ACCESS

2.1 Goals of the Modernisation Initiative

The Bahamian Payments System Modernisation Initiative (PSMI), of which the digital currency project is a recent component, targets collectively improved outcomes around financial inclusion and access, making the domestic payments system more efficient, non-discriminatory in access to financial services across the entire archipelago. The main goals are that 100% of the population has access to digital payments services; universal access to banking services of a deposit account maintenance nature; a reduction in the size of legitimate but unrecorded economic activities that take place in the informal sector; and full admission of micro, small and medium-sized businesses into the digital space. The positive outcomes are also explicitly aimed at strengthening national defenses against money laundering and other illicit ends, including activities that thrive in cash intensive environments. More universally enabled access to electronic payments and to digital financial services also dovetails with the strategy to deliver government services through digital channels, thereby improving tax administration and increasing the efficiency of spending.

2.2 Existing Measures of Financial Inclusion and Access

Average measures of financial development and access, mask the archipelagic disparities in access to basic financial services, and similarly highlight the costly nature of delivering services through physical channels in The Bahamas. Relative to the size of the economy, the domestic deposit base of approximately $6.5 billion and outstanding credit to the private sector at $6.2billion equate to respective 60.5% and 57.9% of GDP in 2018. Relative to the size of the population, The Bahamas has the 35th highest density of bank branches in the world and the 15th highest density of automated banking machines. However, there are significant gaps in who has access.[1] Given the dispersed geography, with pockets of sparse populations, many rural, Family Island communities have limited or no access to these physical modes of delivery, with

[1]See IMF Financial Access Survey database. https://data.imf.org/?sk=E5DCAB7E-A5CA-4892-A6EA-598B5463A34C.

services being totally unavailable, or only through electronic channels. Moreover, the branch network has been scaled back in response to the rising costs of maintaining such operations. When coupled with other difficulties in establishing banking relationships, these pockets of the Bahamian domestic environment therefore remain captive to sole reliance on cash transactions, with consequent exposure to opaque or illicit activities that thrive in such settings, and with costs—particularly to the public sector—to deliver cash-based assistance or payments.

The domestic financial system has also discriminated in access through both official policies and the in-house practices of licensed institutions. Even as policies have been relaxed, the system has only transitioned gradually to a more accommodating state, as anecdotal feedback from the 2018 and 2019 reforms underscore.[2] The 2001 suite of legislation that addressed global anti-money laundering (AML) concerns and subsequent years strengthening of the Bahamian international tax cooperation arrangements introduced onerous customer due diligence systems that effectively excluded or slowed basic financial access.[3] Customer due diligence standards also tightened, in more recent years, as commercial banks responded to more demanding terms on correspondent banking relationships (CBRs). This followed international assessments that placed the Bahamian AML/CFT regime at higher risk. Until 2018, Exchange Control Regulations also maintained broad exclusions on non-residents' access to Bahamian dollar deposit accounts, when these might have facilitated domestic payments transactions.[4]

Additional evidence on financial inclusion were obtained from a baseline survey conducted in 2018,[5] similar to other surveys used for OECD countries. This highlighted the gap between which financial products were utilized, versus those of which they were made aware. The survey[6] indicated both a high degree of awareness and access to basic deposit facilities in The Bahamas, although that has not translated into increased level of use of such products. About 93% of the surveyed persons had knowledge of savings accounts and 85% knew of checking accounts compared to a lesser 80% and 70% of the same individuals who used such instruments. Further from a payments perspective, only 48% of individuals had access to credit card facilities, against awareness of these by 89% of those surveyed. Other measures of inclusion also exposed gaps,

[2] Banks did not all implement the adjusted customer due diligence standards at the same time.
[3] Just up to 2018, a common requirement to establish a personal deposit account at domestic bank was for the applicant to produce multiple forms of official identification, evidence of employment and proof of physical address. Risk-based application of procedures that would have eased constraints on the majority of domestic clients started to be endorsed in the 2018 legislative reforms.
[4] Evidence of a permit to reside or work in The Bahamas was a requirement in order for a non-resident to maintain a Bahamian dollar deposit account.
[5] The Bahamas Financial Literacy Results 2018
https://www.centralbankbahamas.com/news.php?id=16402&cmd=view
[6] See a snapshot of the results in the appendix.

in the use of investment and insurance products, including pensions (see Table 1 in the Appendix).

The Central Bank's survey also uncovered evidence of self-exclusion from banking services partly because of the customer due diligence requirements, and in the case of businesses, exclusion from use of electronic transactions because of the costs. In particular, in cases where individuals reported not having a bank account, some indicated that it was due either to the inability to, or the inconvenience of satisfying KYC documentary requirements. Meanwhile, anecdotally, businesses that either reported not accepting electronic payments or still had a preference for cheque writing as opposed to wired payments, commonly cited the costs of the electronic options as an inhibiter.

2.3 Baseline Financial Inclusion Data from Exuma

In the Summer of 2019, the Central Bank also conducted a targeted baseline survey on financial inclusion and access for Exuma, alongside new data for the rest of The Bahamas, which provides a context for consumer education and awareness and tracking financial inclusion measures as the pilot progresses.[7] The results also highlight room for increased use of digital financial transactions once costs, ease of use and cyber security concerns are addressed.

The Exuma results, which are summarized in the Appendix, underscore high access to basic bank accounts by 93% of the island's residents. The access numbers though, are on the higher end against participation in savings accounts for slightly more than 9 out of 10 persons on average in the survey, with both results potentially elevated due to the surveys being conducted over land phone lines, and potential exclusion of undocumented persons. Additionally, the Exuma survey indicates that some two-thirds of bank accounts receive deposits that originate from salary payments, and about 15% receive pension payments. Where bank accounts were not used, lack of trust in the institutions or the inconvenience of getting to a bank were the most cited reasons for self-exclusion (collectively for 17% of those without accounts).

About 96% of surveyed Exumians own mobile devices, and about 40% use these to perform some forms of bill payments or online banking transactions. Close to two-thirds of respondents disclosed a willingness to use mobile devices for payments or commercial transactions in the future. When disclosed, there was a reluctance to use electronic banking and financial transactions, which was skewed more toward older respondents, and mostly reflecting unease or distrust with electronic platforms, including cyber security concerns.

Anecdotally, the Central Bank has noted elsewhere that businesses' willingness to embrace electronic payments on either the receipting or disbursing end, has been inhibited by costly merchant fees.

[7] The national survey results are being published separately.

2.4 Tailoring Financial Inclusion Intervention

While the Central Bank is developing a broader national financial inclusion strategy that would address these issues, improved access to payments services, would provide the conduit through which other financial services could be more easily reached. This strategy would also rely on sustained financial literacy campaigns to boost product awareness and encourage more positive behavior around personal finances. Embracing electronic payments at higher rates will also require education around cyber safe financial behavior.

3 ADVANCING PAYMENTS INFRASTRUCTURE DEVELOPMENT

The digital currency initiative fits in with the wider reforms that have supporting regulatory and policy changes at their centre. As in previous iterations, it will also involve direct investments in infrastructure improvements.

3.1 Automated Clearing Arrangements

The Central Bank started the modernisation initiative in the early 2000's to automate the payments settlements process among the clearing banks (commercial banks). In 2004, the Bank invested directly in the start-up of the Bahamas Interbank Settlement System, the real-time gross settlement (RTGS) system for large value payments between clearing banks. The Central Bank then promoted efforts to establish the commercial bank owned, Bahamas Automated Clearing House (BACH) in 2010, for electronic settlement of small-value retail payments.[8]

The ACH and RTGS have improved the speed and efficiency of domestic payments. They have supported development of electronic point of sale payments at the retail level, including use of debit cards; and added to the efficiency and speed of cheque processing, with an intentional and evident trend in favour of increase use of wire transfers over cheques. Fiscal policy has also helped, as on July 1, 2013, the Government removed the stamp tax on Bahamian dollar electronic funds transfer or debits. Only cash withdrawals and cheque writing still attract stamp tax.

3.2 Non-Bank Direct Participation in Settlements

The Central Bank is now encouraging non-bank participation in the provision of electronic payments, to spur innovation, competition and faster adoption of electronic solutions. This reform started with the enactment of the Payments Systems Act (PSA) in 2012, which established a regulatory framework for electronic payments, including stored value products. Once the

[8] The RTGS settles payments on a gross basis, where the value of the individual transaction is $150,000 or greater. All lower value, retail payments are processed through the ACH, with commercial banks netting off debts and credit on a bilateral basis and settling the differences among each other through RTGS payments. Settlements clear though balances that each institution maintains with the Central Bank.

supporting Payment Instruments (Oversight) Regulations were introduced in 2017, the Central Bank began to accept license applications for non-bank providers of payment services providers (PSPs). These entities can operate in the same markets for stored-value products as banks, credit unions and money-transmission businesses (MTBs). There have already been three licensed PSPs, with other applications under review. Several MTBs are also developing digital payments solutions under the regulatory oversight of the Central Bank.

The draft new Central Bank legislation contains provisions that would level the playing field even further. The Bank has signalled that it will allow direct participation of non-clearing banks in the ACH and RTGS systems. Regulated credit unions, international banks, PSPs and MTB's would be permitted to establish settlement accounts directly with the Central Bank as opposed to having to negotiate settlement arrangements with commercial banks. The Central Bank has also proposed that the Government and the National Insurance Board would be allowed to join the ACH and RTGS, as the two largest single originators and recipients of payments. Both entities already maintain accounts with the Central Bank that can satisfy settlements. Opening of the ACH to broader participation will require regulations, and commercial bank initiated changes in the private ACH arrangements.[9]

3.3 Strengthening Ease of Access to Financial Services

Throughout recent regulatory reforms, the Central Bank was also guided by the principle that access to payment services should not discriminate between whether the products originate from banks or from other regulated entities; and that the range of access that users of cash currently enjoy in services should persist when the products were digitised. Also, irrespective of whether consumers availed themselves of mobile payment services or traditional bank deposits, the Central Bank has taken the stance that the ease of access and risk tailored customer due-diligence should be similar.

On ease of access, streamlined customer due diligence standards were introduced in 2018 under revised AML Guidelines[10] which simplify the identification and address verification requirements to establish personal deposit accounts or access other services from financial institutions. A passport is now sufficient to open a bank account; or two other pieces of identification in the absence of passport. This shifts more emphasis to transactions monitoring process after account relationships have been established, and limits enhanced due diligence to customers which banks

[9] The PSA allows the Central Bank to designate certain parts of the domestic payments system as systemically important and, as a result, to impose additional regulatory conditions on their operations. This would include access to such parts of the system on a non-discriminatory basis for other payment services firms.

[10] Streamlined Requirements for Account Opening https://www.centralbankbahamas.com/legal_policies.php?cmd=view&id=16883

assess to be of higher risk. For very low-value stored products, the identification process need not be invoked.[11] The Central Bank also signalled that a job letter or proof of employment would not be a requirement to open a personal deposit account. This affects the cross-section of the resident adult population who might not be employed, but would be entitled to transaction accounts, such as savings facilities with debit cards attached.

The other easing, which the Central Bank undertook in 2018, was to remove Exchange Control restrictions from non-residents' access to Bahamian dollar (B$) deposit facilities. Irrespective of immigration or work permit status, these persons can open and maintain B$ deposit accounts with balances of up to $50,000 without approval from the Central Bank.

To progress beyond these regulatory steps, the Central Bank recognised that, in The Bahamas, "public goods" outcomes still existed, even where the same circumstances might produce strictly private sector efficient solutions in larger developed or developing country settings. Outcomes still have to ensure that all pockets of the archipelago are serviced by the private sector solutions that emerge. Also, the solutions should connect all consumers regardless of the consumers' choice of service provider. It is an interoperability requirement, that for The Bahamas would only be achieved swiftly if it were universally profitable. As proposed, the digital currency solution would eliminate this constraint.

4 PROJECT SAND DOLLAR

The intended outcome of Project Sand Dollar is that all residents in The Bahamas would have use of a central bank digital currency, on a modernized technology platform, with an experience and convenience—legally and otherwise—that resembles cash. It is expected that this will allow for reduced service delivery costs, increased transactional efficiency, and an improved overall level of financial inclusion. The anonymity feature of cash is not being replicated, although the Sand Dollar infrastructure would incorporate strict attention to confidentiality and data protection.

A digital fiat currency would not be a "crypto currency" in any sense resembling private instruments in existence. It would be an identifiable liability of the Central Bank of The Bahamas, equivalent in every respect to the paper currency. Its value would be the same as the existing currency. The digital currency would also not be a stable coin, or a parallel currency, in the sense that it would not derive any value separate from the external reserves backing afforded to the

[11] In the AML Guidance Notes these would be accounts that carry $500 or less and for which the monthly reload capacity is $300 or less. Monitoring of transactions for AML purposes, still applies for all accounts which financial institutions maintain. Where higher risks are assessed, supervised institutions may also invoke processes that go beyond identification, such as verification of sources of income or wealth.

Central Bank's demand liabilities.

4.1 Key Specifications of the Proposed Solution

The Central Bank undertook a rigorous process to select a technology solutions provider for the design and implementation of the digital fiat for The Bahamas. The search process stressed a need for a robust solution that addressed both the archipelagic and infrastructural challenges of providing electronic financial services, as well as the requirement to provide a solution that was robust against international regulatory standards.

In March 2019, NZIA Limited was selected as the solutions provider. A few key aspects of the proposed solution are as follows:

- Achieving interoperability among existing and new channels for the provision of payments services. All payments services firms would have access to the digital currency and would be able to use the Sand Dollar Network to settle retail Bahamian dollar payments.
- Supporting "offline functionality" even if communication between the islands is disconnected. Built-in safeguards would allow users to make a pre-set dollar value of payments when communications access to the Sand Dollar Network was disrupted. Wallets would update against the network once communications were re-established.
- Near instantaneous validation of transactions/real-time transactions processing.
- Point of sale support for businesses accepting payments. Through PSP tailored solutions, business would be able to process payments with modern credit and debit card machines or mobile phone apps.
- Fully auditable transactions trail (non-anonymous). Transactions monitoring still protects user confidentiality, and would be governed by strict regulatory standards around access.
- Monitoring for fraud detection.
- Restriction of digital currency to domestic use. A Bahamian CBDC would be for domestic use only, and prohibited from acceptance by non-domestic payees. Wallet holders would still have the option, through PSPs, to integrate accounts with commercial banks, to make electronic purchases of foreign exchange, enabling use of their accounts internationally.
- Multi-factor authentication for wallet users. Users would have to supply two passcodes, one randomly generated, to complete some payments transactions.
- Digital ID solution (using KYC and identity features incorporated in the system design) that can be piloted for use in the financial services sector.

The digital version of the Bahamian dollar would be available for both wholesale and retail applications. Wholesale application would ordinarily restrict usage to payments settlements at the inter-bank level, akin to clearing house transactions. The proposed retail application, would also allow the general public to make and receive digital payments. Each holder would maintain direct claims on the Central Bank and legally have the equivalent of accounts with the Central Bank.

Over the pilot phase, the Central Bank will work along with the technology provider to ensure that all the relevant facets of the digital system are fully functional before it is more widely deployed. The pilot will launch in Exuma in December 2019 and expand to Abaco in the first half of 2020. The Abaco setting will test emergency wireless communications features that would enable rapid financial services recovery following natural disasters; and connect with the island's retail businesses early in their recovery process.

4.2 Monetary Policy and Financial Stability Safeguards

The Bank is closely attentive to the monetary policy and financial stability implications of a digital currency and is incorporating prudent safeguards for these.[12,13] These go beyond customer due diligence and transactions monitoring standards that tackle financial crimes (money laundering, terrorism financing, and proliferation) and tax evasion. One concern is that a CBDC could compete with traditional banking services, as a deposit alternative and draw resources out of banks. If it were to happen on any significant scale, it would leave the issuing central bank in the suboptimal position of having to reallocate domestic resources, a role that is best reserved for licensed financial institutions.[14] A consideration too is whether holdings of digital currency would earn interest, which would be another reason for the public to view them like deposits. Financial stability risks would also be highlighted by concerns that sudden, large shift of funds into CBDCs could present a form of bank run. Early international regulatory caution around issuance of

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[12] The policy considerations and risks of CBDCs has been extensively documented by organisations such as the Bank for International Settlements (BIS), International Monetary Fund (IMF) and the Financial Stability Board (FSB). The Financial Action Task Force, has weighed in on recommended standards to counter financial crimes abuse. See the Appendix for a selected bibliography.

[13] That said, official sentiments towards CBDCs has shifted. A BIS Survey indicated that 70 percent of all central banks were exploring some work on CBDCs. The Bahamas and Eastern Caribbean Central Bank, are in this subset, both intending to make the digital currency available to the general public (a retail version). Many other central banks are only exploring issuing wholesale CBDCs that would be restricted for use in payments settlements among financial institutions. There is also the apparent competition from potential global stable coins like the proposed Facebook libra that has drawn global reaction from standards setting bodies and regulators. Regulators acknowledge that the rise in popularity of cryptocurrencies were in measure responses to gaps in the efficiency and reach of the international payments settlement mechanisms, especially for low-value transactions like remittances.

[14] Adrian, Tobias; Mancini-Griffoli. "The Rise of Digital Money." Fintech Notes (International Monetary Fund). Washington, D.C., July 2019.

digital currency also highlighted cyber security and other risks that could cripple payments networks and severely disrupt smooth functioning of the affected financial sector.

By policy, the Central Bank has imposed several design factors into the digital currency proposal to mitigate the aforementioned risks. So that it does not operate in practice as a substitute for traditional banking deposits, limits will be placed on the amount of the B$ instrument that individuals, businesses and other non-supervised financial institutions would be able to hold. Moreover, to be enabled for higher-value transactions, personal digital wallets will have to be linked to deposit accounts at domestic financial institutions, into which any excess holdings of the currency would have to be deposited. Because the ultimate goal of Project Sand Dollar is financial inclusion, individuals would still be able to have mobile wallets without the need for a bank account, but with less functional capabilities. Without exception, though, all wallets held by businesses would have to be linked to established bank accounts. To further remove similarities with deposits, interest will not be paid on any holdings of digital currency.

Financial stability concerns and runs on bank deposits are related to the speed at which electronic transfers can be enabled, aside from whether the instrument used is a CBDC. Safeguards are being developed nonetheless for The Bahamas. The Sand Dollar infrastructure will deploy real-time consolidated transactions monitoring to provide early warning of critical threats on individual banks' liquidity. It will deploy circuit breakers, if necessary, to prevent systemic instances of failures or runs on bank liquidity.

4.3 The Roles and Contribution of Key Stakeholders

The major stakeholder groups for the digital currency include the Central Bank, the general public, financial intermediaries licensed by the Central Bank, the public sector (including the National Insurance Board), and general businesses and entities other than licensed financial intermediaries. They each have different respective roles to play in the modernization process.

The Central Bank's role would be multi-purpose, including currency issuance, monitoring of holdings and sponsoring a centralized KYC/identity infrastructure. In particular, although the Bank will not provide front-end customer service, nor directly sponsor digital wallets, it will ultimately maintain the ledger of all individual holdings of the digital currency. On a near-to medium-term timeline, the Bank will also promote a centralized KYC register to maintain identification and profile data that would either mandate or allow individuals who do not maintain such information within banks or licensed intermediaries, to supply the data for the register. By regulation, the register would be maintained to be compliant with AML/CFT standards to enable other financial relationships to be established by Central Bank supervised entities (SFIs). This register would draw on data in government maintained systems, once statutory provisions are enabled, or consent-enabled access frameworks are established.

Financial intermediaries include all Central Bank SFIs that would be allowed to operate as sponsors of mobile payment wallets, including banks, credit unions, MTBs and PSPs. Within this group, the Central Bank expects that PSPs and MTBs will possess the technology to offer mobile wallets from the outset. It is not expected that either banks or credit unions will have enabled technology for mobile wallets at the onset of the digital currency's introduction, but this would remain an option for them to pursue.

Banks and credit unions are expected to contribute to the customer due diligence regime; facilitate connectivity of deposit accounts with mobile wallets; and enable foreign exchange transactions. In particular, the Central Bank will promote regulations to permit all PSPs, with the consent of enrolling participants, to rely on KYC documentation already possessed by commercial banks. By regulations, it is ultimately proposed that a legal obligation be imposed on banks and credit unions to share customer requested KYC confirmation with any SFI provider of payments services. Banks, ultimately, will also be required, through regulation, and customer consent frameworks to honor real-time direct debit or withdrawals from deposit accounts of wallet holders that finance acquisitions of digital currency.

The public sector has multiple roles to play, including as lead originators and recipients of digital payments. This includes equipping both the payments receipting and disbursing systems to conclude transactions in digital currency; and becoming direct participants in the ACH. In particular, the Government and the NIB are expected to be the two largest originators of digital payments. Both also represent the largest store of official data on the status of private commercial entities that might enroll in digital payments services.[15]

Private commercial entities and others beyond the public sector and Central Bank SFIs would represent the core "business" or "B" component of digital payments. For these entities, enrollment in digital currency will always require a link between wallets and bank deposit accounts, so that excess receipts can be transferred into banks. In each case, status as a business would have to be evidenced from existence on the business license register, for expediency, making use of proposed information sharing mechanisms with the Department of Inland Revenue.

The general public is intended to mean individuals (retail level "peers" or "Ps") as originators or recipients of digital payments. It could also include sole proprietors who operate as micro and small businesses, provided that the volume and profile of their transactions do not single them out as businesses. Whenever the active transactions profile distinguishes a wallet holder as a potential commercial operator, the Central Bank will require the financial intermediary to

[15] The Central Bank proposes to establish information sharing arrangements (MOUs) with the relevant public sector agencies to provide financial institutions have access to such due diligence information.

undertake the due diligence to enroll the wallet as a business operated account; or through the due diligence process, document the affirmation that the account is non-commercial.

4.4 Tailoring the Digital Currency Experience

The Central Bank will impose a ceiling on how much digital currency can be maintained in a mobile wallet, according to the category of user and the level of required customer due diligence. Central Bank SFIs will not face any limit on holdings, as these would be interchangeable for the clearing balances which SFIs maintain with the Central Bank. Other non-individual wallet holders (primarily businesses) would be permitted to hold total balances which are the greater of $8,000 or 1/20th of their annual sales receipts, subject to a maximum ceiling of $1 million. Monthly transaction limits would also apply: proposed at 1/8th of annual sales or $20,000, whichever is greater.

For individuals, wallets established with basic due-diligence, would be capped at a maximum holding capacity of $500 and subjected to monthly transactions totals against either payments or receipts of $1,500. Personal accounts, which undergo more enhanced due diligence around identification, verification of contact, would be enabled to operate within a maximum holding amount of $5,000 and subject to an annual transactions limit of $100,000 (or $10,000 per month). Personal wallets, once connected to deposit accounts at financial institutions, would be enabled to undertake higher total transactions value, on the condition that the transactions flow through deposit accounts, since the maximum amount of digital currency holdings would remain capped. The Central Bank will vary these limits over time as may be necessary to satisfy the robustness of the AML/CFT regime, under the principle that the more elevated due-diligence would always enable accounts to operate with higher transactions limits.

The wallet establishment process is intended to be simplified, and reliant upon procedures established by the Central Bank; and the approved KYC system of banks and payment services providers. It will be possible to initiate the process through banks (eventually credit unions), PSPs or MTBs, but in all cases using Central Bank pre-established account codes. [16] Users would be able to download the Sand Dollar app to mobile iOS (Apple) or android devices and then complete the account setup process through a licensed service provider. All personal users would be able to elect to establish the lowest level of transactions activation; and then to subsequently enable higher access amounts by completing the enhanced due diligence process.

A card-based version of the digital wallet will also be piloted for users who elect not to use a mobile device, or for users that elect to undertake some transactions offline from the mobile app. This should appeal to individuals who might wish to operate initially in a less digital setting

[16] See Appendix for a diagram of the eco-system.

for ease of comfort. These individuals would be able to receive updates of their wallet balances through point of sales devices.

4.5 The Digital Payment Process

Sand dollar payments would occur in a secure tokenized environment, requiring just the mobile phone, or the dedicated point of sales terminals that businesses and other receipting entities deploy. The simple payment process will utilize QR codes generated on the payer's digital Sand Dollar Card or the mobile device. An in-person payment would then be executable in one of three forms:

1. A scan of the payee's static QR code, then entering the amount required on the next screen;
2. A scan of the payee's dynamic QR code with an embedded amount, and then confirming at next screen; or
3. A transmission of payment amount to the payee via their Sand Dollar unique handle, alias or address

Potential high volume originators of mobile payments for payroll, social assistance and other purposes will also have access to batch transactions processing capability, utilizing the Sand Dollar Infrastructure and platforms developed by the PSPs. This includes the Government, NIB and private businesses. These would be akin to batch transactions currently processed through the ACH but with gross and net settlements occurring in digital currency.

5 The Bahamas' Implementation Plan

The Exuma Pilot will parallel intensive work to develop and refine the regulatory framework for digital financial services. The Pilot will launch on December 27, 2019, with the enrollment of wallet users through each of the participating financial institutions. In the period leading up to launch, the Bank and NZIA held intensive one-on-one conversations and group discussions with financial institutions to clarify expectations around their participation in the Pilot. In November 2019, a special session of the National Payments Council (NPC) convened with key stakeholders to reaffirm the approach to the project, with emphasis on KYC standards for onboarding, zero cost carve out for the P2P payments, and outlines of the intended regulatory standards on data protection.

NZIA has tested and pre-installed portions of the private communications network for the Sand Dollar Payments system. The Sand Dollar systems will also use existing public communications infrastructure to process payments messaging over standard internet connections.

As the pilot engages, work will mature on the proposed legal and regulatory reforms for the digital currency, taking account of enhanced governance and consumer protection standards needed generally for a modernized Bahamian infrastructure. The consultation process and promulgation of regulations is expected to be completed by mid-2020. This process, alongside any modification which the lessons from the Pilot dictate, will precede any generalized national deployment of the Sand Dollar. A key legal reform will be enactment of the new Central Bank Bill early in 2020, to provide the framework for digital currency regulations and access of credit unions, PSPs and MTBs to direct settlement accounts with the Central Bank. Reforms are also anticipated under the Payment Systems Act, to similarly strengthen digital consumer protection standards; and the AML/CFT Regulations and Guidelines will need amending to accommodate the eKYC portability.

The Central Bank has already acknowledged the importance of promoting the restoration of Abaco's financial system, through early deployment of the digital currency on the island. This will commence in February 2020.

6 Gauging Potential Benefits against Costs

While the financial costs of establishing and maintaining a digital currency framework are measurable on the Central Bank's balance sheet, many of the benefits will accumulate off balance sheet. On balance sheet, the Central Bank's currency printing costs are expected to moderate, in proportion to the rate of adoption in digital payments. But most of the benefits will accrue in the wider economy.[17]

6.1 Improved Financial Inclusion

The potential to improve financial inclusion, especially for remote communities, is significant. More centralized and portable KYC data, coupled with digital channels for both deposits and withdrawals, would permit banks to provide basic deposit services remotely, and to rely on the digital infrastructure to extend credit. The reach of banking services would be extendable beyond the physical branch, and banks would be further enabled to reduce costly branch networks.

6.2 Reducing the Ill Effects of Cash Usage

A reduction in cash use, coupled with enhanced financial transactions monitoring, would also effectively strengthen national defenses against money laundering, terrorist financing and other illicit abuses of the financial system. Further enhancements to the AML/CFT regime would also favour the standing of the international financial services sector and cut into national risks assessments that affect the ease of access to correspondent banking relationships. Cash usage

[17] See Summary Table in the Appendix

also imposes physical security risks on businesses and creates more exposure to fraudulent losses relative to electronic point of sales transactions. As it relates to physical safety, a widely adopted CBDC would also place users at less risk of violent crimes that target holders of cash, and potentially reduce security and insurance cost associated with keeping cash on business premises.

6.3 Reduced Transactions Costs

The Central Bank is also directly tacking transactions costs to promote more widespread adoption of electronic payments, and wider access to real-time payment settlements. Increased transfers in digital currency would reduce costs incidences arising from current use wire of transfers, cheques, inter-bank transfers, and existing bill payment mechanisms. The ACH processes thousands of transactions on a daily basis. Although the fees assessed within the ACH are minimal, banks attach addition direct costs to transactions, while merchant fees are levied for debit and credit transactions. While a digital currency will not eliminate these forms of transactions, it would offer a lower cost alternative to a broader cross-section of the public.

6.4 Strengthened Economic Surveillance

By drawing out more commercial activity into the formal economy and strengthening general accounting information systems within businesses, wider adoption of digital payments would also benefit revenue administration systems within the Government. In particular, it would strengthen the information and enforcement systems that the Government relies upon for tax collection. Moreover, increased digital financial inclusion would improve overall estimation and monitoring of economic activity, with better attendant input to evidence-based policy making.

7 Education and Marketing Strategy

Public education and marketing will focus on creating business and consumer awareness of the digital currency, the wallet signup process and cyber security. PSPs will actively participate in this process, and orient users to their tailored or branded experiences. The simplified customer due diligence process for enrollment will be highlighted, along with the proposed portability of eKYC data. In addressing general consumer comfort around the security of electronic transactions, a heavy focus will be placed on educating users on the encrypted protections for funds stored in the payments network, and on minimum security and password protection standards that would be required on personal mobile devices. The Bank will use a number of promotional outlets, including print, broadcast and social media outreach. Promotional presence at cultural and recreational events will also be pursued; along with regular presentation to business and civic groups .

8 CONCLUSION

A widely adopted Bahamian central bank digital currency would promote financial inclusion and wider economic and financial development. A successful rollout hinges on making the instrument accessible to all residents of the archipelago on a non-discriminatory basis and ensuring that the experience, in practice, resembles cash. It also requires that major participants such as the Government, public utilities and the National Insurance Board actively participate from the outset, as the largest originators and recipients of retail payments in the country.

This undertaking will rely on an evolved regulatory structure for domestic payments and other financial services. The Central Bank will, therefore, remain actively engaged with the Government and other stakeholders to ensure that the legal framework develops in tandem with payments system needs; that the country achieves positive financial inclusion outcomes; and that the commercial sector benefits from a more efficient and secure infrastructure. The Bank will also ensure that adequate safeguards and policies are imposed to address the integrity of financial transactions, in line with best international standards for AML/CFT; and that resilient mechanisms are instituted to preserve financial stability and maintain private financial institutions' central role in the financial intermediation process. Engagement and outreach will intensify in the months ahead, as the Exuma pilot provides the instructive feedback to extend the digital reach to the rest of The Bahamas.

Appendix :

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A1. Tables and Charts

Table 1 **Bahamas—Selected Indicators of Financial Access** **Surveyed Knowledge and Use of Products**[18]				
Product or service		% of respondent answering "yes"		
		Heard of	And own jointly or personally	Want to learn more
i.	Savings Account	93	80	30
ii.	Debit card	91	70	24
iii.	Checking Account	85	37	25
iv.	Insurance policy	87	59	34
v.	Pension Fund	82	33	36
vi.	Mortgage	88	31	29
vii.	Credit card	89	48	21
viii.	Mobile Phone banking	70	40	26
ix.	"Asue"	89	33	20
x.	"Numbers" Account	56	19	20
xi.	Bonds	60	13	35
xii.	Stocks and shares	71	24	39
xiii.	Investment Account	62	22	41
xiv.	Mutual Funds	60	15	35
xv.	Equity Funds	51	13	37

Select data from G20 countries

In comparison to The Bahamas, the G20/OECD INFE report on financial literacy in G20 countries indicates that, on average-

- 63% of persons own a savings or retirement product
- 52% have insurance
- 51% have a credit product

[18] Central Bank of The Bahamas, Bahamas Financial Literacy Survey 2018

Digital Sand Dollar Eco-System

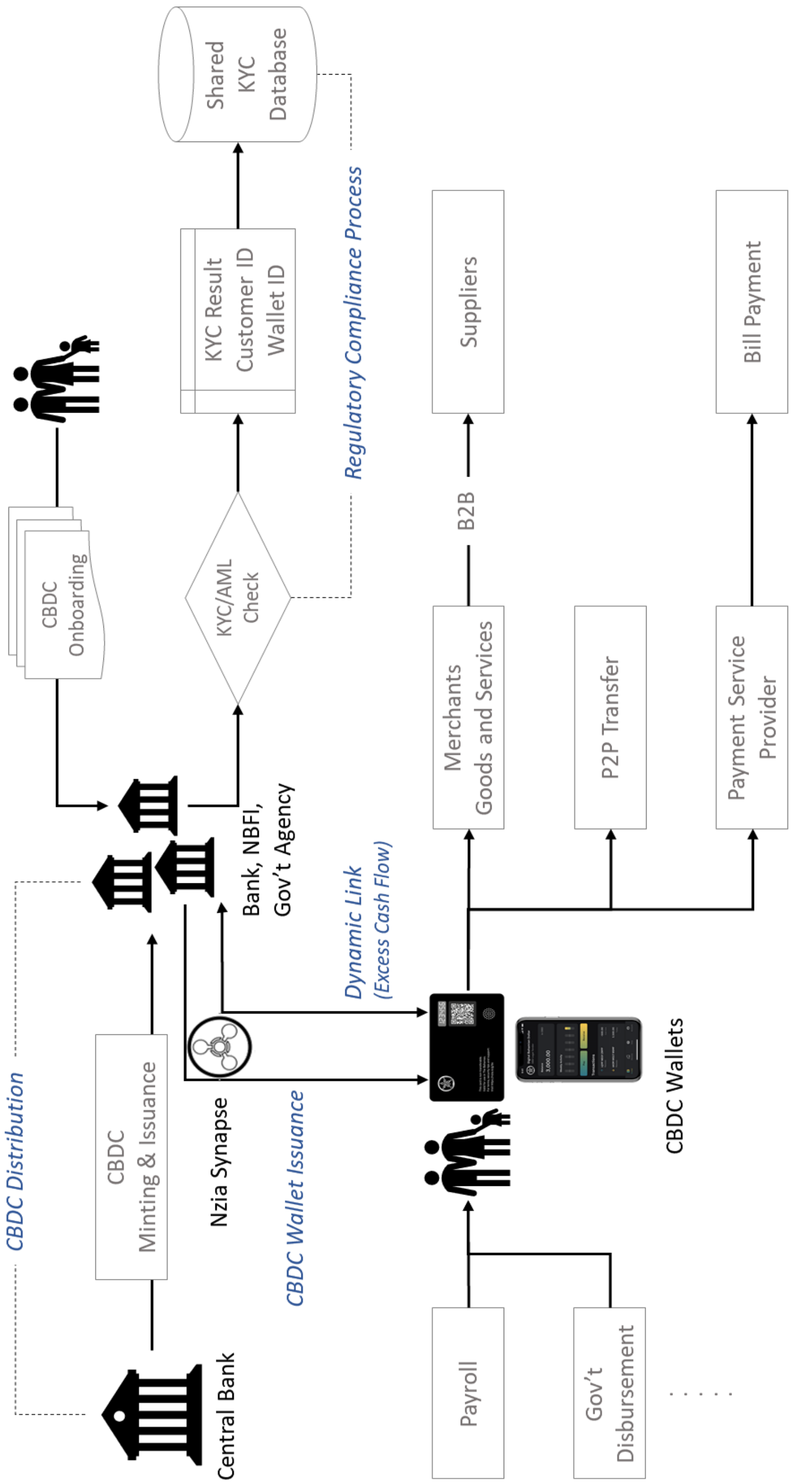


TABLE 2: Summary of Costs and Benefits of Digital Currency	
Costs	**Benefits**
Cost of services provided by the Technology Solutions Provider	Financial Inclusion – improved access to digital payments for the unbanked and underbanked
Ancillary costs related to preliminary work for the launch of the pilot	Lower transactions costs – reduced transaction costs for retail and institutional payments
Legal fees for external expertise on the required amendments to facilitate the issuance of digital currency	Economic growth and digital innovation – creation of new digital ecosystem can result in greater economic activity which can spill over into other technology sectors
Infrastructure expenses	Technology efficiency – faster settlement speed due to not having to rely on banks
Shared costs to establish a national identity infrastructure	Reduced rate of increase in cash production, storage, transportation and costs.
	Improved information and enforcement for government tax administration; more efficient expenditure delivery for low value payments
	Can encourage more competition in private payment systems and between financial institutions
	Better data coverage of economic activities for evidence-based policy making

A2. Tiered KYC Requirements.

Tiered KYC Requirements for Sand Dollar Accounts			
	Description	**Threshold/Limit**	**Customer Due Diligence/KYC Requirements**
Simplified (Level 1)	**Low-Value Accounts** 1) The accounts can be opened online via preset online form, email or face-to-face through any of the authorized commercial banks, (credit unions eventually) payment service providers (PSPs) and money transmission businesses (MTBs) through their respective designated agents. 2) No initial upload amount is required for opening this account. 3) Each digital account will be linked to a physical device such as a payment card (issued to applicants) and mobile phone. 4) Funds can be credited or loaded the by account holder or by 3rd party transfers, but withdrawals can only be made by the account holder. 5) Operation of the wallet is valid only within The Bahamas.	Maximum Holding Limit: B**$500** Maximum Transaction Limit per month: B**$1,500** As either the sum of payments or receipts. All transactions except for; cash withdrawal, disbursement for government services, utility bills, school fees, post-paid telephone/broadband internet bills, or such transactions as determined by Central Bank from time to time, shall count towards the 'Maximum Transaction Limit'. Thus, the limit restricts the aggregated value of: 1) Deposit to own or someone	1) No official ID is required to open a digital account at this tier. ~~2)~~ Basic customer information required to be provided are: a) Full Legal Name b) Date of Birth c) Physical Address/P.O. Box d) Telephone number associated with the customer (which must be mobile if the account is access through mobile device) e) Photo provided by applicant or taken by an on-boarding agent. 3) This information may be sent electronically to authorized entities to be processed. 4) Minors under the age of 16 years old will be required to evidence consent of a parent or guardian with an acceptable form of ID[19].

[19] Categories of acceptable forms of ID documents are outlined in *'Streamlined Requirements for Account Opening, Provision of Financial Services and Customer Identification'* (https://www.centralbankbahamas.com/download/054392600.pdf).

Tiered KYC Requirements for Sand Dollar Accounts			
	Description	**Threshold/Limit**	**Customer Due Diligence/KYC Requirements**
	6) International transfers of funds are prohibited.	else's account; 2) Physical or online merchant payments; 3) Person to person transfers; and 4) Any other type of transactions not explicitly exempted by this paragraph.	
Regular (Level 2)	**Medium-Value (personal) Accounts** 1) The accounts must be opened face-to-face through any commercial banks, [credit unions eventually] payment service providers (PSPs) and money transfer businesses (MTBs) through their respective designated agents. 2) No initial upload amount is required for opening this account. 3) Evidence of basic customer information and ID verification are required. 4) Each digital account will be linked to a physical devices such as a payment card (issued	Maximum Holding Balance: B**$5,000** Maximum Transaction Limit: B**$10,000** per month or B$100,000 per annum	1) ID requirement waived if applicant already has an existing relationship with any of the authorized commercial banks & the financial institution is either a sponsor of the wallet or enables attachment of the wallet to a deposit account of the wallet holder at the financial institution. 2) If the applicant has no existing account relationship with any of the authorized financial institutions, then he/she must provide all of the above (in Level 1) KYC information **plus** any one of the following: a) Valid Passport [of any nationality] b) Driver's License issued in the Bahamas c) Bahamas issued National Insurance Board (NIB) Card d) Bahamas issued Permanent Residence Card, or permit for Work, Residency, Spousal Permit

Tiered KYC Requirements for Sand Dollar Accounts			
	Description	**Threshold/Limit**	**Customer Due Diligence/KYC Requirements**
	to applicants) and mobile phones. 5) Deposits can be made by account holder and 3rd parties, but withdrawals must be made by account holder only. 6) Operation is valid only within Commonwealth of the Bahamas. 7) International fund transfer is prohibited. 8) Not interest bearing.		3) This information may be sent electronically to authorized entities to be processed.
Enhanced (Level 3)	**High-Value/Business Accounts** 1) Authorized on-boarding entities must obtain, verify and maintain copies of all required documentations for account openings. 2) The accounts must be established face-to-face through any of the authorized commercial banks, payment service providers (PSPs) and money transfer businesses (MTBs) through their respective designated agents.	Maximum Holding Balance: B**$8,000,** or 1/20th of annual sales, up to an annual limit B$1 million. Maximum Transaction Limit per month: B**$20,000** or 1**/**8th of annual revenues whichever is greater. NB: Annual sales are based on VAT or Business license filing.	Applicants are required to comply with the Enhanced Due Diligence measures published in the AML/CFT Guidelines, 2009[20] (as amended) issued by Central Bank of the Bahamas. Evidence of current existence on the business license register is required VAT TIN. Enrollment details must correspond to official records Due diligence procedures undertaken by wallet providers should establish that person acting on behalf of commercial and other entities are duly authorized to do so.

[20] See https://www.centralbankbahamas.com/download/032474800.pdf for *'Central Bank's Guidelines for Supervised Financial Institutions on the Prevention of Money Laundering, Countering the Financing of Terrorism & Proliferation financing'*.

Tiered KYC Requirements for Sand Dollar Accounts			
	Description	**Threshold/Limit**	**Customer Due Diligence/KYC Requirements**
	3) No initial funding is required to open this account. 4) Evidence of basic customer information and ID verification are required. 5) Each digital account will be linked to physical devices such as payment cards (issued to applicants) and mobile phones. 6) Operation is valid only within The Bahamas.	*Limits may be adjusted on a case-by-case basis.	Wallet(s) must be linked to an active bank account.

A3. Market Research on Exuma

Introduction

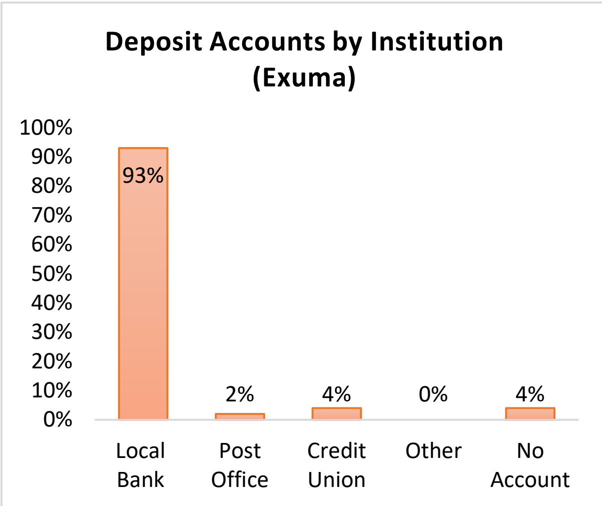
Following the March 1, 2019 selection of the preferred technology solutions provider for the digital currency project, the Central Bank started the groundwork for the launch of the Exuma Pilot, undertaking a baseline financial inclusion survey on the island. The survey attempted to assess the level of financial services available to residents relative to their needs; and to determine the willingness of residents to adopt digital payments via a mobile or online platforms. Overall, Exuma exhibits levels of financial access comparable to the national averages, with a high mobile phones usage rate. While there is openness to greater use of digital payments services, there are existing pockets of reticence, linked mostly to the convenience of access or security concerns of using digital financial services.

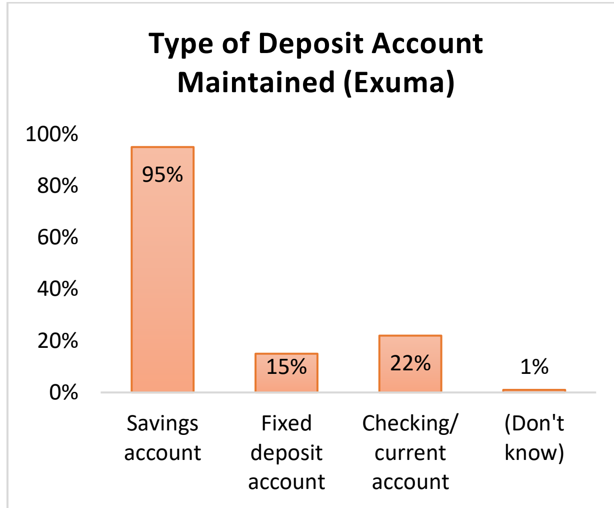
Methodology

The Exuma survey was administered randomly to 519 residents, via telephone and door-to-door interviews in July 2019. The sample results were then weighted to reflect the demographic distribution of the latest population census. Persons were polled on their access to banking/financial instruments, whether they have used a mobile device or internet service to perform transactions with a bank or credit union, as well as the likelihood of them using a mobile device to conduct various electronic transactions.

Access to Banking/Financial Institution

Respondents indicated a higher rate of usage of basic deposit facilities than the national average. Some 93% indicated that they operate a deposit account within a local bank, compared to the national average in the 80% range. Some 2% indicated that they held a deposit account with the local post office, while 4% stated that they have a deposit account with a credit union, and 4% informed that they did not own a deposit account.



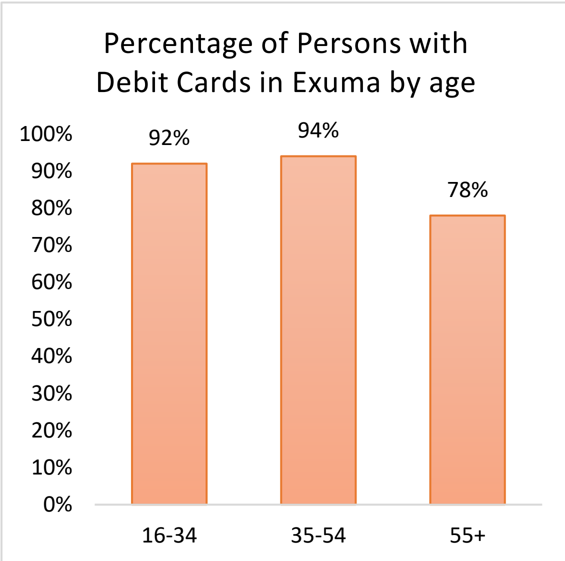


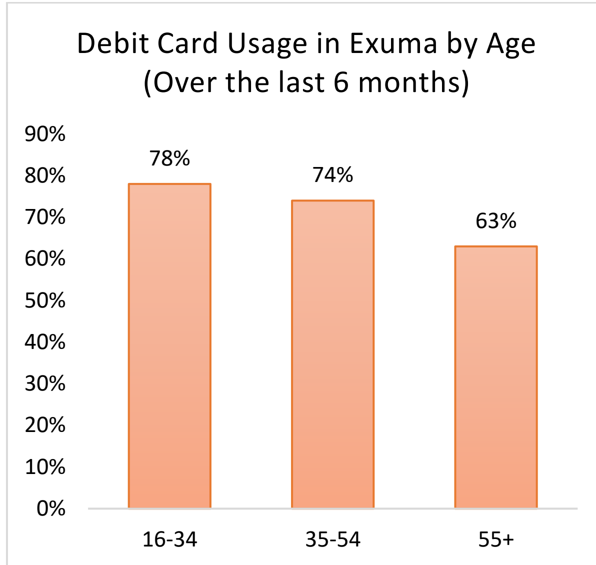
When asked what type of deposit accounts they maintained, 95% of persons disclosed that they had savings facilities, with a higher fraction of men (97%) than women (94%) indicating such. Further, an estimated 15% disclosed ownership of fixed deposits; and 22% maintained checking accounts.

On the method frequently used to access deposit accounts, the majority surveyed (92%) used a local bank branch on the island; some 4% of persons frequented the post office; and 3%utilized an on-island credit union branch. Only 10% of respondents stated that they used online banking to access their deposit accounts.

In an attempt to determine if residents' basic financial needs were being adequately addressed by banks, the survey queried individuals on the reason why any of them used web shop accounts. Half of the residents surveyed indicated that they did not own such accounts, with a higher rate for women (54%) than men (46%). Further, while 36% admitted that web shops were used strictly for gaming, some 9% of respondents disclosed that they used these accounts for both gaming and savings; and 3% strictly for storing their savings. The results showed that the greatest percentage (12%) of individuals who used web shop accounts for both gaming and savings were between 16-34 years.

As for debit card ownership, 90% of individuals answered in the affirmative. Queried on their use of these cards to make purchases within the last 6 months, 92% of the holders said yes, with the rate of usage highest among the 16 – 34-year-old category (97% of such responses), and the lowest for those 55 years of age and over (79%).





As to the means by which money was deposited into accounts, a majority (66%) of those surveyed received salary payments. Separately, cash and cheques were also disclosed as deposit instruments for 56% and 36% of personal accounts; while a small percentage (15%) indicated that monies were deposited from pension payments. About 15% of account holders disclosed that no funds were being deposited into their accounts.

On the withdrawal side, 80% of persons indicated that they use ATM facilities. Also 57% of persons disclosed that some withdrawals were done in-branch; some 11% wrote cheques, but only 13% used online banking.

For respondents that indicated that they did not have an account with a bank or a financial institution, 12% stated that the reason for such was that they did not trust financial institutions. A lesser fraction (5%) stated that services were located too far away, while 4% said that they did not wish to take up any services.

Mobile Device/Internet Banking

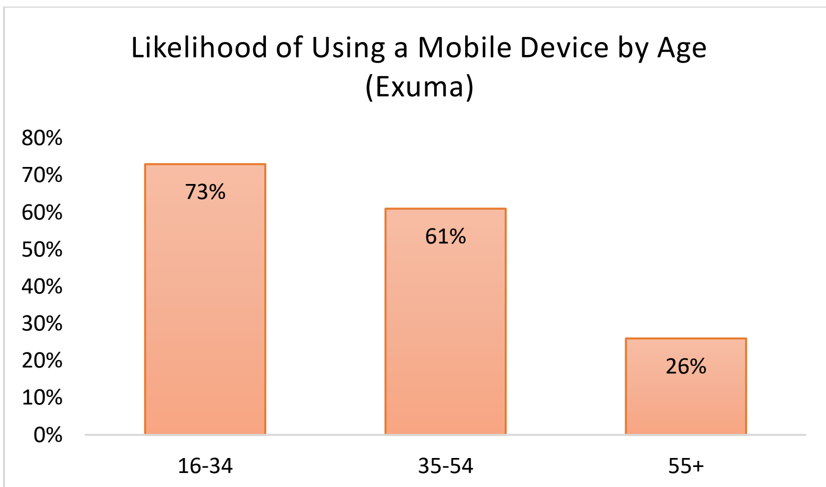
As an indication of the potential for a wider embrace of digital services, respondents were asked whether they owned a mobile device. The disclosed ownership rate was 96%. Half of the owners indicated that they did not use their mobile devices to perform any transactions during the last 6 months, while 40% used their devices to pay bills and 39% used them to make purchases. Transactions with a mobile device were mostly conducted by individuals between the ages of 16 and 34 years of age. In addition, the survey revealed that females use mobile devices more frequently to carry out transactions than males in all of the instances identified.

Respondents were also asked if they have used any other mobile phone or internet services other than banks and credit unions to carry out transactions. About 60% answered in the negative. An analysis by gender showed that this was the case for 61% of males and 59% of females. Only 30%

of persons stated that they used other mobile or internet services to make purchases; and 29% indicated that they used the devices to pay bills. Moreover, 27% of persons admitted using the devices to check their deposit balances, while 23% used them to send money.

Regarding the likelihood of individuals using their mobile devices to pay bills in the future, 37% of those surveyed were so inclined. Nearly half of the younger respondents (16 and 34 years of age) were in this category. Moreover 37% of respondents said that they would be very likely to make a future purchase on their mobile device.

Meanwhile, about 34% of respondents said they were very likely to receive mobile payments, whereas 26% indicated that it would be very unlikely. About 35% of residents indicated that they were very likely to make mobile payments, in contrast to 25% who indicated that they were very unlikely to do so.

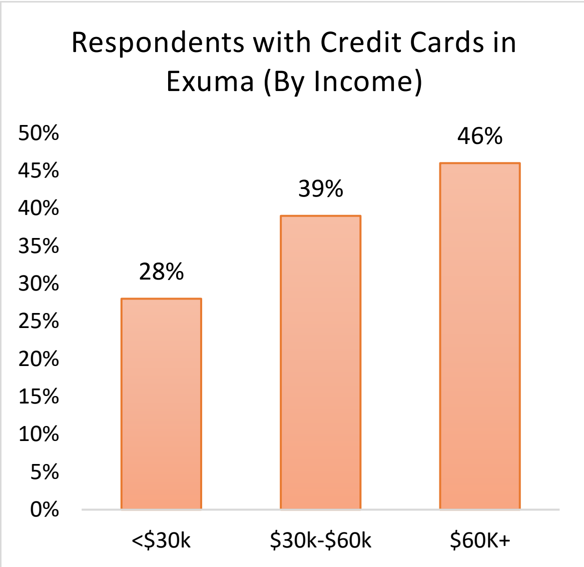


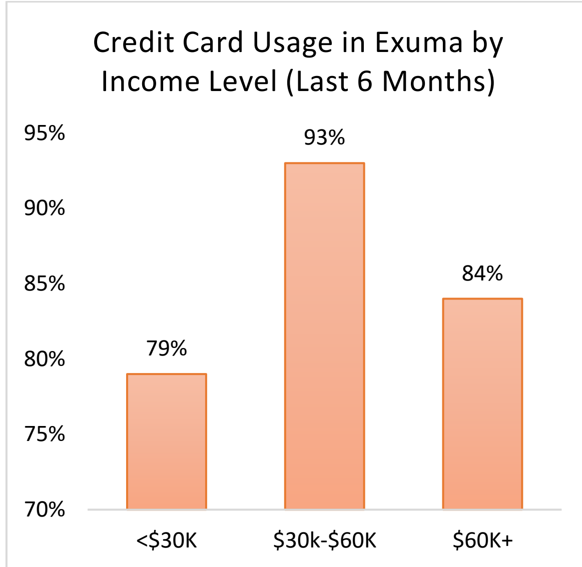
Credit

On access to credit facilities, the majority (75%) of Exumians surveyed indicated that they had no loans with any financial institution, while 23% responded positively. As to the admitted credit products in use, more than half (51%) of respondents identified credit card balances; 35% stated residential mortgages; and 30%, automobile loans.

Respondents were further queried on the type of credit or loan products they had used in the last 5 years. About two-thirds stated that they did not have any loans within that period; 21% indicated credit card usage; and 11%, automobile loans.

The respondents were also asked whether or not they possessed a credit card. This was confirmed for 34% of individuals. Asked if they had used their cards within the last six (6) months, the majority (86%) of card holders said “yes”, with more females (92%) than males (80%) indicating such.

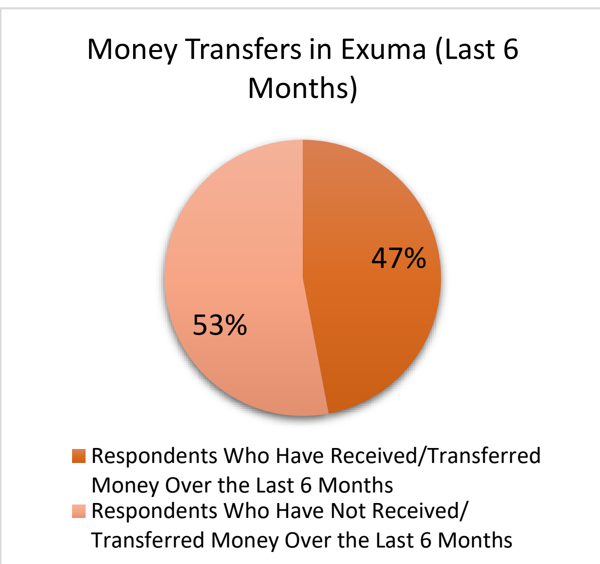


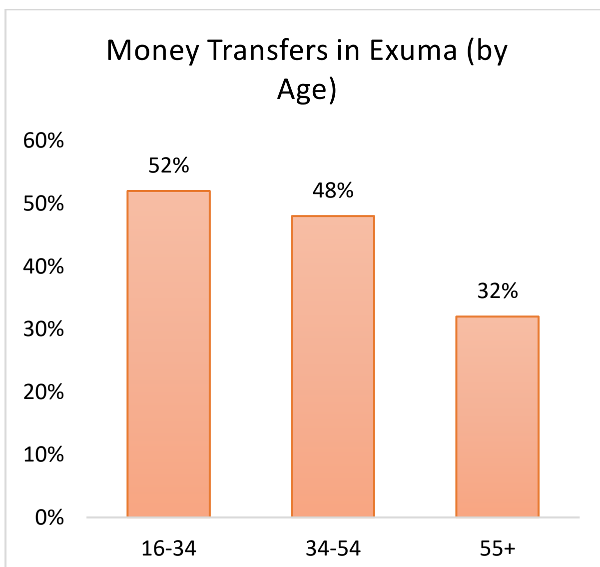


Payments

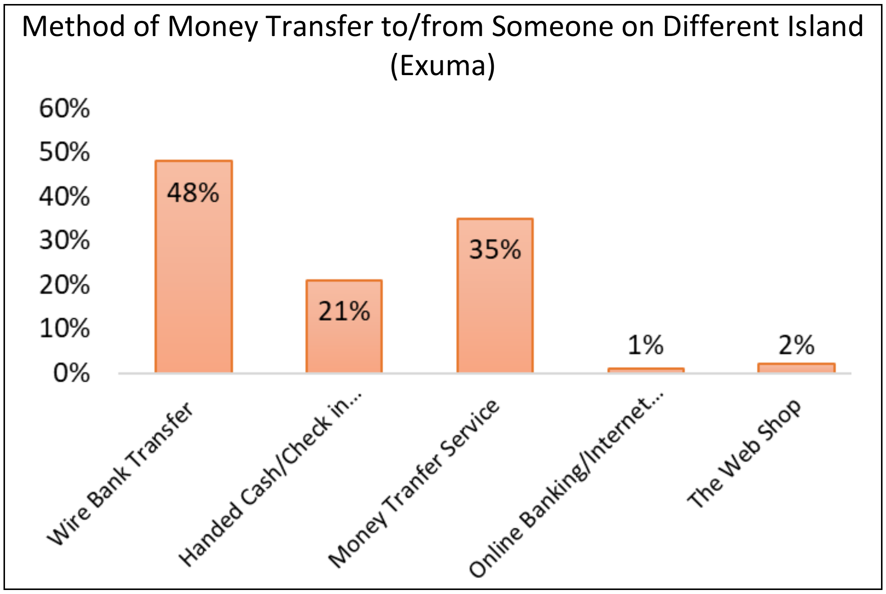
Various questions were used to gauge the respondents' payments behavior, touching on issues such as receiving and transferring funds, making utility bill payments; the forms of payment used; receipt of funds from employment and the method of payment encountered for salary disbursements.

About 47% of persons disclosed that they had either received or transferred money to another person.





In terms of preferences for the transfer or receipt of funds, respondents relied heavily on formal financial services channels. Nearly half of respondents (48%) used a bank; 35%, money transfer services; and nearly a quarter (21%), cash or cheques. Only about 2% of respondents admitted to using a web shop, while 1% used online banking/internet transfers.



Moreover, 82% of respondents noted that they paid utilities and other bills within the last six (6) months. Among them, persons between the ages of 35-54 years had the highest response rate (87%), followed by those over the age of 55 (81%), and then persons between 16-34 years of age (78%). Unlike the general transfer and receipt of payments, 60% of respondents settled bills in person via cash or cheque, while 41% used banks or formal financial institutions. Further, only 6% of persons disclosed using a money transfer service for bill payment, and only 1% of persons used online banking for this end.

In terms of receipt of wages, 80% of respondents confirmed receiving money from an employer in the form of salary or wages within the last six (6) months. Some 72% of residents received salary and wages via direct deposit to a bank/formal financial institution account. Nonetheless, some 32% of persons still received salary and wages via cash/cheque.

When asked about their willingness to use a mobile device to make or receive payments to conduct a number of activities, 56% of respondents stated that they were either likely or very likely to use a mobile device to pay a bill. Comparatively, 43% of respondents stated that they were either unlikely or very unlikely to use a mobile device to pay a bill. Among the respondents, females were more disposed than males to use mobile device to pay a bill. Age can in some cases be a determining factor for willingness to embrace technology, so much so that only 23% of persons over the age of 55 were at least likely to use a mobile device for bill payments, while 57% of them were very unlikely to do so.

When questioned on their likeliness to use a mobile device to make a purchase, 34% of respondents said that they were very likely to do so, while 28% said that they would be very unlikely. It was found that persons ages 16-34 years were very likely to use a mobile phone to make a purchase (43%), which compared to 34% of persons of ages 35-54 years.

Similar to the responses for making a purchase, 32% of respondents said they were very likely to receive a payment via mobile phone, while 28% said they were very unlikely to do so. In terms of gender, 29% of males and 28% of females noted that it would be very unlikely for them to receive a payment via mobile phone. Again, the highest percentage (39%) of residents more likely to receive a payment by mobile phone were in the 16-34 years of age group, this compared to 33% for those between the ages of 35 and 54 years.

With regard to sending money and checking account balances, 35% of respondents indicated that they were very likely to use a mobile phone for these transactions. Additionally, by gender, females were more likely than males to utilize a mobile device for sending money (36% versus 33%) and checking account balances (36% versus 34%). Residents in the highest-income bracket ($60,000+) were more likely to use a mobile phone to process payment transactions. When asked about any other payment transactions that they may conduct using a mobile device, 99% of respondents stated that they would not execute any payment transaction.

Conclusion

Overall, the Exuma survey reveals a high rate of access to mobile devices and a willingness of more than half of residents to undertake more payment on digital platforms. It is revealed also that more convenient access to financial services could induce more individuals to partake in traditional banking services. In addition, there exist opportunities to target consumer education around approaches to being safe in the cyber world of financial services. For Project Sand Dollar, public awareness around security within the digital currency infrastructure will also have to be heavily emphasised.

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Macroeconomic Policy Institute

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THE DIGITAL EURO AND CENTRAL BANK DIGITAL CURRENCIES: BEWARE OF TAKING-OFF TOO EARLY

Peter Bofinger[1]

ABSTRACT

The paper discusses central digital currencies (CBDCs) with an analytical focus on the European Central Bank's Digital Euro (D€) project, which provides a unique lens for assessing the potential and challenges of CBDCs. The paper differs from the literature on CBDCs and the D€ by adopting a systemic perspective that distinguishes between the role of CBDCs as a new payment object and as a new payment system based on CBDC accounts. In a worst-case scenario, the D€ project could be a total flop, with people not opening accounts and the system failing to compete with existing platforms. This would be in line with the dismal experience of countries that have already introduced CBDCs. In a more positive scenario, many households would open D€ accounts alongside commercial bank accounts, potentially reducing the dominance of US platforms. However, even in this scenario, it is unlikely that there will be significant holdings of D€ deposits as a means of payment, making the D€ payment system an inefficient and costly detour between existing commercial bank accounts. The offline version remains difficult to justify. Our CBDC tracker shows that the ECB's strong commitment to the D€ is unique among central banks in advanced economies. Many of them, including the Federal Reserve, currently rule out the option of a retail CBDC. Thus, the ECB's unconditional commitment to the D€ carries a high risk of failure. It is therefore unclear why the ECB is not considering a scheme based on the existing SEPA infrastructures.

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The Digital Euro and Central Bank Digital Currencies:

Beware of Taking-Off Too Early

August 2024

Research Project for the Hans-Böckler-Stiftung

Professor Dr. Peter Bofinger

Julius-Maximilians-Universität Würzburg

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The Digital Euro and Central Bank Digital Currencies: Beware of Taking-Off Too Early

Executive Summary

Central Bank Digital Currencies (CBDC) have become a focal point for central banks worldwide: The Bank for International Settlements (BIS) recent survey (2024) shows that 94% of 86 responding central banks were engaged in CBDC work by the end of 2023.

The paper discusses the CBDC with an analytical focus on the European Central Bank's (ECB) Digital Euro (D€) project. It offers a unique lens for assessing the potential and challenges of CBDC in an advanced currency area. The paper also provides anecdotical evidence on CBDC projects that have already been implemented. In addition, based on statements of central banks in advanced economies and other major central banks, the paper surveys the current state of discussion on CBDC.

The paper differs from the literature on CBDC and the D€ by taking a **systemic perspective**, which consequently differs between the role of CBDC as a new payment object and as a payment system based on CBDC accounts.

The ECB's motivations for the D€ include macroeconomic and microeconomic considerations. The **macroeconomic justification** of a retail D€ as a “monetary anchor” is questionable as long as there is sufficient for central bank money by commercial banks. This also applies to argument that private "digital currency areas" might displace established monetary units by private currency units. So far, there is no evidence of such developments in the retail space. Thus, from a macroeconomic perspective there is no need of the D€ as a payment object.

Microeconomic considerations do not indicate a demand for holding D€ as a **payment object**. As far as the **online version** of the D€ is concerned, there are no benefits for private households holding D€ [i]as a payment object. The legal difference between central bank deposits and commercial bank deposits is irrelevant for small deposit holdings. Moreover, holding D€ deposits in parallel with commercial bank deposits increases the risk of negative balances for low-income households which involves high overdraft interest rates. In particular, due to the “waterfall fall” functionalities of the D€ scheme, the D€ payment system can be used with zero D€ holdings. The **offline version** of the D€ is in many cases inferior to holding cash. Consumer surveys indicate only very limited use cases.

The proposed **D€ payment system increase the number of payment transactions by a factor of two to three.** This is due to the coexistence of commercial bank accounts and D€ accounts which requires two separate settlements schemes (TARGET2 and N€XT). The need to open specific bank accounts for the use of D€, in contrast to credit card schemes

and PayPal, may **hinder widespread public acceptance**. In addition, as commercial banks have to open and manage D€ accounts free of charge, they are unlikely to promote D€ accounts. So far it is unclear which institution might operate run the D€ payment system, i.e. the **network through which information flows between payers and payees** are sent. If the ECB were to take on this role, it could stifle innovation and competitiveness vis-à-vis private providers. **Implementation problems with the offline version** could prevent smartphone payments, which would require not very user-friendly payment cards.

Given these complexities, it is surprising that the ECB does not even mention the alternative approach of **creating a pan-European payment system based on existing infrastructures**. A natural candidate is the **SEPA Instant Payment System**, as the ECB explicitly acknowledged 2019. As the European Payments Initiative argues, the D€ scheme does not offer any new value compared to SEPA Instant Payments. This approach could achieve the ECB's objectives, as supported by the Banque de France's endorsement of an EPI-payment solution for European payment market sovereignty.

In a **worst-case scenario**, the D€ infrastructure could see limited adoption, with people not opening accounts and the scheme failing to compete with existing platforms. As our **survey of existing CBDC schemes** shows, this would in line with the consistently poor experiences of countries that have already introduced CBDCs.

In a **more positive scenario,** the D€ payment scheme will reach a wide acceptance, with a high number parallel D€ accounts alongside commercial bank accounts potentially reducing the dominance of US payment platforms. However, even in this scenario, significant holdings D€ deposits are unlikely, making the D€ scheme an inefficient and costly detour between existing commercial bank accounts. The offline version remains hard to justify.

Our "**CBDC tracker**", based on statements of central banks in advanced economies and of some other major central banks, shows that the ECB's absolute commitment to its D€ project is unparalleled. Many central banks, including the Federal Reserve, currently explicitly ruling out the option of a retail CBDC.

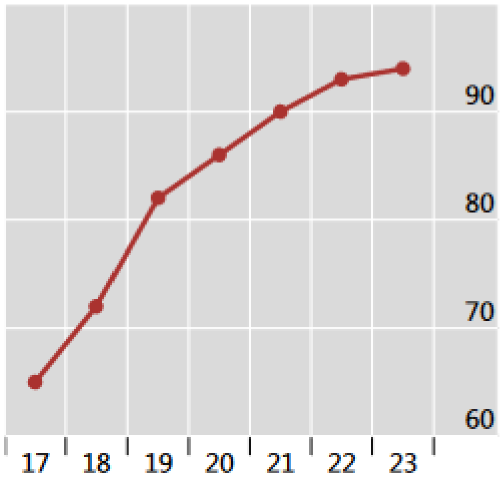
In conclusion, the perception of a widespread retail CBDC launch off is misleading. The ECB has embarked on a dangerous adventure with high costs for the taxpayer and high risks for its reputation. Therefore, central banks considering implementing CBDC should carefully scrutinize the D€ project.

1 Introduction

As the recent BIS survey on CBDC (BIS 2024) shows, more and more central banks are working on CBDC. From a sample of 86 responding central banks, at the end of 2023, 94% were engaged in CBDC work (Chart 1). According to the CBDC Tracker provided by the Atlantic Council, in May 2024 134 countries and currency unions, representing 98% of global GDP, are currently exploring a CBDC. In May 2020 that number was only 35 (Atlantic Council 2024).[1]

Chart 1: Share of central banks working on CBDC

as a percentage of respondents



Source: BIS (2024)

The view that CBDC is becoming an indispensable element of a national monetary system in same way as cash is also supported by the strong efforts of the European Central Bank (ECB) to launch a **Digital euro** (D€). After an investigation phase (November 2021-October 2023), the ECB is now in a preparation phase (November 2023-October 2025) after which a phase of "potential development and rollout" which is scheduled. While the ECB is a frontrunner in the group of advanced economies, **China** and **India** have already implemented CBDC schemes in their countries.

In this paper, we want to take a closer look at the discussions on CBDC, especially in advanced economies and major emerging market economies. In most central bank reports and speeches of central bank representatives, a more nuanced view can be found that differs from the ECB's enthusiastic commitment to CBDC. In any case, the experience of those countries that have already introduced CBDC suggests a cautious assessment of the necessity and prospects of success of CBDC.

[1] https://www.atlanticcouncil.org/cbdctracker/

The ECB's **D€ project** provides a particularly good basis for assessing the prospects of CBDC. It is already relatively well developed and therefore makes it possible to identify the problems that could arise with such a fundamental reorganization of a country's or a currency area's monetary order. We will therefore present and discuss the Digital euro in detail below. While the D€ has been discussed in earlier papers (Bofinger and Haas 2023b), new ECB publications, notably "Update on the work of the digital euro scheme's Rulebook Development Group" (ECB 2024a), "Progress on the preparation phase of a digital euro: First progress report" (ECB 2024b) and a "Stocktake on the digital euro" (ECB 2023b) allow a more specific analysis of the D€ project.

In **section 2**, we present a **systemic approach on CBDC**. It is characterized by the insight that there is no such thing as a "CBDC" or a "Digital euro". For an analysis of payment systems, it is necessary to differentiate between payment objects, payment instruments and payment schemes. We will see that the prospects for CBDC vary depending on the individual constituent elements.

In **section 3**, we present and discuss the ECB's D€ project. We show that the **motivations of the ECB for introducing the D€** are based on macroeconomic and microeconomic considerations.

D€ as a payment object

In section 3.2 we first analyze the justification for the D€ as **a new payment object**. We show that there is no need for a retail D€ as a **monetary anchor**, as long as there is sufficient demand from commercial banks for central bank money. We also question the concept of "**digital currency areas**" as a justification for the D€. So far, there is no evidence that digital retail payment platforms plan the introduction of "private currencies". In summary, we do not see macroeconomic issues that call for the introduction of D€ as a payment object.

From a **microeconomic perspective**, it is difficult to see why private households should hold D€ deposits (**online version of the D€**). The difference between a central bank deposit and a commercial bank deposit, or central bank money and private money, is irrelevant for small deposit holdings. However, for low-income households, holding D€ deposits increases the risk of a negative balance in the commercial bank account, which is very costly. Due to the waterfall functionalities, it is not necessary to have a positive D€ balance to use the D€ payment system.

As for the **offline version**, which requires a positive D€ balance in a wallet, the question is what advantages it can offer over using cash. Consumer surveys confirm our finding that there is no obvious use case for this version of the D€.

D€ as a payment scheme

In section 3.3 we analyze the **rationale of a payment system based on D€ accounts.** We show that the scheme envisaged by the ECB leads to a doubling or tripling of settlement transactions due to the parallel scheme of bank accounts and settlement schemes (TARGET and N€XT).

The need to open specific accounts for the use of the scheme, which is not required for credit card schemes and PayPal, might negatively affect the **acceptance of a D€ payment scheme**. This is particularly challenging as the creation of new markets requires "**dyadic alliances**" between the main players, i.e., commercial banks and the central bank. In the case of commercial banks, it is not very plausible that they would actively promote the opening of D€ accounts. The insight that it might be difficult to convince people to a D€ has led central bankers to think of enforcing D€ accounts by making public payments to such accounts only.

The blueprints for the D€ payment system indicate a **dominant role for the ECB** in a D€ payment scheme. This could have negative effects on the innovation activity of a European payment scheme and impair its competitiveness vis-à-vis the dominant private payment schemes.

Finally, the payment system based on the offline version faces serious implementation problems. They could prevent the use of smartphones as payment instruments requiring payment cards which are not very user-friendly.

In **section 4,** we briefly present an alternative approach to creating a pan-European payment system that is independent of US payment platforms. Surprisingly, the ECB has already floated the concept of using the SEPA instant payment system as the basis for such a system in 2019 under the heading "**SEPA for cards**". The European Payments Initiative points out that the € does not offer any new added value compared to SEPA instant payments. That such an approach could also reach the objectives that the ECB is trying to reach is indirectly confirmed by the Vice-Governor of the Banque de France, who argued that an EPI-payment solution "will help strengthen the sovereignty of the European payment market by providing an alternative to using foreign schemes such as Mastercard and Visa".

In **section 5**, we present two scenarios for the D€. In a **worst-case scenario**, the entire infrastructure would not be actively used by the population. People would not open accounts and the scheme would not be able to withstand the competition with existing platforms. This would be in line with the experience of those countries that have already implemented CDBCs.

In a **positive scenario**, the D€ payment scheme would be designed attractively enough to be used by the population which is willing to open D€ accounts in parallel to their commercial banks. In such a scenario, it might even be possible to reduce the dominance of US payment platforms. However, even in such positive scenario it is not likely that the D€ would be used as a payment object, i.e., that people would hold significant deposits on their D€ accounts. As a result, the D€ payment scheme would turn out as an inefficient and very expensive way of linking existing commercial bank accounts. Even in a positive scenario, it is difficult to imagine a use case for the offline version.

In **section 6**, we present a summary of our own **CBDC tracker**, which is based on 22 central bank statements in major OECD countries and other important countries. There is no other central bank that is as strongly committed to the introduction of a CBDC as the ECB. Some central banks explicitly rule out the option of a retail CBDC for the time being. This applies above all for the Federal Reserve.

In this section, we also provide anecdotical **evidence for countries that have already introduced CBDC**. As there is no official information on the progress of these projects on central bank websites, we have to rely on newspaper reports. They all indicate that it is very difficult for CBDC projects to gain significant acceptance as a payments object and a payment scheme.

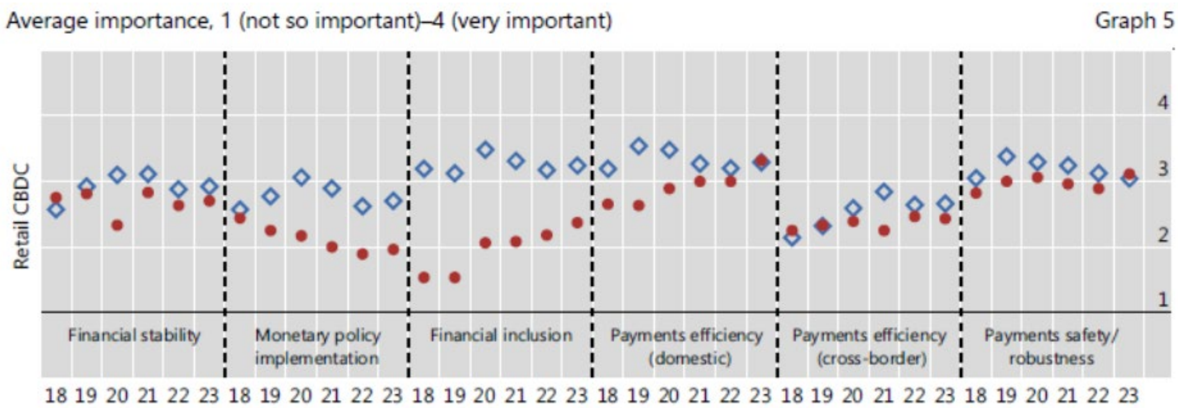
In summary, we conclude that the impression of a widespread take-off of retail CBDCs is misleading. There is no clear consensus about the use case of CBDC as payment object or a payment scheme. With its unconditional commitment to the D€, the ECB is an outlier among central banks in advanced countries. This implies a high risk of failure for the ECB's project. The ECB should therefore prepare for the failure of its project and consider how to deal with it in a way that limits the damage to its reputation.

2 What is CBDC?

The BIS survey (BIS 2024) shows that for central banks in advanced countries "**payments efficiency**" is the most important motivation for issuing a retail CBDC.

Chart 2: Motivations for issuing a retail CBDC

red dots: Advanced economies; blue squares: emerging market and developing economies



Source: BIS (2024)

For an analysis of the potential and the implications of CDBC, it is therefore necessary to have a clear understanding of the constituent elements of a **payment system**. The BIS

Committee on Payments and Market Infrastructures (CPMI) defines a payment system as follows:

“A set of instruments, procedures, and rules for the transfer of funds between or among participants; the system includes the participants and the entity operating the arrangement.”[2]

From this, three key elements of a **payment system** can be defined:

Payment objects (“funds”) are the basis for making payments: cash or deposits held with commercial banks. They are identical to **money** in the definition of M1.

Payment instruments are the technical devices for initiating payment transactions: They include banknotes and coins, cards, cheques, smartphones, personal computers and QR-codes.

Payment schemes are infrastructures for the information and payment flows between the payer and the payee. Examples include SEPA for banking transactions, PayPal and credit card systems for retail and online transactions and Target for the settlement of payments.[3]

The discussion of CBDC suffers from the fact that there is **no consequent differentiation between these core concepts**. This confusion can be related to the fact that CBDC is often regarded as a **digital form of cash**, and that for cash such a differentiation is not required. In the words of the Banque de France (2018):

“This confusion stems from our day-to-day use of fiduciary money, i.e. banknotes and coins, which are both money (a store of value, unit of account and medium of exchange for commercial transactions) and payment instruments (used to transfer value). This is not the case for any other payment instrument.”

In other words, cash is simultaneously a payment object, a payment instrument and a peer-to-peer payment scheme. However, it is important to note that this identity does not apply to **digital payments systems**. For example, when a payment is made with a credit card,

the **payment object** is a deposit in the bank account to which the credit card is linked,

the **payment instrument** is the credit card in physical form, or in electronic form if embedded in a smartphone,

the **payment scheme** is operated by the credit card company.

[2] https://www.bis.org/cpmi/publ/d00b.htm?selection=49

[3] The ECB (2021) describes **payment schemes** as follows: “A scheme is a set of formal, standardised and common rules enabling the transfer of value between end users by means of electronic payment instruments. It is managed by a governance body. The scheme rules describe the procedures and functions which enable payers and payees to use or accept electronic payment instruments.” https://www.ecb.europa.eu/paym/pol/instr/html/index.en.html

The Banque de France (2018) also addresses a related confusion concerning the term "**means of payment**":

"As regards 'means of payment' and 'payment instrument', the difference here relates to the use of terminology. 'means of payment' is commonly used as a broad term covering both payment instruments (banknotes and coins, cards, cheques, credit transfers, direct debits and so on) and money (fiduciary money or scriptural money, i.e. bank account balances), without distinguishing between the two."

Thus, in this paper, following the terminology of the Banque de France, we will avoid the ambiguous term "means of payment" and instead use unequivocal terms "payments object" and "payments instrument."

Based on this systemic perspective, CBDCs can be regarded as a new payment object (money) and/or a new payments scheme. While CBDCs are often also referred to as a "payment instruments", this expression does not match the classification made here. A CBDC scheme requires **technical devices** as payment instruments, such as credit cards or smartphones that can be used as wallets.

2.1 CBDC as a payment object

The object nature of CBDC is obvious, as it is designed as a digital asset which is a liability on the central bank balance sheet. In this paper, we will only address the so-called **retail CBDCs** which are accessible above all to private households. There is also an intensive discussion on **wholesale CBDCs**, which are designed for the used above all by financial institutions.[4]

Retail CBDCs can be regarded as a digital substitute for cash ("digital cash") or as a substitute for traditional commercial bank deposits ("central bank money for non-banks").

Table 1: Classification of payment objects

	Physical	**Digital**
Central Bank	Cash	CBDC
Commercial Banks		Bank Deposits

Due to this hybrid nature, CBDC fundamentally changes the traditional **division of labor between the central bank and commercial banks**. So far, central banks offer the physical payment object, while commercial banks produce the digital payment object. Thus, with CBDC as a digital payment object, central banks enter into competition with commercial banks. According to standard economic theory, such an intrusion of the government into the sphere of the market requires the identification of a **market failure** that needs to be repaired by government intervention.

[4] For a more detailed discussion of the differences between wholesale and retail CBDC see Panetta (2022b).

2.2 CBDC as a payment scheme

So far, there is also clear division of labor in the provision of retail payments infrastructures. The **physical payment** scheme is based on cash, and it is provided by central banks. **Digital payment schemes** are characterized by a coexistence of private infrastructures with an infrastructure provided by the central bank.

- In Europe, the network for **information flows** authorizing and initiating payments between payer and payee is provided above all by **SEPA** (Single Euro Payments Area). It is managed by the European Payment Council (EPC), an international not-for-profit association formed of 77 members who are payment service providers (PSP) or associations of PSPs. PayPal, national payment schemes (e.g. Bizum in Spain) and credit card companies are other providers of payment schemes.
- The network organizing the **flow of funds** from the payer's account to the payee's account ("settlement") is provided by central bank operated systems, like TARGET2 in the euro area.[5]

Table 2: Classification of digital payment schemes

	Private	**Central Bank**
Infrastructure for the flow of information between payee and payer	SEPA, credit card companies, PayPal	"CBDC"
Infrastructure for the flow of funds between payee and payer		TARGET2

The hybrid nature of CBDC also changes this division of labor. With CBDC as a form of **digital cash**, central banks provide a digital payment infrastructure that competes with private payment service providers. Viewing CBDC as an **alternative to bank deposits** does not necessarily raise the issue of new payment network. CBDC deposits could easily be integrated into the existing private payment infrastructures. However, as we will see, especially in the case of the Digital euro, some central banks have the ambition to develop a completely new payment network which competes with private payment schemes.

Again, the extension of the central bank activities into an area previously operated by private institutions raises the question of a **market failure** that justifies a government

[5] The Berlin Group (2024) differentiates in this context between "clearing" and "settlement". "Clearing is performed in order to transmit the transaction data needed to validate the transaction between the card acceptor, the cardholder and their respective institutions within the card payment scheme, the acquirer and the card issuer. Settlement is performed between the banks of the card issuer and the acquirer in order to finally debit the cardholder's bank bank. account and to credit the card acceptor's account at the acquiring Normally it takes place between zero and two days after the clearing."

intervention. And even if this is the case, one must ask whether a CBDC is the only solution for such a problem.

2.3 A systemic approach

A systemic perspective provides a conceptual framework for the analysis of CBDC. It requires that the rationale (or the uses cases) of CBDC must be discussed separately for

- CBDC as a new payment object,
- CBDC as a new payment scheme based on CBDC as a payment object.

Finally, it also leads to the question of whether there are alternative payment schemes for achieving the goals that are expected from a CBDC scheme based on CBDC as a payment object. The various options are presented in table 3.

Table 3: Classification of CBDC solutions

<table>
<tr><th colspan="2" rowspan="2"></th><th colspan="2">New payment object (means of payment)</th></tr>
<tr><th>No</th><th>Yes</th></tr>
<tr><td rowspan="2">New payment scheme</td><td>No</td><td>Status quo</td><td>CBDC payments object integrated in existing payment solutions</td></tr>
<tr><td>Yes</td><td>New payment scheme (without CBDC) orchestrated by central banks</td><td>CBDC as payment object and payment scheme</td></tr>
</table>

3 The Digital Euro: A Frontrunner in the CBDC Run

Among the advanced economies, the European Central Bank has made the most progress in the analysis and the concrete preparation of a CBDC. We will therefore discuss the Digital euro in detail, as it helps to identify and to analyze the core features and challenges of a comprehensive CBDC project.

3.1 What are the objectives of the ECB's project?

The ECB provides a comprehensive description of the D€ benefits in its "opinion on a proposal for a regulation on the establishment of the digital euro". (ECB 2023). In this paper the ECB presents the "**'monetary anchor' role of central bank money**" as the main motivation for introducing the D€:

"To preserve the singleness of the euro and the effectiveness of monetary policy, and thus to enable the ECB to achieve its primary objective of maintaining price stability, the euro needs to continue to fulfil all functions of money as a unit of account, means of exchange and store of value. Making central bank money available to the public not just in physical form, through cash, but also in digital form, will allow central bank money to continue to play its role as a monetary anchor and as an efficient means of payment, in a context where people increasingly choose to pay electronically, rather than in cash. Thus, the Digital euro will contribute to underpinning the stability of the monetary and payment system and to preserving the integrity of the euro in all its forms. This, in turn, is a precondition for the continued effectiveness of the ECB's monetary policy, which is aimed at preserving price stability."

Thus, for the ECB, the main rationale for the D€ seems to be of a **macroeconomic nature**. From the statement it is obvious, that in this context, the ECB regards the D€ as a form of money, i.e., as a **payment object**.

The **microeconomic dimension** of having a "**universally accepted digital means of payment**" is listed in second place:

"Making central bank money available in digital form for retail transactions would also have broader benefits, in particular by offering a universally accepted digital means of payment that can be used throughout the euro area for payments in shops, online and from person to person."

The term "means of payment" leaves open, whether the ECB has in mind a **payment object or a payment instrument**. This distinction is irrelevant for cash, but it is important for digital payments: For a vendor, it does not matter where the customer's bank is located and in what currency the account is held. What matters is that the customer uses a credit card as a payment instrument that the vendor is familiar with.

In third place, the D€ is presented as a **payment scheme**, i.e., a "**pan-European platform"**:

"Furthermore, the digital euro would safeguard the strategic autonomy of the Union's payment ecosystem, while supporting competition and innovation in payments to the benefit of consumers and merchants alike. The digital euro would facilitate the development of payment solutions subject to European governance arrangements and provide a pan-European platform on which innovative services can be built."

Thus, the "opinion" shows that the ECB regards the D€ in a broad sense, encompassing it as a payments object and a payment system. So far, the ECB has far paid little attention to the need for a "universally accepted" payment instrument in its D€ concept.

3.2 The D€ as a payment object

The ECB plans to issue the D€ in two different forms. In the **online version**, private households open a D€ bank account in parallel to their existing bank account. These accounts must be opened and managed by commercial banks free of charge. The deposit on the D€-bank account is a liability of the ECB. In the **offline version**, households can hold the

D€ on a smartphone wallet. Like cash, D€ is created by withdrawing from a D€ bank account or from an ATM.

The ECB plans **holding limits** for both forms of D€ holdings. For the online version the holding limit is not yet defined, but it seems that it will not exceed 3.000 euro.[6] Due to anti-money laundering and combating the financing of terrorism (AML/CFT) policies the holding limits for offline D€ will be much smaller. It might also be necessary to set limits for the number and the amount of transactions. Thus, the ECB wants to restrict the holding of D€ to the monetary function of a **means of payment** by discouraging its use **a store of value**.

The holding limits for D€ accounts and the lack of an overdraft facility require a so-called **waterfall- and reverse-waterfall functionality** for the D€:

- "**Waterfall**": If a D€ account is credited by an amount that exceeds the holding limit, the excess amount is automatically transferred to the payee's commercial bank account.
- "**Reverse Waterfall**: If a payment from a D€ account exceeds the deposit on that account, the difference is automatically provided by a transfer from the payer's commercial bank account to his D€ account.

An analysis of the **object function** raises two interrelated questions:

- How can the D€ contribute to the "monetary anchor role" that the ECB emphasizes?
- What is the use case for private households to hold D€ online or offline for making payments?

3.2.1 The macroeconomic perspective: Is there a need for a "monetary anchor"

While the BIS survey (BIS 2024) shows that for central banks in advanced economies the monetary policy implications of CBDC are not the main motivation (Chart 2), the monetary anchor plays a dominant role in the ECB's argumentation for the D€. Former member of the ECB executive board, Fabio Panetta (2022a), explains the role of the monetary anchor as follows:

"(...) even digital payments will ultimately depend on the anchoring role of public money to function smoothly. Confidence that 'one euro is one euro' whatever form it takes rests on our ability to convert, at par, private money – such as funds held in bank deposits or digital wallets – into public money, which is the safest form of money available. This

[6] A recent Bundesbank research indicates that the optimal amount could be in the range of 1,500 to 2,500 Digital euro per person. See Bidder, R. et al. (2024), CBDC and banks: Disintermediating fast and slow, Deutsche Bundesbank Discussion Paper No 15/2024.

possibility of conversion reinforces confidence in the various forms of private money used for euro payments, ensuring the smooth functioning of the payment system."[7]

In Bofinger and Haas (2023a), we have argued that the ability to exchange deposits from a commercial bank account into a D€ account in fact contributes to the convertibility of private money, which is particularly valuable in a crisis. Thus, a valid argument can be made that the ability to hold D€ deposits could increase the confidence in private money. But the **institutional design of the D€** as envisaged by the ECB, is not compatible with an such an anchor role:

- Making a strong case for the convertibility of commercial bank money into central bank money is not compatible with rather low **holding limits.**
- The ECB does not plan to allow D€ deposits for the **corporate sector**.
- The demand for central bank deposits in times of instability would not be a demand for the D€ as a means of payment, but as a **store of value**.

Low holding limits for D€ deposits also question the ECB's argument that the D€ "is a precondition for the continued effectiveness of the ECB's monetary policy, which is aimed at preserving price stability". Moreover, it can be shown that for an effective central bank control over the process of credit and money creation, it is sufficient that **commercial banks** have a stable demand for central bank money (Bofinger and Haas 2023a).[8] With the instrument of minimum reserves, the central bank can always generate a sufficient demand for bank reserves.

In sum the arguments of the ECB for the monetary anchor role, which it so far has not presented in a comprehensive theoretical analysis, are not very convincing.

This also applies to the argument that the D€ is required to maintain the **convertibility into cash** (Brunnermeier, 2024)[9] in an environment where the use of cash is declining in retail payments. The solution to this problem is not the issuance of a D€ but maintaining an adequate cash infrastructure by the ECB. In fact, the ECB promises in its "Eurosystem cash strategy" that cash will remain "widely available":

> "The ECB and the national central banks of the euro area are committed to making sure that cash remains widely available and accepted. We therefore welcome the European Commission's proposal for a new EU Regulation to strengthen the legal tender status

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[7] https://eaccny.com/news/chapternews/ecb-speech-fabio-panetta-public-money-for-the-digital-era-towards-a-digital-euro/

[8] https://www.suerf.org/publications/suerf-policy-notes-and-briefs/the-digital-euro-cbdc-as-a-monetary-anchor-of-the-financial-system/

[9] „Traditionell ist die Verankerung des Euros im Bankensystem so gestaltet, dass die Konvertibilität zum Bargeld das Entscheidende ist. Wenn ich ein Bankkonto habe, dann kann ich das Guthaben in Bargeld umwandeln. Wenn die Bedeutung des Bargelds zurückgeht, dann geht diese Verankerung verloren.“

of euro cash. The proposal aims to ensure that access to and acceptance of euro banknotes and coins is legally guaranteed throughout the euro area."[10]

Box: The flawed concept of "digital currency areas"

The announcement of Facebook to create a payments system with a new currency (Libra)[11] was an important trigger for the engagement of many central banks in the field of Central Bank Digital Currencies. Central bankers feared that private currencies might outcompete public currencies. Brunnermeier et al. (2019) supported this view by propagating the concept of "**digital currency areas**":

„The most important consequence of a system based on digital platforms may be that agents begin to write contracts in a unit of account specific to a platform rather than the central bank's unit of account. A change in the unit of account convention may become more likely with a large technological change that eliminates the use of cash and shifts economic activity towards platforms with their own units of account." [12]

The **failure of** the Libra concept shows that the risk of private monies crowding out public monies is not very high. First, even the Libra currency was not originally designed as a private currency, but as a currency basket made up of public monies. Second, this design was soon abandoned in favor of a concept of stablecoin Libras based on national currencies (Dollar-Libra, Euro-Libra, Yen-Libra, etc.). But this did not save the project.

The main problem with creating private currencies or units of account is that currencies are like **languages** that are deeply enshrined in the minds of people. Therefore, it requires high inflation episodes for people to switch to foreign currencies.

Another major flaw of Libra was its design, which required a positive balance on a Libra account in order to make payments. As the PayPal scheme shows, a successful payment scheme simply taps into existing accounts.

Thus, at least for the time being, the risk of private currencies gaining a dominant position that would threaten the unit of account role of the existing currencies and thus the business of central banks, cannot be regarded as a justification for introducing a D€.[13]

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[10] https://www.ecb.europa.eu/euro/cash_strategy/html/index.en.html
[11] https://whitepaper.io/document/475/libra-1-whitepaper
[12] Brunnermeier, M. K., James, H., und Landau, J.-P. (2019). The Digitalization of Money. NBER Working Paper Series, No. 26300.
[13] Brunnermeier (2024) still believes in his concept: „Durch die Digitalisierung besteht die Gefahr, dass viele private Gelder entstehen werden, mit denen man Transaktionen durchführen kann, die nicht notwendigerweise an den Euro gekoppelt sind. Diese können an andere Währungen gekoppelt sein, sie können aber auch eigenständig existieren. Der Vorteil des digitalen Euro ist, dass man die Koppelung an den Anker des Euros weiter behält und diese Gefahr für die Einheit der Währung abwendet.“ Wortprotokoll der 81. Sitzung Finanzausschuss Berlin, den 19. Februar 2024

3.2.2 The microeconomic perspective: Why should private households have a demand for holding D€ as a payment object?

The macroeconomic rationale of the D€ can also be assessed from a microeconomic perspective. For the D€ to be an effective monetary anchor, there would have to be sufficient demand for holding D€ as a payment object. As table 1 shows, the holding of D€ can either be regarded as a substitute for holding deposits on a traditional bank account or for holding cash in a physical wallet.

Online use of the D€

The main difference between of a deposit in a D€ account and a commercial bank account is the fact that the commercial bank deposit implies only the right to convert it into central bank money while the D€ deposit is central bank money. In its publicity campaigns for the D€, the ECB argues with the safety of the D€:

"A euro will always be a euro. One digital euro would always be worth exactly the same as a €1 coin."[14]

But in practical life this differentiation is of little relevance due to the deposit insurance schemes which protect bank deposits in the EU to up to 100.000 euro. It would be a dangerous strategy it the ECB tried to sell the D€ with argument that bank deposits are not 100% safe.

One might think that, at least in the introductory phase, the demand for CBDC deposits could be increased by paying attractive interest rates. However, this is excluded by Article 16 ("Limits to the use of the digital euro as a store of value") of the Proposal for a Regulation of the European Parliament and of the Council:

"Within the framework of this Regulation, the digital euro shall not bear interest."

While there are no obvious benefits of holding deposits in D€ accounts, one can argue that this could lead to higher banking cost, especially for people with low incomes. A **parallel holding of deposits** on the commercial bank and the D€ account increases the risk of an overdraft of the commercial bank account which is very costly. In addition, as the D€ account does not provide an overdraft facility, the commercial bank account will always remain the dominant account.

One might think that the ability to use the D€ payment scheme might be an incentive to hold deposits on the D€ account. But due to the waterfall functionalities, the D€ payment scheme can be used while always keeping a zero balance on the D€ account.

Therefore, from an **information and transaction costs** perspective, the best solution for households is to maintain a zero balance on the D€ account and to take full advantage of the waterfall functionality.

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[14] https://www.ecb.europa.eu/euro/digital_euro/features/html/index.en.html

This also shows that the ECB's argument that the D€ has "**cash-like features**" does not apply to the online version. While using the cash payment systems requires a holding of cash, the D€ payment system can be used with zero holdings of D€ deposits.

Offline use of the D€

The offline use of the D€ requires holding a positive D€ balance in the digital wallet. In this regard, the D€ is like cash. But the use case for the offline use is not very clear. Even without internet connection, offline credit payments are already possible, e.g. during flights. When paying with a credit card on a plane, the offline credit line stored on the card applies.

A "Study on Digital Wallet Features" produced by Kantar (2023) for the ECB questioning focus groups comes to the following conclusion:

"The possibility of paying offline was considered the most innovative of the presented payment features. None of the participants recalled having used this option via other payment methods. In every country, most participants acknowledged the convenience of this function for situations where they do not have access to the internet (e.g. in areas without internet coverage, when running out of data, or when using in-flight mode). However, most also noted that these situations are rather limited, so they thought they would rarely use this option."[15]

Like cash, holding positive D€ balances on a smartphone wallet implies the risk that one loses the smartphone or that it is stolen. Therefore, **compared with the online use** the only benefit of the offline use is a higher degree of anonymity. But if anonymity is the relevant criterion, it is not clear why the Digital euro should be a superior solution to cash.

For a comparison of the advantages of offline D€ holdings **compared with cash** one can use the information on the Bundesbank's website, which provides a comprehensive description of the **advantages of using cash** (Table 4).[16]

Table 4: The advantages of using cash

Cash (Bundesbank)	**Digital Euro**
"It ensures your freedom and autonomy. Banknotes and coins are the only form of money that people can keep without involving a third party. You don't need access to equipment, the internet or electricity to pay with cash, meaning it can be used when the power is down or if you lose your card."	The D€ requires equipment in the form of a smartphone and it also requires that the battery is not empty
"*It's legal tender*".	The proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the establishment of the "Digital euro" from 28 June

[15] https://www.ecb.europa.eu/press/pr/date/2023/html/ecb.pr230424_1_annex~93abdb80da.it.pdf
[16] https://www.bundesbank.de/en/tasks/cash-management/the-eurosystem-cash-strategy/the-eurosystem-cash-strategy-and-the-role-of-cash-859166

	2023 grants the D€ legal tender status in Article 7. But Article 9 defines a set of exceptions which includes the right for a microenterprise not to accept the Digital euro, unless it accepts comparable digital means of payment. Thus, while cash must be accepted generally, this would not be the case for the D€.
It ensures your privacy. Cash transactions respect our fundamental right to have our privacy, data and identity protected in financial matters	Even if the offline use would allow a higher degree of anonymity, it would not reach the anonymity of cash
It's inclusive. Cash provides payment and savings options for people with limited or no access to digital money, making it crucial for the inclusion of socially vulnerable citizens such as the elderly or lower-income groups	The use of the D€ requires a certain degree of digital competence which not guaranteed by elderly or lower income groups
"It helps you keep track of your expenses. Cash allows you to keep closer control of your spending, for example by preventing you from overspending."	Digital solutions cannot substitute the constraint set by physical money.
It's fast. Banknotes and coins settle a payment instantly."	In this regard, the D€ and cash are similar
It's secure. Cash has proven to be secure in terms of cybercrime, fraud and counterfeiting. And, as it's central bank money, it doesn't entail financial risks for either the payer or the payee."	There is also no obvious difference between the D€ and cash.
"It's a store of value. Cash is more than just a payment instrument. It allows people to hold money for saving purposes without default risk. It is useful for small person-to-person gifts and payments. For example, parents can entrust small amounts of cash to their children for small purchases, (...) Cash also contributes to the financial literacy of children."	This aspect clearly favors the using of cash instead of D€ which is explicitly designed to avoid the use of the D€ as a store of value.

In sum, there is no obvious case for offline use where the D€ would be superior to cash.

3.3 The D€ as a payment system

For the ECB the need of a pan-European payment solution and the sovereignty of the European payment system play a decisive role in its D€ project:

"The Eurosystem's Digital euro project aims to ensure central bank money evolves alongside current payment preferences and trends, as well as to facilitate electronic payments everywhere in the euro area and strengthen Europe's strategic autonomy."[17]

[17]https://www.ecb.europa.eu/euro/digital_euro/progress/shared/pdf/ecb.deprp202406.en.pdf

The ECB justifies the need for the D€ with the following argument: "Currently, there is no European digital payment option that covers the entire euro area"[18]

In 2019, the ECB made a similar statement but acknowledging that there are no problems paying all over Europe with one card:

"The Eurosystem acknowledges that, in general, European cardholders are able to pay with one card all over Europe. However, at present the pan-European acceptance of cards issued under a national card scheme is entirely reliant on co-badging with an international card scheme."

While the dominance of the US payment platforms, especially in card schemes, can be regarded as a market failure which justifies a government intervention, it is not obvious whether a payments scheme based on the D€ would be the best solution to this problem.

Two different options are possible:

- Introducing a D€ payment scheme which connects the existing national schemes **indirectly** by the creation of parallel infrastructures based on D€ accounts.
- Connecting the national infrastructures **directly** by the creation of a European-wide card scheme or by making the existing schemes interoperable throughout the Europe.

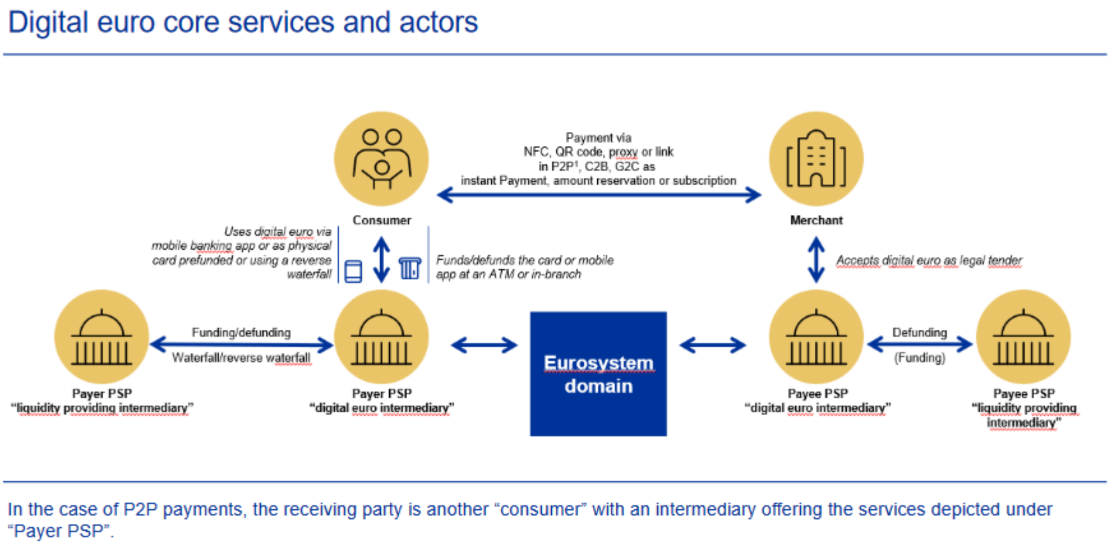
Since embarking on the D€ project the ECB has never explicitly discussed the pros and cons of such an alternative approach. This approach would have the advantage that one could use the existing payment infrastructures instead of creating a completely new payment universe. In addition, it would be in better condition for the competition with US payment platforms as it would be based on retail payment schemes which are widely in use and with which customers are already familiar.

[18] https://www.ecb.europa.eu/euro/digital_euro/html/index.en.html

3.3.1 Payment transactions within the D€ scheme

The ECB presents the D€ payment system with the following chart (Chart 4):

Chart 4: The D€ payment scheme



Source: ECB (2024a)

It shows the special feature of the D€ payment system that it can only operate with D€ accounts. Compared with existing payment schemes this leads to a **tripling of transactions**:

- In order to make a payment form a payer to a payee, the scheme transfers money from the payer's its commercial bank account to its D€ account (funding/reverse waterfall). This transaction is executed via TARGET2.
- From the D€ account of the payer a transaction is made to the D€ account of the payee. This transaction is executed via N€XT, the ECBs scheme for D€ online payments. [19]
- As firms will not be allowed to hold positive D€ balances, the money will be immediately transferred to the payee's commercial bank account (defunding/waterfall) which again requires a TARGET2 transaction.

In the unlikely case, that the payer holds a positive balance on its D€ account, which is sufficient for the payment, the transactions only double.

Thus, compared with a solution based on existing infrastructures the D€ scheme requires

- a parallel system of bank accounts and

[19] "The digital euro back-end prototype for online payments, called N€XT, is a bespoke design developed from scratch by the Eurosystem. The architecture of N€XT is not that of a distributed ledger, rather it is based on a UTXO data model which has been made popular by distributed ledger technologies (DLTs)." (EZB, 2023b, p. 5)

- a parallel settlement scheme for D€ settlements (N€XT) as TARGET2 is reserved for the settlement between banks.

While the ECB has never presented an estimate of the costs for establishing and operating such a parallel payment universe, it seems likely that it will be more expensive than a solution based on existing structures. The multiplication of settlement transactions is also difficult to reconcile with the ECB's commitment to **sustainability** which Vice-President Guindos (2023) has stated as follows:

"Looking to the future, we will continue to honour our commitments to stepping up our sustainability and climate protection efforts."

3.3.2 The acceptance of the D€ payment scheme

The parallel structures of the D€ payment scheme are not only very expensive they might also jeopardize the acceptance by the public and thus reduce its competitiveness relative to US payment platforms.

The main impediment is the need to open **an additional bank** account which is not required for the use of credit card schemes or e.g. PayPal. In addition, for many people the logic of the waterfall functionalities and the lack of an overdraft facility will not be obvious.

A major disadvantage of the D€ scheme compared with other payment platforms is its **limitation on accounts denominated in euro**. This reduces its regional scope to the euro area so that even Europe is not completely covered by this payment scheme. Thus, it is not correct if the ECB praises the D€ as a "pan-European payment solution".

For the competition with other platforms, one has to consider that they offer not only the pure payment transaction but also **related services**, above all consumer loans (without interest in the short-term) and consumer protection in online purchases. Some platforms also offer financing and marketing services for merchants.

Commercial banks play a crucial role in the acceptance of the D€ scheme, as they are the only institution that communicates directly with potential D€ users. As Ozcan and Gurses (2019) show, an important precondition for the creation of new markets is the cooperation between the dominant players ("**dyadic alliances**"). This is especially important, if the "new market requires complementary resources from different kinds of large firms or large firms from different industries". In this case, the authors also mention the "Difficulty in reaching an agreement due to diverging plans for the new market (...) and beliefs about relative bargaining power."

According to the ECB's design for the D€, commercial banks are obliged to open and to manage D€ accounts free of charge. In addition, if a customer decides to transfer deposits from its commercial bank account to a D€ account, the bank suffers a loss of cheap refinancing which it has to substitute by more costly refinancing sources. While the acceptance among merchants might be supported by lower fees, it is unlikely that they would stop accepting the established payment schemes. Therefore, on the side of the customers there would be no incentive to switch to the D€.

Representatives of the Eurosystem also do not seem to be convinced of the acceptance of the D€ scheme. They therefore envisage **enforcing the opening of D€ accounts** by making public payments on D€ accounts only. E.g. Burkhard Balz (2024), member of the Bundesbank executive board, at the public hearing of the Finanzausschuss of the German Parliament on 9 February 2024 made the following statement:

"The specific use case, as we call it, is payments from government agencies directly to people via the digital euro wallet or vice versa." (our translation).

And:

"For me, use cases also include, for example, being able to pay child benefit directly and other state benefits." (our translation)

One could argue that in the past it had not been possible to make direct payments from the government to its citizens, e.g. during the energy crises. But in Germany, the institutional framework has been changed by linking the tax number with the IBAN number so that it is now possible to make such direct payments. [20]

Overall, forcing people to open D€ accounts would have a negative impact on the public perception of European integration. Already today, many people have the impression that the EU is involving to much in areas which go beyond its competencies. In addition, as the experience with the Digital Yuan shows, people who receive such payments seem to transfer the funds immediately to their commercial bank account. [21]

3.3.3 The dominance of the ECB in the European retail payment system

According to the rule book (ECB 2024a), the **Digital Euro Service Platform** (DESP) would become the key player in the D€ payment scheme. As Chart 5 shows, this institution would provide the link between the bank of the payer and the bank of the payee. The rulebook (ECB 2024a) describes e.g. the case of a payment which is initiated by the payer as follows:

> "1. The payer presents the amount to be paid to the payee.
>
> 2. The payee verifies the amount, consents and taps to accept the payment.
>
> 3. The payer receives the payee's consent and submits the payment request to its intermediary.

[20] https://www.bundesfinanzministerium.de/Content/DE/Standardartikel/Themen/Steuern/Weitere_Steuerthemen/Organisation_Automation/2023-12-11-meldung-iban-bzst.html

[21] https://www.coindesk.com/policy/2024/05/13/chinas-digital-yuan-isnt-taking-off-despite-state-employee-salary-trial-report/

4. The payer’s intermediary validates the payment request and sends it to the DESP.

5. The DESP forwards the payment request to the payee’s intermediary.

6. The payee’s intermediary validates the payment request.

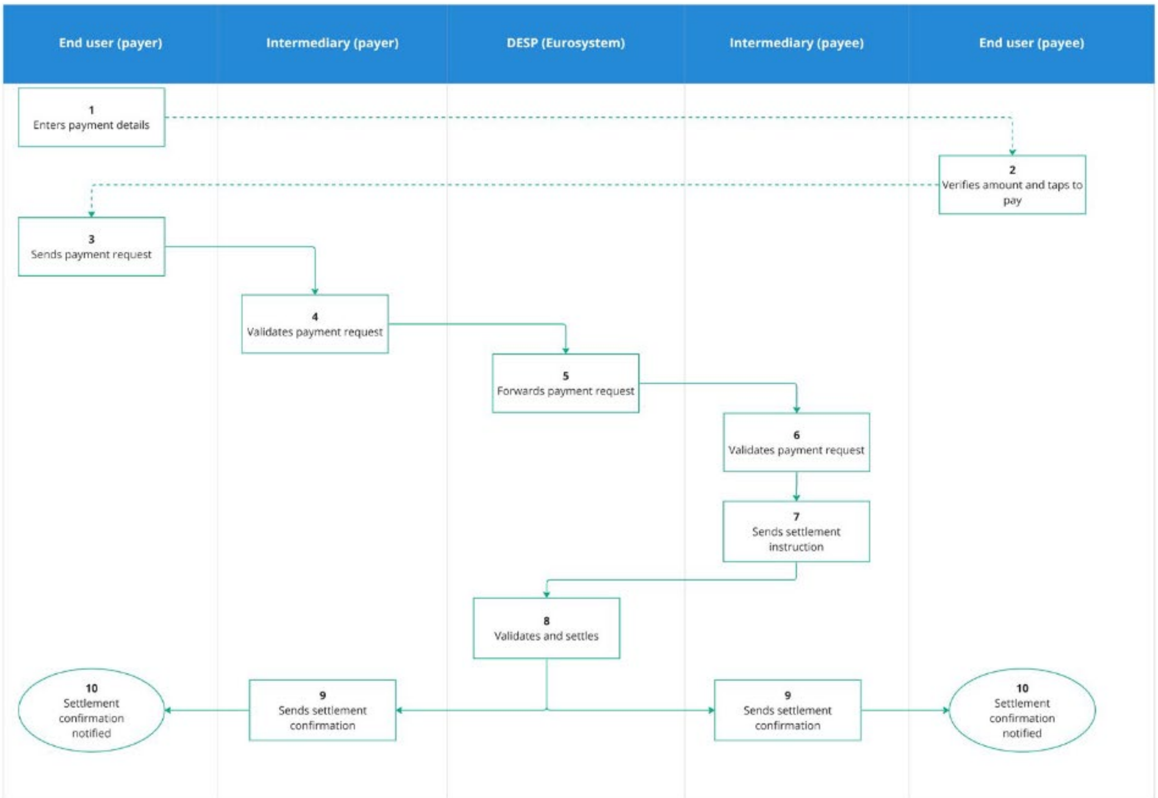
7. The payee’s intermediary sends the settlement instruction (including funding instruction if the reverse waterfall applies and/or defunding instruction if the waterfall applies) to the DESP.

8. The DESP validates the settlement instruction, settles the transaction and confirms the settlement to both the payer’s intermediary and the payee’s intermediary.

9. Each intermediary sends a settlement confirmation to its end user.

10. The payer and the payee are notified of the successful settlement of the transaction.”

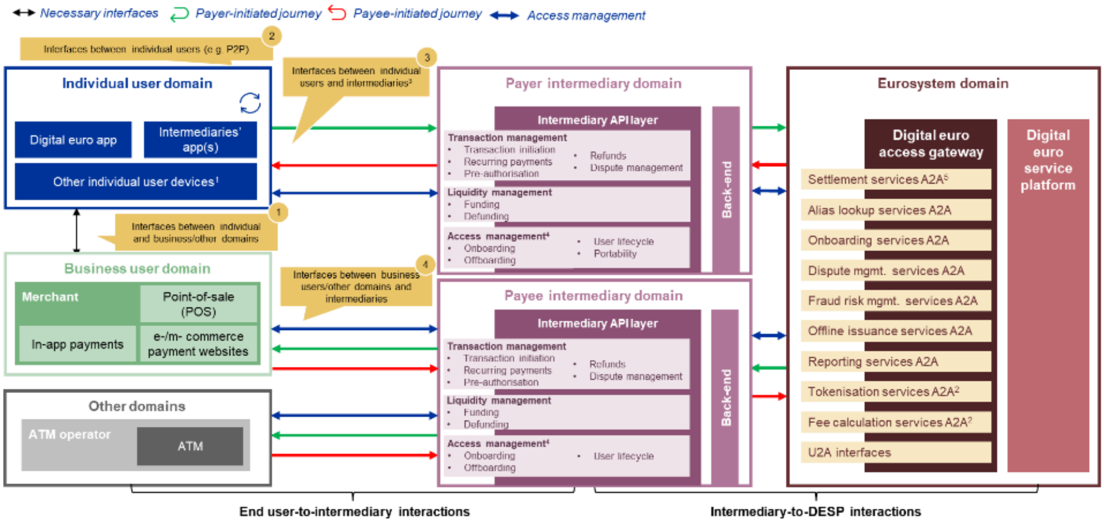
Chart 5: High-level process flow of a Digital euro payer-initiated transaction



Source: ECB (2024a)

As chart 5 shows, the DESP leaves no room for non-bank payment service providers. The dominant role of the DESP is also reflected in another chart of the rulebook:

Chart 6: High-level architecture



Source: ECB (2024a)

While it is not totally clear how the system would function, the concept outlined in the rulebook seems to lead to a solution where the ECB would dominate the complete payment scheme leaving no or only little room for private payment service providers. This point was raised in the statement of the European Payments Initiative (EPI 2024) for a public hearing of the Finanzauschuss of the German Parliament on 19 February 2024:

“EPI does not believe that the digital euro should be additionally developed as a broad payment solution. In our view, it is not the role of a public authority or the central bank to become a privileged provider of solutions in this market environment, but that the private sector should develop its own solutions at European level (to avoid fragmentation of the market) that can compete with international solutions such as PayPal and Apple Pay. These private solutions should also offer consumers the choice to use the digital euro as a means of payment and, by building up additional services, offer the digital euro attractive. Private providers are in competition with each other, and it would be against the principle of a level playing field in Europe if a regulatory authority, which is supposed to regulate its future competitors, were to become a preferred provider of solutions in this market game.” (our translation)

The negative effects of a centralized payment scheme, especially on innovation are also mentioned by the Rijksbank (2023):

“However, such a high level of governance may reduce the scope for achieving the overall objectives of fostering innovation and competition, as it reduces the ability of participants to design their own unique e-krona services.”

In other words, the dominant role of a public institution in the D€ payment system might lead to solutions which are not competitive in relation to privately managed payment platforms. The result could be the opposite of what Burkhard Balz (2024) expects:

“The third motivation is that a digital euro could promote competition and innovation in European payments.”

Thus, one can ask whether the aim of gaining European sovereignty in the payments landscape would not be better served by a solution that relies on private payment providers.

3.3.4 The difficulty of implementing the offline solution

The Riksbank has started very early discussing the scope of a central bank digital currency. In recent paper “E-krona pilot Phase 4” (Riksbank 2024) the focus has been “on testing and evaluating whether it is possible to design a secure, balance-based offline solution.” A surprising result of the study is “the fact that mobile phones are insecure components so that user-to-user payments require many steps to be considered secure, which compromises user-friendliness.” As a result, all offline transactions require cards that must be loaded online.

The complexity of such a payments solution can be demonstrated with the transactions that are required to top up the payments card (Riksbank 2024):

> "1. The user opens their e-krona app on their mobile phone and enters the amount to be transferred.
>
> 2. The user enters the PIN code of the e-krona app and brings the card to the NFC reader of the mobile phone.
>
> 3. The mobile phone creates a digitally signed request that is sent to the in-termediary's e-krona node.
>
> 4. The intermediary verifies the digital signature and transfers the amount from the user's online wallet to the user's shadow wallet.
>
> 5. The intermediary reads the updated balance on the user's shadow wallet, signs the balance and sends the signed balance to the user's e-krona app.
>
> 6. The user holds the card against the mobile phone's NFC reader and the user's e-krona app transmits the updated balance to the card.
>
> 7. The card changes its balance to the updated balance value."

In its "First progress report: Progress on the preparation phase of a digital euro" (ECB 2024b) the ECB also discusses these technicalities. The ECB leaves it open whether it will be legally possible to get **effective access to the secure element** (SE) installed in users' devices. In a letter to Thierry Breton from 19 April 2024, Piero Cipollone (2024), Member of the ECB Executive Board admits that currently iPhones cannot be used for the offline D€:

"Crucially, access to the SE is vital for mobile device based offline digital euro payments. Therefore, Apple's proposed commitments, which do not provide full access to the SE of iOS smart phones, would not facilitate offline payments with digital euro on iPhones."

The ECB (2024b) therefore also discusses rather clumsy solutions for cards: "battery-powered smart cards and non-powered smart cards which use a "bridge-device to con-nect."[22]

In sum, the offline solution could require complex transactions and additional devices which reduce **the user-friendliness**. Given the limited advantages of the offline use, it is not clear whether the D€ would receive wide acceptance in this design.

[22] The ECB describes this as follows: "A 'bridge device' is a simple, pocket-sized, battery-powered device for establishing a connection channel between two non-powered smart cards, enabling transactions between them. At a minimum, this device should have: i) a user interface (e.g. screen and keypad), ii) communication capabilities, iii) card reader and near-field communication capabilities, and iv) a small me

4 An alternative: a pan-European payment scheme based on existing infrastructures

The high costs of creating and maintaining parallel payment infrastructures in Europe raises the question if the ECB's aim of safeguarding "the strategic autonomy of the Union's payment ecosystem" cannot be reached in a more efficient way, above all by using the existing payment infrastructures.

Surprisingly, in 2019 the ECB (2019) itself has proposed such a solution under the heading "SEPA for cards":

"The implementation of a European instant payments scheme and the development of common or interoperable instant payments infrastructure to process such payments may create new momentum to interconnect existing national card schemes. The use of this newly installed instant payments infrastructure could be a way to support the interlinking and interoperability of national card schemes and, if full pan-European coverage is ensured, would provide a possible alternative to establishing a European card scheme. To promote the use of such cards, it would be helpful to have a common European logo indicating the possibility of using the cards of national card schemes at EU level."

The advantage of using exiting infrastructures is also mentioned by EPI (2024):

EPI also makes the point that it is already in the process of establishing a pan-European solution using the existing payment infrastructures:

"From the user's point of view, the digital euro does not offer any new added value compared to SEPA Instant Payments (SCT Inst), which were recently defined by EU legislators as a legally binding means of payment that must be offered by banks and other payment service providers across the EU. Indeed, there is no use case (P2P, e-commerce or in-shop payments) or service that the digital euro would serve better than SEPA Instant Payments. However, the digital euro doubles the investments within the EU for two similar infrastructures."

The concept of a SEPA for cards leads to the question of the **payment instrument** that is required for any European solution.

- One solution would be a credit card in physical form that could be embedded into digital wallets like Google Pay or Apple Pay.
- An alternative instrument are QR-codes that can be read by smartphones.

So far, the ECB has not been very specific about this decisive element of its D€ scheme. In ECB (2023b) it states:

"PSPs are responsible for distributing the payment instrument to the consumer and for its maintenance. This may be an app on a mobile device or a payment card."

This leaves it open, whether the mobile device or the payment card would be issued by the private sector or the ECB. But it becomes clear that a pan-European payment instrument is required for both alternatives. In other words, the difficulty to reach such an arrangement in the past is not an argument for a D€-scheme.

An astonishingly clear commitment to a solution based on SEPA and the European Payments Initiative comes from Denis Beau (2023) who is the First Deputy Governor of the Banque de France:

“In particular, the Banque de France and the Eurosystem are actively backing the European Payments Initiative (EPI). This new pan-European payment solution will allow consumers and businesses to make instant account-to-account payments via QR code. It will be integrated in the digital wallet Wero, on which other means of payment and payment-related services will be accessible, such as a digital ID or access to merchant loyalty programmes. This payment solution will help strengthen the sovereignty of the European payment market by providing an alternative to using foreign schemes such as Mastercard and Visa, while ensuring that payments and related data are processed by European organisations.”

As we show in Bofinger and Haas (2023b), the **PIX** payment system in Brazil and the **TWINT** system in Switzerland are good examples for domestic solutions which are able to compete successfully with forego platforms without using a CBDC.

5 Scenarios for the D€

The key question for an assessment of the D€ is whether one can identify **market failures and related externalities** that could justify such a large-scale project. In addition, it is not clear whether the D€ as payment object or a payment system will be able to compete successfully with existing private solutions.

In this paper we show that there is no such thing as a “Digital Euro”. For a comprehensive evaluation of the D€ it is necessary to split up the whole concept into its constituent elements: the D€ as payments object and the D€ as a payments scheme. This avoids the confusion that the ECB creates by referring to the Digital euro indiscriminately as a "means of payment", "payment instrument" and "payment solution". A case in point is a statement that can be found on the ECB’s website which confuses the object function (central bank money”) with the function of the payment scheme:

“Our aim is to combine the benefits of central bank money and the ease with which people make their payments in today’s world.”

D€ as a payment scheme

The ECB argues on the macroeconomic level that the D€ is needed as a monetary anchor in an increasingly digital financial system. But one can show that this is not an externality that could justify a fundamental change in the division of labor between the central bank and commercial banks.

The microeconomic argument that holding D€ deposits provides the "benefits of central bank" is also not convincing. With an effective deposit insurance bank deposits are as safe as central bank money. But for households the need to hold parallel accounts would lead to additional transactions and information costs. With zero interest and the possibility to use the D€ payment scheme with zero balances the use case for holding deposits on D€ accounts is not clear.

The offline use of the D€ requires a positive balance on a wallet or a card. But the use cases for this functionality are limited and it is unclear whether it would be very user-friendly.

D€ as a payment scheme

In the case of payment schemes, the ECB argues that the D€ is required for the sake of the "strategic autonomy of the Union's payment ecosystem". While this is a clear externality, one must ask whether the creation of completely new D€ payment scheme is the optimum solution.

According to the rule book, the ECB is planning to establish a comprehensive pan-European payment scheme which is reserved for transactions between D€ accounts. This requires high costs for creating and maintaining the D€ infrastructure. It might impair the attractiveness of the scheme as, in contrast to other payment schemes, it requires opening a new bank account. In addition, the scheme would duplicate the existing SEPA scheme which is open for all kinds of bank accounts.

If the ECB sticks to its D€ project, which is likely after its strong efforts so far, from the analysis of this paper two scenarios can be derived.

A worst case scenario:

In the worst-case scenario, the D€ project becomes a complete failure. Most households would not open a D€ account and those who would open it, would only keep very low balances on it. Due to the lack of participants, the D€ payment scheme would not reach a sufficient coverage among merchants so that it would also not attractive for payment service providers to connect with the scheme. Due to its technical complexity the offline D€ would also not be used in a significant way. With this outcome, the reputation of the ECB would receive a serious blow as it would need to justify the huge investment costs for parallel infrastructures that remain widely unused.

A positive, but inefficient scenario:

In a positive scenario, most households open a D€ account. But they make full use of the waterfall functionalities and do not hold any significant balances on their D€ accounts. A payment service provider can be found that supplies a common payment instrument, which is widely used by households and merchants. A large share of retail transactions is made with the D€ payment scheme and the dominance of US platforms is reduced. In this scenario, the D€ system would de facto provide an **indirect payment infrastructure** for commercial bank accounts. As already mentioned, such a scheme would, compared with current infrastructures, lead to a tripling of payment transactions which is difficult to reconcile with the ECB's attempts to "supporting an orderly transition to a climate-neutral economy", and to recognize "the importance of continuing to drive positive change by reducing its own impact on the environment."

Thus, in such a scenario the D€ would ultimately provide a **complex detour solution** for payments between commercial bank accounts. It would be **a costly substitute** for the direct solution of reducing dependence on non-European payment platforms via a SEPA for cards. In addition to the complexity and the costs, the dominant role of the ECB in such a scheme could have negative effects on innovation and user-friendliness with the effect that the DE scheme cannot successfully compete with the dominant international platforms.

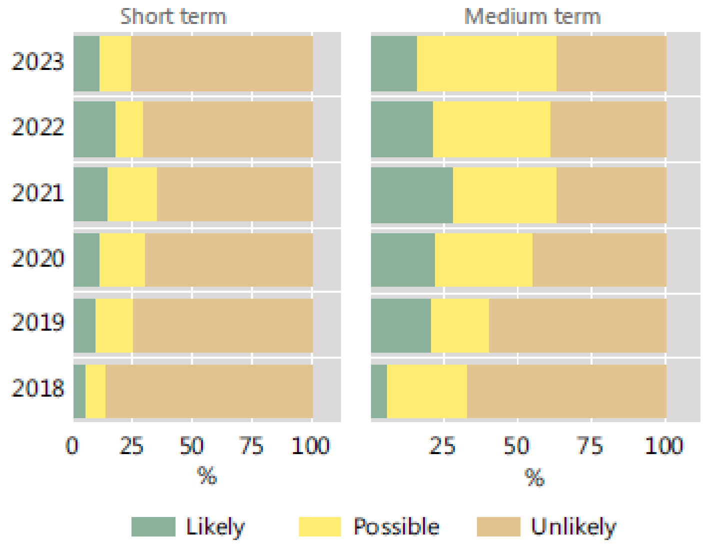
A convincing use case for the offline D€ is difficult to imagine, even in a positive scenario.

6 The international perspective: a sobering picture

Our critical assessment of the D€ is supported by an international perspective. In the **Annex 1** we show that none of the existing CBDC projects have not been able to gain a significant market share although the authorities tried to support their usage. So far there is not a single CBDC success story.

In **Annex 2**, we provide our own "CBDC Tracker" which gives a comprehensive overview of the assessment of CBDC by the central banks in the major OECD countries. The result is striking: In contrast to reports that more and more countries are engaging in CBDC projects, most central banks have a rather sceptical attitude towards the necessity of a retail CBDC. This finding is supported by the recent BIS survey (BIS 2024), which shows that the number of central banks which are planning to introduce a retail CBDC in the medium term is declining.

Chart 7: Likelihood of issuing a CBDC in the foreseeable future (As a percentage of respondents that have not issued a CBDC)



Source: BIS (2024)

The absolute number of central banks that are planning to introduce a retail CBDC within the next few years has declined from 11 to six. Thus, the increasing engagement of central banks in CBDC seems to have led to a certain disillusionment.

7 Summary: Beware of taking off too early

Even though the number of central banks dealing with CBDC is still increasing, this should not lead to the impression that we are now on the verge of a breakthrough in this innovation. The projects implemented so far are anything but success stories. The majority of large and major central banks have a sceptical and often negative attitude towards CBDC.

Against this backdrop, the ECB is taking a major risk with its unconditional commitment to the Digital euro. Even under optimistic assumptions, it is difficult to imagine developments in which the ECB's objectives can be achieved in an efficient manner. It is difficult to understand why the ECB insists on developing a completely new parallel universe instead of attempting to integrate the existing and efficient systems in such a way that a solution can be developed that can compete effectively with the US platforms.

Given the large financial and intangible investments that the ECB has already made in this project, it is unlikely to be politically possible for it to get off the train again. This should serve as a warning to central banks that have so far been cautious about CBDCs not to jump on such a bandwagon too soon.

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Annex: A CBDC tracker based on central bank statements and experiences

I. Countries which have implemented or plan introducing CDBC

Bahamas

China

Eastern Caribbean Currency Union (ECCU)

India

Jamaica

Mexico (planned)

Nigeria

II. Countries with a sceptic view of CBDC (advanced economies, Brazil, Chile, Indonesia, Malaysia, Kenya, Philippines)

Australia

Brazil

Canada

Chile

Czech Republic

Denmark

Hong Kong SAR

Iceland

Indonesia

Israel

Japan

Korea

Malaysia

New Zealand

Norway

Philippines

Singapore

Sweden

Switzerland

Thailan

Taiwan

United Kingdom

United States

Part I: Countries which have started a CBDC project or announced the start of a CBDC project

In the following, we present evidence from newspapers and online reports, as it not possible to find sufficient information the issuance of CBDC on central bank websites. The links to the sources are provided within the text.

Bahamas

Sand Dollar only 0.19 % of the total currency in circulation

"About one year after the Sand Dollar went nationwide (October 20, 2020), Sand Dollar circulation reached around B$300,000; however, adoption was relatively flat for the following year. In May 2023, the Sand Dollar had about 104,664 consumer wallets and around 1,500 merchant wallets (CBOB 2023). After a series of Sand Dollar educational campaigns, promotions, and giveaways—as well as the integration of the rCBDC with government payments and the ACH system—circulation rose by about B$1 million, reaching B$1,099,910 by September 2023 (Branch, Ward, and Wright 2023). Still, this value amounts to only 0.19 percent of the total currency in circulation at the time."

Source: Franklin Nol, Observations from the Retail CBDCs of the Caribbean, Federal Reserve Bank of Kansas City, 10 April 2024. https://www.kansascityfed.org/Payments%20Systems%20Research%20Briefings/documents/10104/PaymentsSystemResearchBriefing24Noll0410.pdf

China

e-Yuan only 0.16 % of the China's M0 (Reuters 19 July 2023)

Transactions using China's digital yuan hit 1.8 trillion yuan ($249.33 billion) at end-June, the country's central bank governor Yi Gang said on Wednesday, marking a jump from over 100 billion yuan as of August last year.

The numbers cement China's role as a leader among countries that are developing their own central bank digital currencies (CBDC) - digital tokens issued by central banks - although adoption is still in the early stages. The e-CNY, as the digital yuan is called, has so far been used mainly for domestic retail payments.

Speaking at a lecture organised by the Monetary Authority of Singapore (MAS) in the Southeast Asian city-state, Yi said China's digital currency in circulation reached 16.5 billion yuan as of end-June.

Total e-CNY transactions reached 950 million, with 120 million wallets being opened, Yi said. Still, e-CNY in circulation accounted for only 0.16% of China's M0 money supply, or cash in circulation, Yi said.

"And you can see that right now the balance of e-CNY is only counting two-tenths of 1% of M0, so that the balance is very small, but with this kind of balance (we) support a big number of transactions, which means that the velocity is high and more efficient," Yi said.

Chinese state-owned banks participated last year in a trial focused on cross-border transactions developed by the Bank of International Settlements.

Source: https://www.reuters.com/markets/asia/chinas-digital-yuan-transactions-seeing-strong-momentum-says-cbank-gov-yi-2023-07-19/

China is paying some workers in digital yuan – but few are choosing to use it (South Chinese Morning Post 13 May 2024)

China's digital yuan, also known as e-CNY, is failing to catch on during a trial in which state employees receive their salary in the central bank digital currency (CBDC), according to a report by the South China Morning Post (SCMP).

Most of the early recipients immediately transfer the digital yuan balances to their bank accounts to spend as cash, the SCMP reported.

"I prefer not to keep the money in the e-CNY app, because there's no interest if I leave it there," Sammy Lin, one participant in the pilot, said. "There are also not so many places, online or offline, where I can use the e-yuan

Source: https://www.scmp.com/economy/china-economy/article/3262194/china-paying-some-workers-digital-yuan-few-are-choosing-use-it

Eastern Caribbean Currency Union (ECCU)

DCash only 0.16 % of total currency in circulation

Less than nine months after the start of the DCash pilot in 2021, the DCash platform went down for close to 10 weeks; when service was restored, around 4,000 wallet holders, roughly 20 financial institutions, and 10 government agencies across the ECCU were participating in the pilot. Later, DCash educational campaigns expanded and included in-person demonstrations. By March 2023, 400 merchants were participating. Overall, DCash circulation appears to have grown modestly from its initial issuance of EC$2 million to EC$2.45 million in March 2023 (ECCB 2022, 2023). This amount is still very small, accounting for only 0.16 percent of the total currency in circulation at the time.

Source: Franklin Nol, Observations from the Retail CBDCs of the Caribbean, Federal Reserve Bank of Kansas City, 10 April 2024 https://www.kansascityfed.org/Payments%20Systems%20Research%20Briefings/documents/10104/PaymentsSystemResearchBriefing24Noll0410.pdf

India

E-rupee: “Litte organic demand” (Reuters 25 June 2024)

Usage of India's digital currency, the e-rupee, has slumped to just a tenth of the peak hit in December, four sources said, reflecting the struggles several countries have experienced in trying to generate public support for digital currencies.

The Reserve Bank of India started a pilot for the e-rupee, devised as a digital alternative to physical cash, in December 2022, and successfully reached a target of 1 million retail transactions per day by December 2023.

The achievement came only after banks were asked to push up transactions by offering incentives to retail users and disbursing a portion of bank employees' salaries using the e-rupee.

But now that the push has diminished, daily transaction numbers have fallen to about 100,000, said two of the sources, who are directly involved in the pilot.

This shows there is little organic demand to use the e-rupee, said a third source, a banker involved in the project.

The sources declined to be identified because they are not allowed to speak to media. The RBI did not respond to an email seeking comment and the data on retail transactions via the e-rupee is not publicly disclosed.

The transactions that are continuing are in part due to banks disbursing benefits to their employees via the e-rupee, all four of the sources said.

This has helped to push up transactions to about 250,000 to 300,000 per day towards the end of each month, the two sources cited earlier said

Source: https://www.reuters.com/technology/india-digital-currency-transactions-slump-after-reaching-initial-cbank-target-2024-06-25/

Inaugural Address by Shri Shaktikanta Das, Governor, Reserve Bank of India on August 26, 2024

“It is important to emphasise that there should not be in any rush to roll out system-wide CBDC before one acquires a comprehensive understanding of its impact on users.”

Source: https://www.bis.org/review/r240828p.htm

Jamaica

JAM-DEX roughly 0.11 percent of total currency

JAM-DEX launched on July 11, 2022; by the end of the month, around 120,000 individuals and 2,300 merchants were reportedly on the JAM-DEX network via the Lynk platform. The first 100,000 customers to sign up for the rCBDC received an incentive bonus of JMD$2,500, resulting in circulation increasing by JMD$250 million. After this initial increase, circulation basically stalled. Consequently, the BOJ engaged in cash promotions, merchant outreach, and an education campaign to encourage adoption. By February 2023, these efforts had resulted in 185,410 individuals, 90 small merchants, and 4,500 micro merchants participating in JAM-DEX. Currently, JAM-DEX circulation is hovering around JMD$257 million, roughly 0.11 percent of the total currency in circulation in Jamaica (Jamaica Observer 2022b; BOJ n.d.; Patterson 2023).

Source: Franklin Nol, Observations from the Retail CBDCs of the Caribbean, Federal Reserve Bank of Kansas City, 10 April 2024. https://www.kansascityfed.org/Payments%20Systems%20Research%20Briefings/documents/10104/PaymentsSystemResearchBriefing24Noll0410.pdf

Mexico

Digital peso delayed without further notice (Cointelegegraph 8 January 2023)

The development of Mexico's central bank digital currency (CBDC) is still at an early stage, and is unlikely to be ready for launch in 2024.

According to local media reports, Mexico's central bank, known as Banxico, is currently working on the legal, administrative and technological requirements for the digital version of the peso. The first of three stages of the proposed launch schedule.

In December 2021, the local government announced its plan to introduce a national digital currency, noting in a Twitter post that "new technologies and next-generation payments infrastructure" would improve Mexico's financial inclusion and projecting a launch by 2024. A year later, authorities reportedly avoided forecasting a launch date.

"The outcome of this initial phase involves the development of a budget that is in the process of being determined, and will in turn allow us to establish a likely date on which the MDBC [CDBC] will be available," Mexico's central bank said.

The original plan included in a first stage the creation of the PagoCel platform, which will allow users to make bank transfers using their cell phone numbers or personal information. A second phase will involve the country's financial institutions, which will issue a security code for digital currencies to be transferred through the Interbank Electronic Payments System (SPEI), a transfer system owned and operated by the central bank.The system will also allow users to make bank transfers using their cell phone numbers or personal information.

Source: https://es.cointelegraph.com/news/mexico-s-digital-peso-delayed-unclear-launch-date

Nigeria

eNaira: Is It Here to Stay or Are Nigerians Going to Say ‘Nay’? EOS Intelligence (15 February 2024)

With the release of eNaira in October 2021, Nigeria became the first country in the African continent and second in the world after the Bahamas to launch a CBDC. Major motivations behind launching CBDC in Nigeria included encouraging financial inclusion, improving cross-border transactions, complementing the current payment systems, and enabling diaspora remittances. However, the adoption of eNaira has been low, with only 0.5% of the Nigerian population using CBDC within a year of its launch.

In a rather desperate move to compel its people to adopt eNaira, the government caused cash shortages in the country. This resulted in protests, riots, and unrest among Nigerians. As a result of the currency shortages in early 2022, Nigeria witnessed a 12-fold increase in the number of e-Naira wallets to 13 million since October 2021.

As of July 2023, the value of transactions had also seen a 63% rise to N22 billion (US$48 million) since its launch in October 2021. According to the International Monetary Fund (IMF), 98.5% of the eNaira wallets were inactive one year after the launch of the CBDC, meaning 98.5% of eNaira wallets have not been used even once during any given week. These low levels of activity mirror the low public adoption of eNaira.

Source: https://www.eos-intelligence.com/perspectives/technology/enaira-is-it-here-to-stay-or-are-nigerians-going-to-say-nay/

Part II: Statements of major central banks on retail CBDCs

In the following, we present statements from central bank publications or from speeches of central bankers on CBDC.

Australia

Reserve Bank of Australia: Australian CBDC Pilot for Digital Finance Innovation (August 2023)

“Considering the broader context – where the Australian payments system is currently meeting most of the needs of end users and work on CBDC in advanced economies is generally still in an exploratory stage – it is likely that any serious policy consideration of issuing a CBDC in Australia is still some years away.

Source: https://www.rba.gov.au/payments-and-infrastructure/central-bank-digital-currency/pdf/australian-cbdc-pilot-for-digital-finance-innovation-project-report.pdf

Speech by Brad Jones: The Economics of a Central Bank Digital Currency in Australia (17th Central Bank Conference on the Microstructure of Financial Markets Sydney – 8 December 2022)

As far as monetary economics goes, the introduction of a general purpose CBDC would be revolutionary – for centuries, physical cash has been the only source of central bank-issued money to which households and non-financial firms have had access. Prior to crossing this Rubicon, a strong public interest case would first need to emerge. On balance, we have yet to see that case made in Australia. We are not alone here – no other advanced economy central bank has committed to issuing a general purpose CBDC. But with our eAUD pilot program in full swing, and changes in the digital economy and money and payments landscape occurring at a frenetic pace, the Bank is keeping an open mind.”

Source: https://www.rba.gov.au/speeches/2022/sp-ag-2022-12-08.html

Brazil

Economist Intelligence Unit: Brazil prepares to launch digital currency by early 2025 (7 May 2024)

Whereas Pix is an instant payments system focused on retail transactions, the Drex is the digital representation of the Brazilian currency, the Real. The use of blockchain technology, as is the case for cryptocurrencies, and distributed ledger technology (DLT) will provide security and transparency, helping to engender confidence in the Drex. However, unlike cryptocurrencies, which are unregulated and decentralised, the Drex will be regulated and its value guaranteed by the BCB, meaning that its value will be stabilised, equal to the Brazilian Real. These features will make the Drex more suitable for carrying out the larger transactions that are required in wholesale and government operations. For example, the

Drex could be used to price assets, conduct streamlined cross-asset operations without intermediaries, facilitate international transactions and automate contracts, to the benefit of the country's business environment.

In practice, the Drex Platform is a Distributed Ledger Technology (DLT) ecosystem, in which regulated financial intermediaries will convert balances of demand deposits and electronic money in Drex, so that their clients have access to various intelligent financial services. Thus, the retail Drex will enable the population to access various types of financial transactions with digital assets and smart contracts to be settled in the wholesale Drex issued by the BCB within the Drex Platform

Source: https://www.eiu.com/n/brazil-prepares-to-launch-digital-currency-by-early-2025

Canada

Bank of Canada: Digital Canadian Dollar (Webpage Bank of Canada)

In an era of rapid digitalization, we need to do the necessary work to be ready if Canadians' payment preferences or needs change. As commerce becomes ever more digital, Canadians should continue to have all the benefits of money issued by the central bank.

Whether and when Canada will need a Digital Dollar is uncertain. Ultimately, Canadians will decide—through their representatives in Parliament—if a Digital Dollar should be issued.

Source: https://www.bankofcanada.ca/digitaldollar

Chile

Central Bank of Chile: Emision de moneda digital. Secunda inforem: Avances de la exploracion conceptual, Marzo 2024. (Eigene Übersetzung)

The evaluation of the advantages and challenges associated with an MDBC indicates that its issuance is not justified today, but that it cannot be ruled out in the future. In line with what most central banks around the world are doing, the BCCh has decided to continue with the process of exploring CDBC, in order to be prepared to do so in the future. This includes moving forward with practical experimentation via proofs of concept.

Finally, it is necessary to mention that the Bank still considers that there is not yet sufficient information to make a final decision regarding the issuance of an CDBC. Therefore, the decision to explore further should in no way be understood as a decision to issue an MDBC or as a change in the Bank's commitment to provide cash to those who require it.

Source: https://www.bcentral.cl/documents/33528/130503/Segundo-Informe-MDBC.pdf/1c506d66-1dbf-2434-54bd-3997ec84784b?t=1712352384816

Denmark

Governor Signe Krogstrup's speech at the conference New types of Digital Money at Danmarks Nationalbank (9 March 2023)

"The question of a retail CBDC goes far beyond technology. Its introduction would change the structure of the financial system and the respective roles and demarcation lines between commercial banks, central banks and other institutions, in the provision of money.

Several reasons have been proposed for introducing retail CBDC. Examples include improving critical infrastructures, financial inclusion or strengthening competition and cybersecurity. Some of these issues are not new and have typically been addressed by regulation, or by improving existing technologies. It is not clear to me that we require a different approach now, but perspectives and circumstances across countries differ.

A key question often voiced is whether the decline in cash use will eventually lead to a lack of trust in money, and if so, whether a retail CBDC could take the role of cash in ensuring this trust.

As already noted, based on what we know today, it is not clear to me that cash in the hands of private citizens is the anchor of trust in our monetary system, certainly not in Denmark. But this is an open question, and I look forward to discussing today.

Source: https://www.nationalbanken.dk/media/zh3n2jbu/skro-keynote-cbdc.pdf

Denmarks National Bank: New types of digital money (23 June 2022)

Central Bank: "At present, and with the associated costs and possible risks, it is not clear how retail CBDCs will create significant added value relative to the existing solutions in Denmark."

Source: https://www.nationalbanken.dk/media/z12aimyo/analysis-no-8-new-types-of-digital-money.pdf

Hungary

Anikó Szombati, Chief Digital Officer of the Hungarian Central Bank (CoinDEsk 10 May 2023)

"For the moment we don't see any imminent need for large scale retail CBDC to be introduced" by regular citizens and merchants, Anikó Szombati, Chief Digital Officer of the Hungarian Central Bank, said at an event hosted by think tank the Official Monetary and Financial Institutions Forum.

But, she added, "we are also exploring the possibilities for issuing a central bank digital currency" via a series of pilots, and "would like to remain in the forefront of CBDC research.

Source: https://www.coindesk.com/policy/2023/05/10/hungarian-central-bank-sees-no-imminent-need-for-e-forint/

Anikó Szombati: Interview Global government Fintech (4 September 2023)

Overall her key message is ultimately similar to most central banks' thinking on (retail) CBDC, which she describes as "a society-wide project in the long-term".

"We haven't identified yet such a strong motivation factor that would drive us to launch a 'Big Bang' project," Szombati concludes on CBDC.

Source: https://www.globalgovernmentfintech.com/hungary-fintech-interview-central-bank-of-hungary-aniko-szombati/

Indonesia

Bank of Indonesia on its website: Project Garuda: Navigating the Architecture Of Digital Rupiah

Bank Indonesia believes that Digital Rupiah has the potential to preserve the sovereignty of Rupiah in the digital era, including supporting integrated digital economy and finance as well as creating the opportunities for more equitable and sustainable financial inclusion. Nonetheless, most central banks are still mindful before taking a decision to issue a CBDC for the public. There are stages of further experimentations and discussions required.

Source: https://www.bi.go.id/en/rupiah/digital-rupiah/default.aspx

Japan

Central Bank Digital Currency Experiments: Progress on the Pilot Program (April 2024)

In the pilot program, the Bank has been conducting experiments and discussions from a broad perspective based on the two pillars of "development of a system for the pilot program and experimentation" and the "CBDC Forum." Taking into account the discussions at the CBDC Forum, the Bank will proceed further with efforts to develop the system.

Source: https://www.boj.or.jp/en/paym/digital/dig240531a.pdf

Remarks by Mr Kazuo Ueda, Governor of the Bank of Japan, at the Fintech Summit FIN/SUM 2024, Tokyo, 5 March 2024.

While CBDC is being explored on the assumption that it will possess the features of cash that I have just described, there is, in fact, a stark difference between the two, namely, in terms of tangibility. Specifically, whereas cash is a tangible asset and comes in physical form, such as paper and metal, CBDC is intangible, with information on the amount and holder provided in the form of electronic data. This intangible feature is a crucial point in considering the differences between CBDC and cash.

Whether to issue a retail CBDC in Japan should be decided by discussions among the public.

(...) the sharing of roles between central bank money and private money as well as private firms' capacity for resource allocation and innovation should also be valued.

Source: https://www.bis.org/review/r240306a.htm

Kenya

Central Bank of Keyna: Discussion Paper on Digital Currency (February 2022)

As is with mobile money, the focus of the assessment of CBDC innovation must be on functionality and the problem it resolves for the people rather than the underlying technology. Whilst CBDC offers opportunities to reduce costs associated with digital payments, it also comes with risks particularly related to cybersecurity and unknowns on how it would impact central banks' core functions of monetary policy, financial stability and payment systems oversight. Further, in the case of Kenya where electronic money has taken root, the proposed value solution offered by CBDC seems to be already met.

Source: https://www.centralbank.go.ke/uploads/discussion_papers/CentralBankDigitalCurrency.pdf

Central Bank of Keyna: Discussion Paper on Central Bank Digital Currency: Comments from the Public (May 2023)

Ultimately, the rollout of CBDC should not be a race to be first. CBK's vision is for a payments system that is secure, efficient, and widely available to and works for Kenyans. Presently, Kenya's pain points in payments can potentially be solved by strengthening innovations around the existing payment ecosystem. Accordingly, implementation of a CBDC may not be a priority in Kenya in the short to medium term. However, CBK will continue to monitor developments in the CBDC world and periodically assess the need for CBDC in Kenya.

Source: https://www.centralbank.go.ke/wp-content/uploads/2023/06/Discussion-Paper-on-Central-Bank-Digital-Currency-Comments-from-the-Public.pdf

Korea

Ledger Insights: Korean wholesale CBDC pilot to support tokenized deposits (4 October 2023)

Today the Bank of Korea (BoK) announced plans for a wholesale central bank digital currency (wholesale CBDC) pilot in conjunction with the Bank for International Settlements

(BIS). Key motivations for the Korean wholesale CBDC include acting as a settlement asset for commercial bank tokenized deposits, and exploring the BIS' Unified Ledger concept.

The central bank previously ran retail CBDC trials but has concluded there is no current need for a retail CBDC, given the efficient payments landscape. However, it will continue to explore technology for an offline CBDC and privacy preserving technologies.[23]

Source: https://www.ledgerinsights.com/korean-wholesale-cbdc-pilot-to-support-tokenized-deposits-unified-ledger/

Malaysia

Bank Negara Malaysia (Central Bank Malaysia): Annual Report 2020

At the moment, the Bank does not have any immediate plans to issue CBDC. In Malaysia, the financial system continues to support the functioning of the economy while meeting the needs of individuals and businesses. To this end, the existing monetary and financial policy tools have remained effective in safeguarding monetary and financial stability. Moreover, domestic payment systems, including the RPP continue to operate safely and efficiently to support the needs of the economy and allow real-time digital payments.

Source: https://www.bnm.gov.my/documents/20124/3026128/ar2020_en_box2_digitalcurrency.pdf

Malaysia Financial Sector Blueprint 2022-26 - A Booster For Digital Finance (NEW STRAITS TIMES, 24 Februar 2022)

To catch up with the popularity of the Central Bank Digital Currency (CBDC), BNM will intensify research and experimentation on the use of CBDC for Malaysia's monetary and financial infrastructures with the initial focus on wholesale CBDC, making it clear that retail CBDC is not on the radar of the central bank. CBDC will also be handy in exploring emerging payment innovations for cross-border payments, such as the use of multi-CBDC arrangements"

Source: https://www.kkd.gov.my/dasar-privasi/233-kkd-news/21482-malaysia-financial-sector-blueprint-2022-26-a-booster-for-digital-finance

New Zealand

Reserve Bank New Zealand: Digital Cash in New Zealand (17 April 2024)

At the Reserve Bank - Te Pūtea Matua, we're looking at digital cash. It would be an electronic version of cash, issued by the Reserve Bank of New Zealand, but it would not replace cash.

We are in stage 2 of a multi-year, multi-stage process of considering digital cash. We've developed some principles and design options for New Zealand's digital cash, and we want you to tell us if we have got it right and what it would mean for you.

There are many details to work out before we can decide if digital cash is right for New Zealand, and we plan to consult again in the future on whether we should go ahead and issue digital cash.

Source: https://consultations.rbnz.govt.nz/money-and-cash/digital-cash-in-new-zealand/?_gl=1*dmmbrz*_ga*MjAyOTcxNzk5OS4xNzE5NTkxODA3*_ga_51JCWD9FGD*MTcxOTU5MjU3MS4xLjEuMTcxOTU5MjYwMC4wLjAuMA..#documents

Norway

Norges Bank Papers: Central bank digital currency - final report for project Phase 4

In summary, our assessment so far is that with respect to the precautionary approach, introducing retail CBDC is not a very urgent matter. The idea that the introduction of retail CBDC is the most adequate instrument for managing risks in Norges Bank's areas of responsibility associated with new monetary and payment systems is uncertain as well. Nevertheless, we cannot exclude the possibility that highly secured stablecoins in foreign currency issued by, for example, bigtechs, or CBDC from countries with significant economic relations to Norway, may be used by Norwegian audiences to a certain extent. Norges Bank should therefore pursue its assessment of how to ensure that payments in NOK offer required functionality demanded by end users in the future. Retail CBDC, wholesale CBDC, other changes in the settlement system and regulatory instruments are all relevant in such an assessment.

Source: https://www.norges-bank.no/contentassets/fb85d452791d4d1a9f04aa4d3c18683d/norges-bank-papers-2---phase-4---final-report.pdf?v=18122023133556

Philippines

Jan Marlon A. Evangelista, Bank Ofiicer, Payments Policy and Development Department Payments and Currency Management Sector (25 April 2024)

There is minimal perceived added value for the use of retail CBDC in the Philippines given the progress in the implementation of retail payment and financial inclusion reforms.

Account-based CBDCs may not yield much value compared to current retail payment instruments in the Philippines.

Source: https://www.bsp.gov.ph/Inclusive%20Finance/EFLP/EFLP2024_1_2c.pdf

Poland

NPB Management Board (May 2021)

The NBP Management Board has adopted the following stance of Narodowy Bank Polski on the issuance of digital zloty:

For many years Narodowy Bank Polski has been closely monitoring the progress of the work of other central banks on the issue of a new form of currency, i.e., central bank digital currency (CBDC), and it has been evaluating the needs of the Polish market in this respect. At the same time, NBP has been thoroughly examining the potential implications of CBDC issuance – its legal, technological and economic consequences (particularly, for the functioning of the banking sector, financial stability, monetary policy, and the operation of the payment system).

The current circumstances in Poland do not justify the rationale behind the launching of the pilot tests on CBDC issuance or digital currency implementation by other central banks. Until now NBP has not identified a systemic objective for the issuance of digital zloty or any specific needs of consumers or business entities that could not be satisfied by payment service providers in Poland but only through the central bank through the introduction of CBDC. The results of the analyzes conducted show no clear benefits from the introduction of central bank digital currency in Poland versus the identified risks related to its issuance for the economy, cash circulation and the financial system. NBP takes a prudent approach to the possibility of introducing digital zloty and does not currently choose to issue it, in the absence of any convincing justification. NBP's current stance on the issuance of CBDC may be modified should factors (domestic or international) justifying such a change emerge.

Source: https://nbp.pl/en/payment-system/statistical-data/analyzes-and-studies/central-bank-digital-currency/

Singapore

Monetary Authority of Singapore: A Retail Central Bank Digital Currency: Economic Considerations in the Singapore Context (November 2021)

"Overall, MAS' current view is that there is no pressing need for a retail CBDC in Singapore at this point in time. Demand for cash domestically remains some way from the "minimum threshold" where concerns of the negative implications from the lack of cash in circulation might arise.

MAS' decision to proceed with further technological and policy explorations of a retail CBDC should not be taken as a commitment to its issuance. There are broader considerations for CBDC issuance, such as whether the public expects direct access to central bank money as part of the social contract in Singapore. At the same time, while there is general consensus that money and payments are public goods whose provision should not be left entirely to the private sector, the appropriate "division of labour" between the public and private sector ultimately also involves some normative judgement.

Source: https://www.mas.gov.sg/-/media/MAS/EPG/Monographs-or-Information-Paper/A-retail-CBDC---Economic-Considerations-in-the-Singapore-Context.pdf

Sweden

The state and the payments: Summary of the report of Betalningsutredningen, Stockholm 2023

The Inquiry therefore does not currently see sufficiently strong societal needs for the Riksbank to issue an e-krona. Given that development is occurring rapidly, economic, political and technological changes may prompt a new assessment.

Source: https://www.regeringen.se/contentassets/c01377cf65424cf0b12addf64c04374a/english-summary-the-state-and-the-payments.pdf

Sveriges Riksbank: E-krona – state money in digital form

Whether or not to introduce an e-krona in Sweden is ultimately a political decision. An inquiry into the role of the state in the payment market, presented in March 2023, assesses that there is currently insufficient social need for the Riksbank to issue an e-krona. However, global changes may lead to a different assessment in the future. In its consultation response, the Riksbank points out that work on developing legislation for a possible e-krona needs to begin now, so as to shorten the implementation period if the launch of an e-krona becomes relevant later.

Source: https://www.riksbank.se/en-gb/payments--cash/e-krona

Switzerland

Speech by Thomas J. Jordan: Towards the future monetary system. Introductory remarks, event 'Towards the future monetary system', Zurich (8 April 2024)

Some central banks are also exploring the issuance of a digital form of cash as a retail payment instrument. The SNB currently sees no need in Switzerland for such digital central bank money for the general public, also known as retail CBDC. Consumers and businesses already have access to a wide range of efficient and innovative payment instruments offered by the private sector. Retail CBDC could fundamentally alter the current monetary system and the role of central banks and commercial banks, with far-reaching consequences for the financial system. From a Swiss perspective, the risks of retail CBDC currently outweigh its potential benefits.

Source: https://www.snb.ch/en/publications/communication/speeches/2024/ref_20240408_tjn

Taiwan

Central bank Deputy Governor Chu Mei-lie (Taipeh Times, 8 December 2023)

Taiwan's central bank is prudently approaching the issue and has no timetable on when to reach a conclusion, she said.

Source: https://www.taipeitimes.com/News/biz/archives/2023/12/08/2003810290

Taiwan c.bank says no timetable for launching digital currency (Reuters 7 July 2024)

Taiwan's central bank said on Sunday that it has no timetable for launching a digital currency, warning the process will be "huge and complex", but it will hold public hearings on the matter next year to spread knowledge.

Source: https://www.reuters.com/world/asia-pacific/taiwan-cbank-says-no-timetable-launching-digital-currency-2024-07-07/

Thailand

Bank of Thailand: Pilot Program, Retail CBDC Conclusion Report (March 2024)

In a nutshell, the BOT envisions that CBDC can foster competition among FSPs, enable new financial innovations, and make more capable and cost-efficient services available to the public in the future. Nonetheless, challenges associated with Retail CBDC remain such as user adoption, as well as its consequences on the business models of FSPs. Meanwhile, the value-added benefits of CBDC remain unclear to many central banks, leading them to designate their respective CBDC plans as long-term endeavors.

At present, the BOT has no immediate plan to officially issue Retail CBDC, but the BOT will use the results from the pilot, especially insights related to the technology design, to apply to new areas and future studies on enhancing the payment system.

Source: https://www.bot.or.th/content/dam/bot/documents/en/financial-innovation/cbdc-digital-currency/rCBDC%20Conclusion%20Report.pdf

United Kingdom

Treasury Committee, Oral evidence: Bank of England Financial Stability Reports, HC 140, Monday 16 January 2023

Andrew Bailey (Governor at the Bank of England): “I am not convinced about some of the problems that we might be trying to solve. I am not necessarily convinced that the retail payment systems need this sort of upgrade at the moment.

Frankly, I am still thinking hard about this, and the thing that I come back to is that if there is a demand for retail digital money—if there is a demand for stablecoins—and we must set the standard very high because of the need for certainty of value of stablecoins, is it actually different from a central bank digital currency? Should we make that distinction, or not? It remains to me an open question.

From the Bank of England's point of view, our main motivation for a retail CBDC would be to promote the singleness of money by ensuring that the public always has the option of going into fully functional central bank money that can be used in their everyday lives. We have set out a number of arguments for why this might be needed in our consultation paper. But we do not yet know if we'll definitely need to do it – this will depend on how trends in money and payments play out.

Source: https://committees.parliament.uk/oralevidence/12520/pdf

House of Commons Treasury Committee: The digital pound: still a solution in search of a problem? First Report of Session 2023–24

58. There are some potential benefits to the UK economy from a digital pound. A digital pound could help support innovation in domestic payments, while guarding against some of the risks posed by new forms of private digital money by maintaining public access to a form of central bank money. Innovation brought about by a digital pound could also support the UK’s international competitiveness in payments (and related) technologies, particularly if it is amongst the first major central banks to issue a retail CBDC. The extent of these benefits is unclear, however. Nor is it yet clear that a digital pound is the only (or best) means of achieving them.

60. Building the infrastructure needed for a digital pound would also likely be very expensive, and the eventual decision on whether to launch a digital pound will need to be subject to a rigorous cost-benefit analysis. The Bank of England and Treasury must approach this analysis from a neutral stance—the launch of a digital pound must not be viewed as an inevitable consequence of investing in further detailed design work. The policy question must remain ‘why do it’ rather than becoming one of ‘why not do it’.

Source: https://committees.parliament.uk/oralevidence/12520/pdf/

United States

On the website of the Board of Governors of the Federal System: Has the Federal Reserve decided to create a CBDC?

The Federal Reserve issued Money and Payments: The U.S. Dollar in the Age of Digital Transformation as a first step in fostering a broad and transparent public dialogue about CBDCs in general, and about the potential benefits and risks of a U.S. CBDC. The paper is not intended to advance any specific policy outcome and no decisions have been made at this time. The Federal Reserve has made no decision on issuing a central bank digital currency (CBDC) and would only proceed with the issuance of a CBDC with an authorizing law. Testifying before the House Financial Services Committee in March 2023, Chair Powell said a central bank digital currency is, “something we would certainly need Congressional approval for.”

Source: https://www.federalreserve.gov/cbdc-faqs.htm

Jerome Powell testifiying before Congress on March 7 2024 (Reuters)

Federal Reserve Chairman **Jerome Powell** significantly downplayed the possibility of the central bank issuing its own digital currency, and said if it ever came to pass, the government would play a limited role. Testifying before Congress Thursday, Powell said policymakers were "nowhere near" taking action on adopting such a tool.

“People don’t need to worry about a central bank digital currency, nothing like that is remotely close to happening anytime soon," he told the Senate Banking Committee.

He added that the Fed has no interest in establishing accounts for individuals that would compete with the banking system, and it would not support any Fed monitoring of personal financial transactions.

"If we were to ever do something like this, and we’re a very long way from even thinking about it, we would do this through the banking system, the last thing…we the Federal Reserve would want would be to have individual accounts for all Americans," he said.

Source:https://www.reuters.com/markets/us/powell-says-fed-not-remotely-close-central-bank-digital-currency-2024-03-07/

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Digital euro glossary

Disclaimer: Terms and definitions refer to what applies to a digital euro environment.

Term	Definition
digital euro	The digital form of the single currency available to natural and legal persons.
retail central bank digital currency (rCBDC)	A central bank liability in digital form offered to the general public (e.g., individual users, business users and governments or other public authorities) for retail payments.
acceptance solution	A combination of a device for business digital euro users (e.g., a terminal at the POS), a user interface (e.g., a payment application) and a communication technology (e.g., quick response (QR) code-based payment or near-field communication (NFC)-based payment), together supporting the exchange of payment transaction information between payer and payee for payment initiation and user authentication.
access management	Services offered by payment service providers (PSPs) enabling digital euro users to hold digital euro and conduct transactions. These services include the opening of digital euro payment accounts, managing aliases, configuring a waterfall account and providing form factors or acceptance solutions.
access manager	A payment service provider (PSP) that provides digital euro users with access to the digital euro service platform (DESP). An access manager can act as an instructing party or authorise a third party to act on its behalf.
account information service	An online service to provide consolidated information on one or more payment accounts held by the payment service user with one or more payment service providers (PSP).
account information service provider (AISP)	A payment service provider (PSP) pursuing account information services.

Term	Definition
account portability	Upon a digital euro user's request, transferring from one payment service provider (PSP) to another either the information about all or some digital euro payment services, including recurring payments, executed on a digital euro payment account, or the digital euro holdings from one digital euro payment account to the other, or both, with or without closing the former digital euro payment account, while maintaining the same account identifier. This process is also known as 'switching'.
acquiring of payment transactions	A payment service provided by a payment service provider (PSP) contracting with a payee to accept and process payment transactions, which results in a transfer of funds to the payee.
alias	A unique pseudonymous identifier, such as the digital euro account number (DEAN), which is unique to a given digital euro payment account, used to protect user's identity when processing digital euro payments that can only be attributable to an identifiable natural or legal person by the payment service provider (PSP) distributing the digital euro or by the digital euro user.
alias look-up service	A service that stores digital euro users' aliases and connects them to the respective access manager identifier and DEAN. The service enables this information to be looked up when a payment is initiated, thus enhancing usability and the digital euro user's payment experience.
anonymity	A situation in which no personal data (i.e. data relating to an identified or identifiable living individual user) are used.
application to application (A2A) interface	An interface permitting the interaction between software applications and external services (e.g. wallet services) without human interaction.
assisted use	Any situation in which a digital euro user accesses digital euro services via an access manager and receives additional support, e.g. by interactions with the access manager's staff in one of its branches or using its telephone service as well as systems mimicking human interaction.

Term	Definition
authentication	A procedure which allows the payment service provider (PSP) to verify the identity of a payment service user or the validity of the use of a specific payment instrument, including the use of the user's personalised security credentials.
back-end infrastructure	All hardware and software components (e.g., servers, applications) necessary for recording of digital euro holdings and processing of digital euro payment transactions. The infrastructure interacts with front-end services or other back-end infrastructures via defined interfaces. Its functions include processing payment instructions and storing data on updated digital euro holdings.
blockchain	A type of distributed ledger technology (DLT) in which transactions are validated and recorded in a distributed ledger in separate but connected batches known as blocks.
business user	A natural or legal person allowed to open multiple digital euro accounts, each with a holding capacity of zero. Payments received on the digital euro account(s) are transformed into private money (waterfall) as soon as technically feasible and refunds made from the digital euro account(s) are instantly funded from private money (reverse waterfall).
business-to-business (B2B) payment	A payment from one business digital euro user to another.
central bank money (CeBM)	Central bank liabilities, in the form of either banknotes, bank reserves or digital euro held at the Eurosystem.
conditional payment	A digital euro payment transaction which is instructed automatically upon fulfilment of pre-defined conditions agreed by the payer and by the payee.
confidentiality	An obligation enforced through a set of rules and operational measures which restricts the accessibility and interpretability of data to authorised users within a specific context.

Term	Definition
countering the financing of terrorism (CFT) check	A check aimed at countering the solicitation, collection and provision of money that may be used to support terrorist acts or organisations. As a minimum, the check includes customer due diligence (CDD) and the monitoring, detection and reporting of suspicious transactions.
credit institution	An undertaking the business of which is to take deposits or other repayable funds from the public and grant credits for its own account.
credit memorandum balance (CMB)	A limit defined by the holder of a dedicated cash account (DCA) on the usage of the liquidity of that dedicated cash account (DCA) by an access manager. The number of credit memorandum balances defined for a given dedicated cash account (DCA) is unlimited.
cross-border payment	A payment in which the intermediaries of the payer and the payee are in different jurisdictions.
cross-currency payment	A payment that requires transferring different currencies.
cryptography	Techniques and algorithms that can be applied to data to ensure properties such as confidentiality, data integrity, secure authentication and non-repudiation of messages.
customer due diligence (CDD)	A process to obtain sufficient knowledge of digital euro users (e.g. via know your customer (KYC)) enabling obliged entities to determine the money laundering and terrorist financing risks of digital euro user relationships or transactions.
customer-to-business (C2B) payment	A payment from an individual user to a business user. Typical C2B payments include point-of-sale (POS) payments in shops and e-commerce payments over the internet.
dedicated cash account (DCA)	An account in central bank money, owned and used by a PSP (i.e., DCA holder) for the purpose of enabling digital euro funding and defunding requests at the request and on behalf of digital euro users.
DCA Holder	A PSP which owns one or multiple dedicated cash account(s) (DCA) in the digital euro service platform (DESP).

Term	Definition
decentralisation	The process of transferring a degree of control over an activity, service or organisation from one single entity to several entities.
defunding	The process of reducing a digital euro user's digital euro holdings in their account or device through digital euro redemption, in combination with an increase of digital euro user's private money or an increase in the digital euro user's cash holdings. See funding and waterfall approach.
de-tokenisation	A process of retrieving transaction-related data and/or other sensitive data based on surrogate value, referred to as token.
device	A piece of equipment attributed to a digital euro user that could be used for authorising digital euro transactions and user authentication. Examples include smartphones, wearables, and cards.
digital euro account number (DEAN)	The compulsory unique identifier of a digital euro account.
digital euro payment	A transfer of digital euro between digital euro users.
digital euro payment account	An account held by one or more digital euro users with a payment service provider (PSP) to access digital euro recorded in the digital euro settlement infrastructure to initiate or receive digital euro payment transactions, irrespective of technology and data structure.
digital euro payment scheme	A single set of rules, practices, standards and / or implementation guidelines for the execution of digital euro transactions and which is separated from any infrastructure or payment system that supports its operation, and includes any specific decision-making body, organisation or entity accountable for the functioning of the scheme.
digital euro service	A payment service or other service accessible to a digital euro user in a digital euro environment.
digital euro service platform (DESP)	The technical platform enabling the issuance and redemption of digital euro and providing functions (e.g. settlement) that cannot be accomplished by an individual intermediary on its own.

Term	Definition
digital euro user	An individual user, a business user, a government or other public authorities making use of digital euro payment service, whether in the capacity of payer, payee or both.
digital euro wallet	A service that enables digital euro users to initiate digital euro transactions by storing secure information related the digital euro holdings of a digital euro user, which are either with the Eurosystem or local in an offline digital euro device.
digital operational resilience	The ability of a financial entity to build, assure and review its operational integrity and reliability by ensuring, either directly or indirectly through the use of services provided by ICT third party service providers, the full range of ICT-related capabilities needed to address the security of the network and information systems which a financial entity uses, and which support the continued provision of financial services and their quality, including throughout disruptions.
direct access	A type of access to a retail central bank digital currency (rCBDC) for which the central bank provides onboarding, distribution and settlement services directly to digital euro users.
distributed ledger technology (DLT)	A type of technology that support the distributed recording of encrypted data.
distributed system	An infrastructure where multiple independent components appear as a single coherent unit to its users, which requires these components to collaborate on their tasks, typically via the exchange of messages over a network. These components can be made redundant and/or be separated geographically to increase performance, scalability, availability and/or resilience, e.g. to avoid single points of failure or to mitigate geographic concentration risks. The components can be operated either by a single entity or multiple entities.
distribution of digital euro	A process of transferring digital euro from the digital euro issuer to digital euro users’ accounts or devices through the processes of digital euro issuance and funding.
e-commerce payment	An electronic payment between two digital euro users for the purchase of goods or services via the internet.

Term	Definition
electronic money (e-money)	Electronically, including magnetically, stored monetary value as represented by a claim on the issuer which is issued on receipt of funds for the purpose of making payment transactions, and which is accepted by a natural or legal person other than the electronic money issuer.
electronic money institution (EMI)	A legal person that has been granted authorisation to issue electronic money.
enhanced due diligence (EDD)	Detailed rules for particularly rigorous digital euro user identification and verification procedures beyond the regular customer due diligence (CDD) necessary for the establishment of the identity and business profile of a digital euro user.
entries	Recordings in back-end infrastructure representing the holdings that are available to a digital euro user.
environment	A combination of IT platforms, actors and their roles that enables digital euro services to be provided to digital euro users in accordance with the relevant legal framework and technical documentation.
European Data Protection Representatives (EUDPR)	Representatives in the EU (with regard to obligations under the General Data Protection Regulation) of non-EU firms which act as controller or processor of personal data while offering goods or services, irrespective of whether a payment of the data subject is required, to data subjects in the EU.
form factor	A combination of a device from an individual digital euro user (e.g. mobile device, physical card), a digital euro user interface (e.g. a payment application) and a communication technology (e.g. quick response (QR) code-based payment or near-field communication (NFC)-based payment), together supporting the exchange of payment information between payer and payee for payment initiation and authentication.
funding	The process of increasing a digital euro user's holdings in their account or device through digital euro issuance, in combination with a reduction of another liquidity source from the digital euro user (e.g., cash or private money). See defunding and reverse waterfall approach.

Term	Definition
government or other public authorities	Public authorities allowed to open multiple digital euro accounts, each with a holding capacity of zero. Payments received on the digital euro account(s) are immediately transformed into private money (waterfall) and refunds made from the digital euro account(s) are instantly funded from private money (reverse waterfall).
government-to-person or business (G2X) payment	A payment from a government or other public authorities to an individual user or business user (e.g. subsidies and rebates).
hashing	Hashing is a computational one-way operation that transforms a string of characters into a fixed size output string from which it is not possible to re-construct the original input. It is used to verify the integrity of data without revealing it.
holdings	An amount of digital euro available to a digital euro user. Holdings may be accessed by digital euro users under their contractual relationship with digital euro payment service providers (PSPs). The holdings increase or decrease as the result of a successful payment, funding or defunding operation.
identification	The process of determining an individual user's, business user's, government or other public authorities' identity.
individual holding limit	The maximum amount of digital euro that can be held by each digital euro user.
individual user	A natural person who is allowed to open a digital euro account on which to hold digital euro, subject to certain holding limits.
initiation channel	Technological means through which a payment can be initiated and verified by a payment service provider (PSP). This differs based on the type of payment environment, particularly remote payments versus proximity.
instructing party	An intermediary or third entity acting on behalf of an intermediary that can instruct digital euro transactions and receive notifications and reports sent by the digital euro service platform (DESP). See access manager.
instruction	An order issued by a digital euro user to its payment service provider (PSP).

Term	Definition
intermediated access	A type of access to a retail central bank digital currency (rCBDC) in which the central bank does not interact directly with digital euro users but relies on intermediaries to provide onboarding, authentication, distribution or other payment services.
interoperability	The use of common rules, standards and processes across different payment services.
inter-PSP fee	A fee paid for each transaction directly or indirectly (i.e. through a third party) by the payment service provider (PSP) involved in acquiring digital euro to the payment service provider (PSP) involved in distributing digital euro. The net compensation or other agreed compensation is part of the inter-PSP fee.
issuance of digital euro	A process which results in the creation of digital euro units on the Eurosystem’s balance sheet and the redemption of central bank reserves.
know your customer (KYC)	A check aimed at identifying digital euro users and risks attached to providing services to them. The check is also aimed at ensuring that these services are used in line with intermediaries’ expectations and for legitimate purposes. See customer due diligence (CDD).
legal tender	The mandatory acceptance of a means of payment, at full face value, with the power to discharge from a payment obligation.
liquidity management	The processes to support the distribution of the digital euro, i.e., liquidity transfer and funding/defunding.
liquidity transfer	The process to move central bank reserves between a payment service provider’s (PSP) main central bank reserves and central bank reserves dedicated for the use in the digital euro environment. It is executed upon request by payment service providers (PSPs) to satisfy the expected demand from digital euro users controlled and performed by the Eurosystem.
local storage	The secure storage and computational capabilities of a digital euro user’s physical devices, such as smart cards or mobile phones.

Term	Definition
local storage settlement model	A settlement model referring to secure element (SE) in the digital euro user's devices performing the technical tasks of verification and recording, in line with rules set by a central bank.
machine-to-machine (M2M) payment	A payment requiring a transfer solution that can work without human interaction.
m-commerce	A virtual location at which goods and services are sold and paid for, accessed through a mobile app.
merchant	A business user providing products or services to individual users in exchange for payment in digital euro.
merchant category code (MCC)	A four-digit number listed in ISO 18245 standard for retail financial services used to classify a business user by the types of goods or services it provides.
merchant service charge	A fee paid by the payee to the acquirer in relation to card-based payment transactions. In the context of the digital euro, a merchant service charge is interpreted as a fee paid by the payee to the payment service provider (PSP) acquiring a digital euro payment transaction.
national central bank (NCB)	A national central bank of a European Union Member State whose currency is the euro.
near-field communication (NFC)-based payment	A payment made with a short-range wireless (frequently referred to as contactless) connectivity technology that enables communication between devices when in proximity.
offboarding of a PSP	A set of activities conducted by a back-end infrastructure operator to revoke a payment service provider's (PSP) access to the infrastructure.
offline payment	A payment in which authorisation and settlement takes place between payer's and payee's devices, without the need for any connection to the internet or other computer network and therefore only in physical proximity.
offline digital euro device	A combination of hardware and software that allows a digital euro user to pay offline with offline holdings that are stored on the digital euro user's device, without the intervention of a third party.

Term	Definition
onboarding of a PSP	A set of activities conducted by a back-end infrastructure operator to enable a payment service provider (PSP) to access the infrastructure.
onboarding repository service	A service that supports enforcing the holding limits and ensuring the exceptional switching (i.e., account portability) of digital euro payment accounts in emergency situations upon the request of the digital euro user.
online payment	A payment in which settlement requires that at least the payer or the payee is connected to a network. A third party validated solution is considered in the current project.
operator	An entity operating one or more digital euro services, e.g. an alias look-up service or an onboarding repository service.
payee	A natural or legal person who is the intended recipient of funds which have been the subject of a payment transaction.
payee-initiated transaction	A transaction involving an instruction from a payee to a payment service provider (PSP) to debit a payer.
payer	A natural or legal person who holds a payment account and allows a payment order from that payment account, or, where there is no payment account, a natural or legal person who gives a payment order.
payer-initiated transaction	A transaction involving an instruction from a payer to a payment service provider (PSP) to credit a payee.
payment account	An account held in the name of one or more payment service users which is used for the execution of payment transactions.
payment authorisation	The consent given by a payer, or a third party acting on behalf of the payer, to pay.
payment initiation service	A service to initiate a payment order at the request of the payment service user with respect to a payment account held at another payment service provider (PSP).
payment initiation service provider (PISP)	A payment service provider (PSP) pursuing payment initiation services.

Term	Definition
payment institution	A legal person that has been granted authorisation to provide payment services throughout the European Union.
payment instrument	A personalised device(s) and/or set of procedures agreed between the payment service user and the payment service provider (PSP) and used in order to initiate a payment order. Examples of electronic payment instruments include payment cards, credit transfers and direct debits.
payment service provider (PSP)	A legal person providing services (e.g. issuing of payment instruments, acquiring, payment authorisation, digital euro user authentication, offering value added service) enabling payments between digital euro users.
peer-to-peer validated	A digital euro payment solution in which a payment between a payer and payee does not require validation by a third party.
person or business-to-government (X2G) payment	A payment from an individual user (or a business user) to a government or other public authorities (e.g. payments of taxes, duties and fines).
personal data	Any information relating to an identified or identifiable living person, individual user or business user.
person-to-person (P2P) payment	A payment from one individual user to another.
point of interaction (POI)	A physical premise (point-of-sale) or virtual space (e.g., e-commerce and m-commerce) of the merchant at which the payment transaction is initiated.
point of sale (POS)	The address of the physical premises of the merchant at which the payment transaction is initiated.
PSP identifier	An identifier used to uniquely identify a payment service provider (PSP) in the digital euro service platform (DESP).
PSP mapping	A process of linking a digital euro user's digital euro account number (DEAN) and (if applicable) other aliases to the corresponding PSP identifier to enable forwarding of payment data between involved payment service providers (PSPs).

Term	Definition
PSP reference data	A set of information of a payment service provider (PSP) that are relevant for establishing a contractual relationship with the Eurosystem, for connecting to the digital euro service platform (DESP) and for the services it provides (e.g., intermediary type, name, address, contact persons, roles in the system, dedicated cash account (DCA), status).
private money	Money issued by a private entity.
quick response (QR) code-based payment	Payment initiated via the use of a two-dimensional matrix barcode in the form of a machine-readable optical label with digital information, shared between payer and payee.
recovery point objective (RPO)	The maximum amount of time for which data updates (creations, modifications, deletions) can tolerably remain lost/unrecovered as a result of a failure or disaster event. Data changes that precede a failure or disaster event by at least this amount of time are preserved by a recovery.
recovery time objective (RTO)	The maximum tolerable amount of time required to restore one or more applications and associated data to a correct operational state after a failure or disaster event has compromised availability.
redemption of digital euro	A process which results in the destruction of digital euro units and of the corresponding liability on the Eurosystem balance sheet.
residence	The place where a natural person is legally resident in the Union.
reverse waterfall	A method for facilitating the use of a digital euro whereby private money from a linked liquidity source chosen by a digital euro user (e.g. a private money account) is automatically converted into digital euro when the digital euro user's digital euro holdings are not sufficient to make a payment. See waterfall approach and funding.
secure element (SE)	A tamper-proof chip with pre-installed software that can store confidential and cryptographic data and run secure applications.
settlement	The completion of a payment with the aim of discharging digital euro users' obligations.

Term	Definition
settlement model	A model according to which the two technical settlement tasks, namely verification and recording, are allocated among operational entities, or to the local storage devices possessed by digital euro users.
settlement provider	An entity that performs settlement verification (i.e. checking the availability of the payer's money to assess whether it can be transferred from payer to payee) and/or settlement recording (i.e., performing the bookkeeping of the root of title of holdings).
simplified due diligence (SDD)	A simplified or reduced set of scrutiny measures applicable in low money laundering and terrorist financing risk situations, which should address all components of the standard customer due diligence (CDD) procedure.
stablecoin (backed asset)	A digital unit of value that is not a form of any specific currency or basket of currencies. It relies on a set of stabilisation tools to minimise fluctuations in its price against a currency or currencies.
strong customer authentication (SCA)	An authentication based on the use of two or more elements categorised as knowledge (something only the user knows), possession (something only the user possesses) and inherence (something the user is) that are independent, in that the breach of one does not compromise the reliability of the others, and is designed in such a way as to protect the confidentiality of the authentication data.
technical acquirer	An entity that enables business users, governments or other public authorities to technically accept digital euro payments (e.g. terminal provision). It does not hold digital euro users' digital euro and does not necessarily adhere to the scheme.
technical proof	A cryptographic proof or authority, over entries (holdings) or identity in the digital euro settlement infrastructure.
token	A substitute value which replaces payment account reference, end-user identification data, or potentially transaction related data.

Term	Definition
tokenisation	A process of substituting transaction-related data and/or other sensitive data based on a surrogate value, referred to as a token.
transaction	A transaction could be a payment or a funding or a defunding, or a reservation or a combination of the previous (e.g., a payment that requires a defunding).
transaction management	Services offered by intermediaries to digital euro users related to the administration and processing of transactions.
third country	A country that is not a member of the European Union
third party-validated digital euro	A solution in which a third party determines the validity of a transaction between payer and payee.
transaction identifier	A unique identifier for a digital euro transaction.
trusted execution environment (TEE)	An isolated processing environment that ensures (i) the integrity and confidentiality of the data that is being processed and (ii) the authenticity of the software/application running on it.
user identifier	A unique identifier created by a payment service provider (PSP) distributing the digital euro that unambiguously differentiates, for online and offline digital euro purposes, digital euro users but that is not attributable to an identifiable natural or legal person by the European Central Bank and the national central banks (NCBs).
user to application (U2A) interface	An interface suitable for human interaction to permit the exchange of information between software applications of a retail central bank digital currency (rCBDC) and a digital euro user through a graphical user interface.
visitor	A natural person who does not have its domicile or residence in a Member State whose currency is the euro, and who is travelling to and staying in one of those Member States, including for tourism, business or education and training purposes.
validation of a transaction	A process of checking at the level of payment service providers (PSPs) to ensure that the payer is entitled to make a payment, or that the payment fulfils all technical standards.

Term	Definition
verification of a transaction	A set of processes to check the availability of the payer's holdings and perform any other task that may be necessary for the verifying entity, or entities, to assess whether the transaction can be settled.
waterfall approach	A method for facilitating the use of a digital euro by automatically converting the amount of digital euro that exceeds a defined holding threshold into private money, in a linked liquidity source chosen by the digital euro user such as a private money account. See reverse waterfall approach and defunding.
wearable	A broad category of worn or carried physical devices which include a variety of options from less complex devices (e.g., tags) to smart watches.

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Convenzione Interbancaria per l'Automazione

Associazione Bancaria Italiana

Rilevazione sull'IT nel settore bancario italiano

Profili economici e organizzativi

Esercizio 2024

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Presentazione

La “Rilevazione sull’IT nel settore bancario italiano”, curata annualmente da CIPA (Convenzione Interbancaria per l’Automazione) e ABI (Associazione Bancaria Italiana), offre un contributo di analisi sugli aspetti economici, organizzativi e tecnologici dell’Information and Communication Technology nel settore bancario. Oltre che agli operatori bancari – ai quali vuole fornire elementi di confronto e di riferimento utili per valutazioni funzionali alle scelte in ambito informatico – l’indagine si rivolge a tutti coloro che, a vario titolo, sono interessati a conoscere l’evoluzione dell’IT nel settore creditizio.

La Rilevazione si articola in due distinte indagini pubblicate separatamente.

La prima, a cui si riferisce il presente rapporto, è dedicata all’esame dei profili economici e organizzativi dell’IT e analizza l’andamento e la ripartizione dei costi e degli investimenti IT, le principali finalità della spesa informatica, l’assetto organizzativo e le modalità di sourcing, le iniziative di innovazione tecnologica, la composizione e la formazione del personale IT.

La seconda, focalizzata in ogni edizione su una specifica tematica, è riservata ai profili tecnologici e di sicurezza ed è rivolta all’analisi delle scelte IT in materia di metodologie, strumenti e tecnologie innovative, utilizzati nel contatto con la clientela, a supporto dei processi interni e all’esame dei connessi aspetti di sicurezza informatica.

I rapporti delle indagini sono pubblicati sul sito internet della CIPA (www.cipa.it).

La Presidenza della CIPA esprime apprezzamento per il contributo fornito dai gruppi bancari e dalle banche partecipanti alla Rilevazione e ringrazia i componenti del gruppo di lavoro che ha condotto l’indagine e redatto il presente rapporto.

IL PRESIDENTE DELLA CIPA (Banca d’Italia)	LA VICEPRESIDENTE DELLA CIPA (ABI)
Giuseppe Zingrillo	Barbara Pelliccione

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IL QUESTIONARIO

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45 DOMANDE

1.221 VARIABILI

I RISPONDENTI

23 GRUPPI BANCARI
92% del totale attivo dei gruppi

32 BANCHE
63% dei fondi intermediati del settore bancario

L'indagine riguarda la realtà nazionale di banche e gruppi, limitatamente alle componenti bancarie e società strumentali a supporto dell'attività bancaria

ESERCIZIO 2024

RILEVAZIONE ECONOMICA CIPA

I DATI DEI 23 GRUPPI BANCARI

€6,3 mld COSTI IT (TCO)

€2,1 mld INVESTIMENTI IT
- **€1,8 mld** per software
- **€290 mln** per hardware

€366 mln SICUREZZA IT (cash out)

247.587 DIPENDENTI
- **12.887** nell'IT

CLOUD COMPUTING

3,4% degli FTE IT

Modelli prevalenti

EURO DIGITALE

AMBITI DI MAGGIOR IMPEGNO ECONOMICO
- Incassi e pagamenti
- Servizi bancari tipici
- Gestione sicurezza
- Gestione sistemi informativi

OPPORTUNITÀ
- Nuovi servizi alla clientela
- Revisione dei sistemi IT periferici
- Revisione/ottimizzazione di infrastrutture e applicazioni

Sintesi

L'insieme dei partecipanti alla "Rilevazione sull'IT nel settore bancario italiano – Profili economici e organizzativi – esercizio 2024" è costituito da 23 gruppi bancari e 32 banche, di cui due non appartenenti a gruppi o appartenenti a gruppi diversi da quelli partecipanti.

Gruppi bancari

I gruppi partecipanti rappresentano complessivamente il 92% dell'insieme dei gruppi bancari italiani in termini di totale attivo consolidato e sono classificati dimensionalmente in sei gruppi Principali, nove Medi e otto Piccoli. Operativamente, la maggior parte di essi svolge in prevalenza attività di tipo retail, che in media costituisce il 63,4% dell'attività complessiva.

TCO

Nel 2024, il total cost of ownership - TCO (spese correnti più ammortamenti) complessivamente sostenuto per il comparto IT dai 23 gruppi bancari partecipanti è stato pari a 6.334 milioni di euro.

Analizzandone l'andamento su un campione costante di 19 gruppi, per l'esercizio 2024 si registra un incremento del TCO complessivo, rispetto all'esercizio precedente, pari al 4,3%. Per la maggior parte dei gruppi, l'incremento del TCO è dovuto all'avvio di nuovi progetti, al rincaro di prodotti, servizi e consumi IT, mentre i fattori che maggiormente contribuiscono alla sua riduzione sono legati alla sospensione o differimento delle attività IT e al risparmio su prodotti, servizi e consumi IT. Per il 2025 è previsto un decremento del TCO dell'1,8%.

La ripartizione del TCO per fattori produttivi evidenzia che i Servizi da terzi assorbono oltre la metà dei costi IT (54,5%); la restante quota è prevalentemente ripartita tra Software in licenza d'uso (24%), Personale interno (12,6%) e Hardware (7%). L'analisi dell'evoluzione del TCO nel quinquennio 2020-2024, e in previsione per l'esercizio 2025, registra per il Software in licenza una crescita importante nel 2023 e un balzo ancora più significativo nel 2024. Le previsioni per il 2025 vedono un decremento o una sostanziale stabilità dei costi per tutti i fattori produttivi.

La ripartizione del TCO per aree tematiche conferma che la maggior parte dei costi IT si concentra nello sviluppo e la manutenzione delle Applicazioni (50%) e nel Data center (22,1%). In quest'ultima area prevalgono i costi per la Server farm (56%) rispetto al Mainframe (44%). Analizzandone l'andamento, nell'esercizio 2024 si possono notare variazioni cospicue per Manutenzione adattativa e correttiva e per Server farm, con trend in aumento, e per Mainframe, con trend in diminuzione.

Cash out IT

Il cash out IT (spese correnti più investimenti) presenta una suddivisione per aree tematiche molto simile a quella del TCO. In tutte le aree, le spese correnti IT prevalgono sugli investimenti.

La Sicurezza informatica assorbe in media il 4,9% del cash out IT. Tale percentuale è comprensiva di una quota stimata (0,7%), segnalata da quei gruppi che riscontrano difficoltà a scorporare analiticamente questi costi. Il trend a campione costante del TCO e del cash out destinati alla Sicurezza IT è in aumento dal 2022.

In valore assoluto, il cash out IT complessivamente destinato a interventi di compliance da 21 gruppi ammonta a 780,9 milioni di euro. Le iniziative informatiche dedicate alla compliance assorbono in media l'11,1% del cash out IT. Le maggiori percentuali di tale spesa sono destinate agli adeguamenti per la vigilanza Banca d'Italia/BCE/EBA/ESMA, alla normativa per la resilienza operativa digitale, ai mercati finanziari e ai servizi di pagamento. Dal 2022 si registra, a campione costante, un trend in crescita.

Ripartendo il cash out IT per aree funzionali, la porzione principale è impiegata nei processi dell'area Operations (41,1%); seguono i processi di supporto (28,6%), di marketing, commerciali e customer service (16,7%) e di governo (13,7%). Il 67,2% del cash out IT è impegnato per il mantenimento dell'operatività corrente (run) e la restante quota (32,8%) è dedicata a iniziative tese a migliorare/innovare l'operatività bancaria (change). Tendenzialmente, la quota del cash out IT dedicata al change aumenta al crescere della dimensione dei gruppi.

Mediamente, il cash out IT destinato a servizi in public cloud è pari al 4,1%, in linea con il dato del 2023. Il trend previsionale per il biennio 2025-2026 risulta in aumento per 16 gruppi.

La percentuale media del cash out IT totale dedicata all'open banking appare contenuta, pari allo 0,5%. Osservando i trend previsionali, nove gruppi, soprattutto quelli già attivi in questo ambito, prevedono un incremento della propria quota percentuale nel biennio 2025-2026.

Investimenti IT e innovazione tecnologica

Gli investimenti IT, che nel 2024 in totale ammontano a 2.140 milioni di euro, si concentrano soprattutto nell'area delle Applicazioni (67,7%), seguita dai Sistemi periferici (16,4%) e dal Data center (10,3%). Il 73,3% di essi interessa il Software e il 26,4% l'Hardware. Per il 2025, i 23 gruppi prevedono un aumento del 12% dell'ammontare complessivo degli investimenti IT rispetto al 2024. In media, nel 2024, 20 gruppi hanno destinato il 3,9% dei loro investimenti IT, pari in valore assoluto a 2,1 milioni di euro, a iniziative afferenti a tecnologie innovative (intelligenza artificiale, application programming interfaces - API, robotic process automation - RPA, distributed ledger technology - DLT, quantum computing).

Indicatori economici

Il capitolo sui profili economici termina con una molteplicità di indicatori, calcolati rapportando tra loro le principali grandezze di conto economico e operative dei gruppi bancari. Tali indicatori sono presentati in serie storiche su tre anni, a campione costante, per classi dimensionali e per modelli di sourcing IT. Nel triennio 2022-2024, tra i principali indicatori, si registra un incremento del rapporto tra costi IT e totale attivo, tra cash out IT e numero di dipendenti, tra utile netto d'esercizio e costi IT, tra costi IT e numero dei rapporti di impieghi e depositi. Viceversa, è interessato da una progressiva riduzione il rapporto tra costi operativi e margine di intermediazione.

Sourcing IT

L'analisi sui profili organizzativi evidenzia che sette gruppi mantengono internamente il governo delle infrastrutture e delle applicazioni, identificandosi nel modello Insourcing, sette si collocano nel modello Facility management – che vede la gestione diretta delle applicazioni e l'affido a terze parti delle infrastrutture del Data center – e nove in Outsourcing per Data center e applicazioni. I gruppi Principali sono prevalentemente in Insourcing, tra i Medi prevale il Facility management, mentre i gruppi Piccoli si orientano in larga parte verso una gestione dell'IT affidata all'esterno. Nella maggior parte dei casi il fornitore è un vendor IT.

Sono curati all'interno soprattutto i Sistemi decentrati e dotazioni individuali e le Applicazioni. POS, Reti dati e Fonia e ATM/chioschi sono invece gli ambiti le cui attività informatiche sono in prevalenza delegate all'esterno.

Cloud computing

Il cloud computing, soprattutto il modello pubblico, è adottato più frequentemente per le applicazioni infrastrutturali, per la gestione del personale, il procurement e la banca telefonica. Nel cloud pubblico prevale il modello SaaS il cui utilizzo viene segnalato da 18 gruppi; 12 utilizzano i modelli IaaS/PaaS. Il cloud privato, adottato da un numero limitato di gruppi, è utilizzato trasversalmente in tutti i servizi applicativi, inclusi i servizi di Operations, caratterizzati da un maggior livello di criticità; il ricorso al cloud privato è sostanzialmente paritetico tra soluzioni on premises e off premises. È presente, generalmente in misura ridotta, ad eccezione dell'ICT governance, il ricorso al cloud ibrido. Emerge infine che, nel complesso, 11 gruppi adottano soltanto il cloud pubblico, uno soltanto il cloud privato e i restanti ricorrono a più di un modello tra pubblico, privato e ibrido.

I gruppi impiegano nel cloud, a vario titolo (governance, centro di competenza, infrastruttura, sviluppo, gestione, ecc.), mediamente il 3,37% degli FTE (full time equivalent) IT complessivi; la percentuale maggiore si registra per i gruppi in Outsourcing (5,2%).

In tema contrattualistico, in merito alla possibilità di negoziare clausole contrattuali ad hoc nella stesura dei contratti con i cloud service providers (CSP), quattro gruppi ritengono di averla (o averla avuta) sempre, quattro ritengono di non averla (o non averla avuta). Un gruppo riferisce di aver avuto la possibilità di negoziarle in gran parte dei casi, mentre la maggioranza dei gruppi (11) riporta di aver negoziato tali clausole solo in alcuni casi. Il modello di responsabilità definito nei contratti è ritenuto sostanzialmente adeguato in termini di bilanciamento delle responsabilità tra provider e gruppo, anche nei casi di limitata capacità negoziale.

La definizione di una strategia di uscita dal cloud pubblico costituisce un altro tema oggetto di analisi: emerge che sei gruppi adottano una exit strategy di tipo generale, 12 dichiarano di definirla in relazione alle singole iniziative e due gruppi non adottano una strategia di uscita.

I CSP segnalati dai gruppi sono circa 30 e, tra questi, la frequenza maggiore riguarda gli hyperscaler. Rispetto al rischio di concentrazione, l'utilizzo del cloud pubblico per l'erogazione dei servizi IT prevede il ricorso a uno o più CSP: mediamente, i gruppi ricorrono a 3,5 CSP per il modello SaaS e 1,8 CSP per IaaS/PaaS.

Elementi di Sicurezza IT

Dal punto di vista delle risorse umane, i gruppi con almeno 50 dipendenti IT allocano nella sicurezza informatica mediamente il 6,7% dei propri FTE IT. Tale media sale al 7,6% se si include il personale tecnico dedicato alla Business Continuity e al Disaster Recovery. Emerge una maggior percentuale di personale tecnico allocato nella sicurezza IT, quasi doppia, per i gruppi con pochi dipendenti IT e in Outsourcing, rispetto a quelli con maggior numerosità. Tale dato comprova la grande attenzione rivolta alla sicurezza cibernetica da parte del mondo bancario. Nell'ambito della security governance, il livello medio delle competenze (score di autovalutazione, il cui valore va da un minimo di zero a un massimo di cinque) registrato nel 2024 è pari a 3,7 e, per il biennio 2025-2026, è percepita la necessità di incrementare tale livello a 4,2, con il 52% dei gruppi che segnala un gap di competenze da colmare. Per la gestione operativa della sicurezza è presente un minor gap di competenze rispetto alla security governance. In tema di innovazione tecnologica applicata alla Sicurezza IT, quasi la metà dei gruppi segnala rilevanti iniziative di innovazione nel 2024 e cinque prevedono di avviarne nel biennio 2025-2026.

FinTech

Nel 2024 tutti i gruppi partecipanti collaborano a vario titolo con aziende operanti nel FinTech. I servizi di pagamento, di personal financial management e account aggregation sono quelli più interessati, sui quali è attivo oltre il 60% dei gruppi. Tra le tecnologie in uso emergono l'intelligenza artificiale, l'RPA e l'open API. I maggiori investimenti IT in questo ambito riguardano soprattutto i servizi di pagamento, il credito, la gestione della regolamentazione e i servizi di investimento.

Euro digitale

Questa edizione intende rilevare una previsione qualitativa dell'impegno economico che dovrebbe essere sostenuto dai gruppi bancari per predisporre il proprio sistema informativo all'introduzione dell'euro digitale e alla sua operatività a regime. Si focalizza, inoltre, sulle opportunità IT che i gruppi intravedono.

Hanno contribuito all'analisi degli impatti sui processi bancari, quantificando previsioni, 12 gruppi in totale. Gli impatti economici riguardano trasversalmente tutti i processi, ma sono previsti con particolare rilevanza per incassi e pagamenti, gestione sicurezza, gestione dei sistemi informativi e per il customer service.

Dal punto di vista strategico, i 12 gruppi segnalano di intravedere l'opportunità di offrire nuovi e opzionali servizi alla clientela; per oltre la metà di essi l'offerta ruota attorno alle molteplici forme di servizi di pagamento - in primis P2P, offline e pagamenti pubblici - ai servizi di investimento/assicurativi e di e-wallet. Alcuni gruppi prevedono di svolgere anche attività di revisione e ottimizzazione della propria realtà IT.

Open banking

Il ricorso all'open banking risulta piuttosto contenuto e avviene principalmente per realizzare servizi di account integration e servizi su open API marketplace, dato confermato anche in previsione, nel biennio 2025-2026.

Innovazione tecnologica

Tutte le aree tematiche risultano interessate da rilevanti iniziative di innovazione tecnologica, in corso o concluse durante il 2024. In particolar modo, oltre la metà dei rispondenti segnala iniziative sulla Server farm e nel campo dello Sviluppo e manutenzione evolutiva. Nell'ambito dei processi bancari, l'area più soggetta a innovazione è quella dei processi di Operations. Prevalgono trasversalmente le iniziative finalizzate al miglioramento dei prodotti e servizi esistenti.

Per il biennio 2025-2026 oltre un quinto dei gruppi segnala iniziative che riguarderanno i Sistemi decentrati e dotazioni individuali, la Server Farm, le Reti dati e fonia fissa e la Sicurezza IT.

Personale IT

I dipendenti IT rappresentano in media il 5,3% dell'intera compagine, parametro stabilmente in crescita negli ultimi anni. I valori più bassi sono relativi ai gruppi Piccoli (4,1%), dato attribuibile al loro maggior ricorso all'esternalizzazione delle attività informatiche.

Tra il personale IT la fascia d'età più numerosa è quella tra i 50 e i 59 anni; la maggior parte degli informatici appartiene al livello dei quadri-direttivi (54,5%) e gli uomini sono in netta maggioranza rispetto alle donne, che rappresentano il 28,9% dell'intera compagine IT. La quota femminile è maggiore nelle fasce più giovani, passando gradualmente dal 14,3% delle over 60 a circa il 35% delle under 40.

Il 56,8% delle risorse IT è allocato nell'area delle Applicazioni, seguono le funzioni trasversali (21,8%), il Data center (10,2%), la Sicurezza IT (6,7%) e quote residuali per i sistemi periferici e trasmissivi.

Competenze IT e formazione

In merito alla formazione tecnica, mediando i valori dichiarati da 15 gruppi con almeno 30 dipendenti IT, si osserva che nel 2024 il 70,1% dei dipendenti IT ha partecipato a iniziative di formazione a pagamento, seguendo in media 3 giornate di corso nell'anno, al costo medio, per i gruppi, di 266 euro per giorno-persona.

Dal punto di vista delle competenze, ai profili informatici più tradizionali sono associati livelli medio-alti, che scendono considerevolmente per i nuovi ambiti tecnologici eccetto che per la sostenibilità e green IT e AI & data science. Per il biennio 2025-2026 è avvertita l'esigenza di rafforzare il livello di competenza in tutti gli ambiti/profili IT, in particolare per AI & data science, cloud management, IT governance, security governance e DLT. Per rafforzare le competenze informatiche, si conferma anche nel 2024 una maggiore propensione dei gruppi a formare il proprio personale, piuttosto che ad assumere o ricorrere a risorse esterne. L'assunzione di personale è più frequente negli ambiti della security governance e AI & data science.

Lavoro da remoto

La modalità di lavoro mista, da remoto e in presenza, risulta in vigore al 2024 per 21 gruppi bancari su 22 rispondenti, con formule e approcci differenti da gruppo a gruppo. Per la maggior parte di essi la percentuale di giornate lavorate da remoto rispetto a quelle complessive è maggiore per il personale informatico in confronto a quella degli altri dipendenti. Tale percentuale, in media pari al 34% per i dipendenti IT, scende al 18% per il resto della compagine.

Postazioni di lavoro

Dai dati segnalati da 22 gruppi emerge che, in media, ogni dipendente ha a disposizione 1,3 postazioni di lavoro (PDL) standard. Mediamente il 78,5% delle PDL è di proprietà del gruppo bancario e il 21,5% è presa in locazione. Circa i due terzi delle PDL di 21 gruppi sono dispositivi portatili, circa il 30% sono postazioni fisse e una quota residuale è costituita da postazioni virtualizzate. Prosegue, anche nell'ultimo triennio, il trend in aumento della quota dei dispositivi portatili.

Banche

Le 32 banche partecipanti alla Rilevazione, analizzate individualmente senza altre componenti di gruppo, rappresentano il 62,8% del settore bancario in termini di fondi intermediati.

L'analisi della ripartizione del TCO per aree tematiche evidenzia che mediamente il 56,5% dei costi viene assorbito dalle Applicazioni e il 18,9% dal Data center; seguono Sistemi periferici (10,7%), Sistemi trasmissivi (5,4%) e Sicurezza IT (4%). Al crescere della dimensione, le banche indicano via via percentuali mediamente più alte sul Data center e sulla Sicurezza IT.

Analizzando il TCO per fattori produttivi, in media la quota preponderante di esso risulta destinata a Servizi da terzi (66,6%).

Il 72% degli investimenti informatici effettuati nel 2024 dalle banche risulta destinato al Software e il 25,7% all'Hardware. L'ammontare complessivo degli invesimenti previsti per il 2025 cresce del 13% rispetto all'esercizio 2024.

Con riferimento all'operatività bancaria, il retail banking rappresenta l'attività prevalente (56%), seguono il corporate and investment banking e il private banking. Circa i tre quarti delle banche rispondenti svolgono più attività, mentre le altre operano all'interno di un unico comparto.

Il modello prevalente per il sourcing dell'IT è l'Outsourcing: il 66% delle banche affida a uno o più fornitori la gestione del Data center e delle Applicazioni. Il 16% delle banche adotta il modello Insourcing, mentre il 19% si basa su un modello misto, affida cioè all'esterno le infrastrutture del Data center e mantiene internamente la gestione delle Applicazioni (Facility management).

In relazione al Data center, quasi un quinto delle banche ne detiene la proprietà e cura sviluppo/evoluzione e manutenzione correttiva/gestione corrente. La quota preponderante (31-34%) si affida a componenti del gruppo interne al perimetro CIPA, un'altra fetta di rilievo (25-28%) ricorre ai vendor e il 13% a consorzi di banche.

Con riferimento alle Applicazioni, circa un quarto delle banche cura direttamente sia lo sviluppo che la gestione, il 31% le affida all'interno del perimetro CIPA, seguito da una quota rilevante che ricorre a soggetti esterni, prevalentemente vendor IT.

In media, il rapporto tra personale IT e totale dei dipendenti delle banche è pari al 5,2%.

Evoluzione del settore bancario italiano[1]

Nel 2024 la dinamica del credito in Italia è rimasta debole, seppure con segnali di ripresa favoriti dal progressivo allentamento della politica monetaria. I prestiti alle imprese hanno continuato a contrarsi riducendosi del 2,6%, soprattutto per effetto di una domanda debole, imputabile alle minori esigenze di finanziamento degli investimenti e agli ancora elevati tassi di interesse. I prestiti alle famiglie invece sono tornati a crescere (+1,1% a dicembre rispetto a un anno prima), guidati principalmente dall'aumento dei finanziamenti per l'acquisto di abitazioni (+1,3%), imputabile alla riduzione del livello generale dei tassi di interesse. Nell'ultimo trimestre del 2024, il flusso di nuovi prestiti deteriorati in rapporto alla consistenza di quelli in bonis è leggermente aumentato (+1,4%), trainato da quello relativo alle imprese (+ 2,4%).

La raccolta complessiva delle banche nel 2024 è scesa del 2,6%, soprattutto per effetto del calo delle passività verso l'Eurosistema. Nella componente all'ingrosso è aumentato il ricorso al mercato interbancario estero e all'emissione di obbligazioni; quella al dettaglio è tornata a crescere, per l'incremento dei depositi da residenti (+1,8%). Il costo medio della raccolta in essere è calato all'1,4%, riflettendo la riduzione dei tassi di interesse. Sono leggermente scesi i tassi di interesse sui depositi, allo 0,7% (0,8% nel 2023), mentre sono lievemente aumentati quelli sulle obbligazioni, al 2,8% (dal 2,7%).

La redditività delle banche nel 2024 è ulteriormente migliorata, il rendimento annualizzato del capitale e delle riserve (return on equity, ROE) delle banche italiane è salito al 12,8%. Hanno contribuito principalmente l'incremento delle commissioni (+9,5%), in particolare quelle derivanti dal risparmio gestito, e in misura minore l'ulteriore aumento del margine di interesse (+3,7%). Il margine di intermediazione si è ampliato del 7,2%, i costi operativi sono cresciuti del 2,5% e le spese per il personale del 5,1% a causa del rinnovo del contratto di lavoro. Il rapporto tra i costi operativi e il margine di intermediazione (cost-income ratio) è sceso al 53,2% (dal 55,6% nel 2023). Al miglioramento della redditività ha contribuito, seppure in misura marginale, anche la flessione delle rettifiche nette su crediti (-6,4%).

Prosegue il processo di trasformazione digitale del settore bancario italiano, la cui efficienza continua a migliorare grazie ai crescenti investimenti in innovazione. Il ricorso ai bonifici online ha raggiunto il 93% dei bonifici totali, con una quota più alta tra le imprese (96%) rispetto alle famiglie (91%). È inoltre progressivamente salita, a 73 unità ogni cento abitanti (68 nel 2023), la quota di clienti con contratti di home banking. Si osserva inoltre il ricorso, seppure da parte di un numero limitato di banche, a nuove tecnologie – inclusa l'intelligenza artificiale – per la valutazione del merito di credito, con potenziali benefici per l'accesso al credito per le imprese più piccole e innovative.

[1] Fonte: Banca d'Italia, Relazione annuale per il 2024.

Campione e note metodologiche

Hanno partecipato alla "Rilevazione sull'IT nel settore bancario italiano – Profili economici e organizzativi – Esercizio 2024" 23 gruppi bancari e 32 banche, di cui due non appartenenti a gruppi o appartenenti a gruppi diversi da quelli partecipanti.

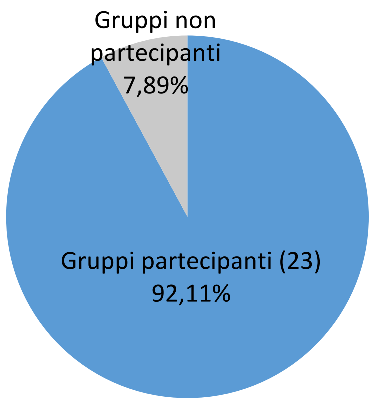
Le analisi contenute nella Rilevazione, salvo diversa indicazione, fanno riferimento al cosiddetto **perimetro CIPA**[2].

Per la Rilevazione vengono utilizzati due campioni: uno riferito ai gruppi bancari (Capp. 1 e 2) e uno relativo alle banche (Cap. 3).

Campione dei gruppi bancari

I 23 gruppi partecipanti rappresentano il 92,11% dell'insieme dei gruppi bancari italiani in termini di totale attivo[3] (Figura 1).

Figura 1 - Rappresentatività dei gruppi bancari partecipanti per totale attivo



Ai fini della presente Rilevazione i gruppi bancari sono classificati secondo due criteri: per dimensione operativa e per modello di sourcing IT.

La classificazione per dimensione operativa si basa sul totale attivo del gruppo, comprensivo di tutte le sue componenti (bancarie e non bancarie) soggette a normativa prudenziale, segnalato nella

[2] Il perimetro CIPA riguarda la realtà nazionale delle banche e dei gruppi, per questi ultimi limitatamente alle componenti bancarie e alle società strumentali, IT e non IT, che operano a supporto dell'attività bancaria.

[3] Il totale attivo considerato al 31 dicembre dell'esercizio in esame fa riferimento al gruppo bancario, comprensivo di tutte le sue componenti, bancarie e non bancarie, soggette a normativa prudenziale (es. banche, società strumentali, società finanziarie, SIM, filiali estere) secondo le segnalazioni di vigilanza consolidata.

matrice di vigilanza consolidata. Secondo questo criterio[4], il campione per l'esercizio 2024 viene suddiviso in sei gruppi Principali, nove gruppi Medi e otto gruppi Piccoli (Tabella 1).

Tabella 1 - Classificazione dei gruppi per dimensione

		Principali	Medi	Piccoli
01005	Gruppo bancario Banca Nazionale del Lavoro		X	
01030	Gruppo Monte dei Paschi di Siena	X		
02008	Gruppo UniCredit	X		
03032	Gruppo Credito Emiliano – CREDEM		X	
03062	Gruppo bancario Mediolanum		X	
03069	Gruppo bancario Intesa Sanpaolo	X		
03075	Gruppo bancario Banca Generali			X
03104	Gruppo Deutsche Bank		X	
03311	Gruppo Sella		X	
03395	Gruppo illimity Bank			X
03440	Gruppo Banco di Desio e della Brianza			X
03599	Cassa Centrale Banca		X	
05034	Gruppo Banco BPM	X		
05036	Gruppo bancario Banca Agricola Popolare di Sicilia			X
05262	Gruppo Banca Popolare Pugliese			X
05387	Gruppo BPER Banca	X		
05696	Gruppo Banca Popolare di Sondrio		X	
05856	Gruppo Banca Popolare dell'Alto Adige			X
06085	Gruppo Cassa di Risparmio di Asti			X
06230	Gruppo bancario Crédit Agricole Italia		X	
06270	Gruppo La Cassa di Ravenna			X
08000	ICCREA Banca	X		
10631	Gruppo bancario Mediobanca		X	
	Tot.	6	9	8

La classificazione per modello di sourcing IT si basa sulle indicazioni fornite dalla capogruppo sulla modalità prevalente di gestione delle infrastrutture e delle applicazioni del gruppo[5]. Secondo questo criterio, il campione per l'esercizio 2024 risulta composto da sette gruppi in Insourcing, sette in Facility Management e nove in Outsourcing (Tabella 2).

[4] Le classi dimensionali dei gruppi sono definite come segue:
- ✓ Principali totale attivo > 120 miliardi di euro;
- ✓ Medi totale attivo >20 e ≤ 120 miliardi di euro;
- ✓ Piccoli totale attivo ≥ 5 e ≤ 20 miliardi di euro.

[5] L'assetto è indipendente dall'eventuale ricorso a forme di outsourcing selettivo per singole iniziative o ambiti.

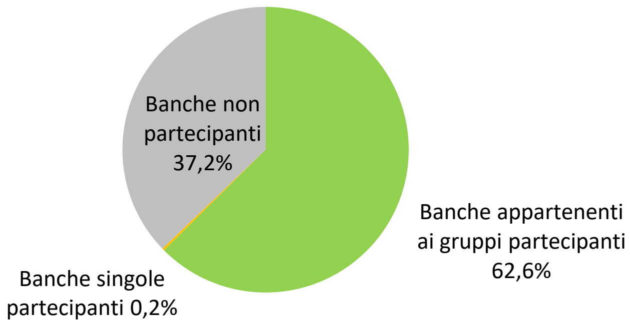
Tabella 2 - Classificazione dei gruppi per modello di sourcing IT

		Insourcing	Facility management	Outsourcing
01005	Gruppo bancario Banca Nazionale del Lavoro		X	
01030	Gruppo Monte dei Paschi di Siena	X		
02008	Gruppo UniCredit		X	
03032	Gruppo Credito Emiliano – CREDEM		X	
03062	Gruppo bancario Mediolanum			X
03069	Gruppo bancario Intesa Sanpaolo	X		
03075	Gruppo bancario Banca Generali			X
03104	Gruppo Deutsche Bank			X
03311	Gruppo Sella	X		
03395	Gruppo illimity Bank		X	
03440	Gruppo Banco di Desio e della Brianza			X
03599	Cassa Centrale Banca	X		
05034	Gruppo Banco BPM	X		
05036	Gruppo bancario Banca Agricola Popolare di Sicilia			X
05262	Gruppo Banca Popolare Pugliese			X
05387	Gruppo BPER Banca	X		
05696	Gruppo Banca Popolare di Sondrio		X	
05856	Gruppo Banca Popolare dell'Alto Adige			X
06085	Gruppo Cassa di Risparmio di Asti			X
06230	Gruppo bancario Crédit Agricole Italia		X	
06270	Gruppo La Cassa di Ravenna			X
08000	ICCREA Banca	X		
10631	Gruppo bancario Mediobanca		X	
	Tot.	7	7	9

Campione delle banche

Le 32 banche (società per azioni e popolari) partecipanti alla Rilevazione rappresentano il 62,8% del settore bancario italiano in termini di fondi intermediati[6] (Figura 2).

Figura 2 - Rappresentatività delle banche partecipanti per fondi intermediati



In Appendice è riportata la rappresentatività delle banche partecipanti in termini di numero di sportelli e numero di dipendenti, con riferimento al perimetro nazionale (Figura 112).

[6] I fondi intermediati (totale dell'attivo di bilancio delle banche al netto delle spese e perdite e delle partite in sospeso) si riferiscono alla media aritmetica su tredici mesi: l'anno di riferimento più il mese di dicembre dell'anno precedente.

Le 32 banche sono classificate secondo la dimensione operativa prendendo a riferimento i fondi intermediati medi presenti in matrice di vigilanza. Secondo questo criterio[7] esse sono suddivise nelle classi: Maggiori (8), Grandi (6), Medie (7), Piccole A (5) e Piccole B (6) (Tabella 3). Rispetto alle edizioni precedenti, da quest'anno la classe "Particolare Operatività", dove confluivano banche con strutture organizzative e operative molto diversificate, non è più presente e le relative banche sono classificate sulla base del parametro dimensionale.

Tabella 3 - Classificazione delle banche

		Maggiore	Grande	Media	Piccola A	Piccola B
01005	Banca Nazionale del Lavoro	X				
01030	Banca Monte dei Paschi di Siena	X				
02008	UniCredit	X				
03032	Credito Emiliano		X			
03045	Banca Akros					X
03062	Banca Mediolanum		X			
03069	Intesa Sanpaolo	X				
03075	Banca Generali			X		
03102	Banca Aletti					X
03104	Deutsche Bank		X			
03239	Intesa Sanpaolo Private Banking			X		
03268	Banca Sella			X		
03296	Banca Fideuram		X			
03311	Banca Sella Holding				X	
03332	Banca Passadore & C.				X	
03385	isybank					X
03395	illimity Bank				X	
03440	Banco di Desio e della Brianza			X		
03442	Banca Wise Dialog Bank - Widiba					X
03493	Cassa Centrale Raiffeisen dell'Alto Adige					X
03599	Cassa Centrale Banca – Credito Coop. Italiano			X		
05034	Banco BPM	X				
05036	Banca Agricola Popolare di Sicilia				X	
05262	Banca Popolare Pugliese					X
05387	BPER Banca	X				
05696	Banca Popolare di Sondrio		X			
05856	Banca Popolare dell'Alto Adige			X		
06085	Cassa di Risparmio di Asti			X		
06230	Crédit Agricole Italia	X				
06270	La Cassa di Ravenna				X	
08000	ICCREA Banca – Istituto Centrale del Credito Coop.		X			
10631	Mediobanca – Banca di Credito Finanziario	X				
	Tot.	**8**	**6**	**7**	**5**	**6**

[7] Le classi dimensionali delle banche sono definite sulla base dei fondi intermediati (f.i.) come segue:
- ✓ Maggiori f.i. per oltre 90 miliardi di euro;
- ✓ Grandi f.i. compresi tra 30 e 90 miliardi di euro;
- ✓ Medie f.i. compresi tra 12 e 30 miliardi di euro;
- ✓ Piccole A f.i. compresi tra 5 e 12 miliardi di euro;
- ✓ Piccole B f.i. compresi tra 1 e 5 miliardi di euro.

Note metodologiche

L'indagine è basata sul questionario per l'esercizio 2024 pubblicato sul sito Internet della CIPA[8], i cui dati sono acquisiti tramite INFOSTAT, l'infrastruttura di raccolta dati via Internet della Banca d'Italia.

Le analisi riportate nella Rilevazione fanno riferimento, salvo diversa indicazione, al perimetro CIPA[2].

Gli aggregati forniti in medie di percentuali relativi alla ripartizione dei costi IT (es. per aree tematiche e per fattori produttivi) vengono calcolati rapportando le diverse componenti al totale dei costi IT sostenuti da ciascuna banca o gruppo bancario e mediando successivamente i risultati ottenuti. In generale, se non diversamente specificato, nel presente rapporto il termine "media" o "media di %" va inteso come media aritmetica dei valori dei singoli rispondenti. In alcune analisi si fa riferimento alla dicitura "quota %" di una grandezza rispetto al totale: tale quota è determinata dal rapporto tra la somma dei valori di quella grandezza per tutti i rispondenti e il totale.

Nelle analisi relative alle aree tematiche, svolte per diverse variabili economiche (TCO, investimenti, cash out), per una rappresentazione efficace dei fenomeni, sono di norma inclusi i rispondenti che forniscono una ripartizione della variabile sufficientemente dettagliata tra le varie aree ed esclusi coloro che attribuiscono oltre il 30% del totale di quella variabile alla colonna E2 ("Costi IT non classificabili" delle tabelle 2.1 e 4.1 del questionario).

Il calcolo degli indicatori economici, riferiti alle principali grandezze economiche di gruppo o banca segnalate nel questionario o ricavate dalle rispettive matrici di vigilanza o dai bilanci riclassificati (limitatamente ai gruppi), viene effettuato determinando l'indicatore per ciascun rispondente e calcolando quindi gli indici statistici tra i rispondenti (medie, coefficienti di variazione e mediane).

In alcune analisi, laddove un singolo rispondente può fornire più risposte associate a uno stesso item, viene riportata l'indicazione "risposte multiple".

Nel caso di analisi riguardanti un campione troppo esiguo di banche o gruppi, che potrebbe consentire di risalire dai dati aggregati ai soggetti rispondenti, i risultati potrebbero non essere resi disponibili.

Si precisa che nei titoli delle figure e delle tabelle, ove queste si riferiscano a banche e non a gruppi bancari, ciò viene espressamente indicato.

Per completezza informativa, nei grafici che si riferiscono a domande compilabili mediante flag/spunte, l'etichetta riporta sia il numero di gruppi che hanno effettivamente risposto alla domanda, sia il totale dei gruppi cui la domanda è stata somministrata (es. "18 rispondenti su 23").

I valori numerici presenti su alcuni grafici possono risentire dell'arrotondamento decimale. In tali casi, la somma dei valori rappresentati potrebbe non risultare pari al 100%.

Ai gruppi e alle banche partecipanti vengono forniti dei "flussi di ritorno", anche personalizzati, che consentono a ogni istituto di valutare il proprio posizionamento in relazione a molteplici grandezze e indicatori, rispetto sia all'intero campione sia al proprio peer group.

Rilevazione dei costi IT

La metodologia adottata per l'analisi dei profili economici IT permette di rilevare:

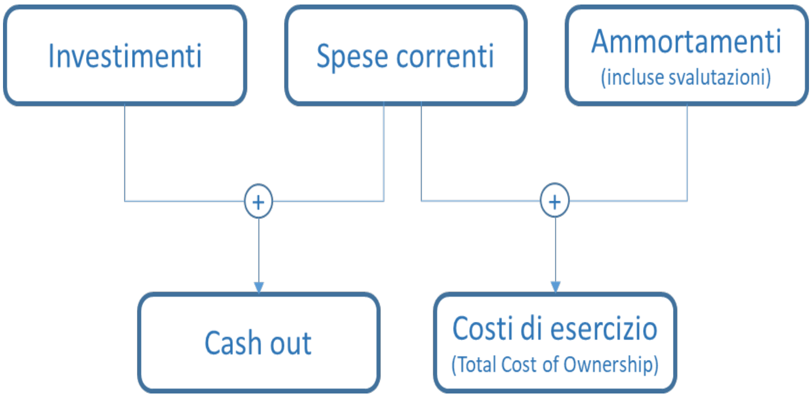
- ✓ il totale dei costi di esercizio (total cost of ownership - TCO), al lordo e al netto di eventuali ricavi IT;

[8] www.cipa.it/rilevazioni/economiche/2024/QUEST_A_2024.pdf

- ✓ il cash out;
- ✓ le spese correnti;
- ✓ gli investimenti;
- ✓ gli ammortamenti.

Laddove non diversamente specificato, nel presente rapporto l'uso del termine TCO è da intendersi al lordo di eventuali ricavi IT.

Lo schema seguente illustra i rapporti esistenti tra le grandezze economiche trattate:



La rilevazione dei costi IT espressi in termini di TCO è realizzata con una tabella a due dimensioni, descritte di seguito: "fattore produttivo" (per riga) e "area tematica" (per colonna).

Il cash out è calcolato come somma degli investimenti e delle spese correnti, ottenute sottraendo gli ammortamenti al TCO.

Fattori produttivi e aree tematiche

I fattori produttivi considerati e i relativi costi sono:

- ✓ **Hardware**: TCO per acquisto, noleggio, leasing e manutenzione delle apparecchiature;
- ✓ **Software**: costi del software di base, del middleware e del software applicativo in licenza d'uso;
- ✓ **Personale interno**: tutti gli oneri sostenuti per i dipendenti IT (es. competenze, contributi sociali, accantonamenti, formazione IT presso società esterne), anche in ammortamento;
- ✓ **Servizi ricevuti da terzi**: costi di Facility management (software di proprietà dell'istituto gestito dal fornitore sui propri elaboratori), di Outsourcing, di personale esterno e di consulenza professionale;
- ✓ **Altri costi IT:** costi IT non riconducibili alle precedenti categorie (es. quelli sostenuti a vario titolo per immobili a uso esclusivo di attività IT, per materiali di consumo, per coperture assicurative sulle apparecchiature e a garanzia delle frodi informatiche).

Le aree tematiche considerate sono:

- ✓ **Data center**: include Mainframe (elaboratori centrali e unità di input/output centralizzate) e Server farm (server accentrati e apparecchiature con funzioni specializzate non tipiche di filiali e non direttamente dipendenti da Mainframe);
- ✓ **Sistemi trasmissivi**: include le Reti dati (collegamento tra sedi/filiali della banca, tra sottosistema centrale e sottosistema periferico e con l'esterno della banca), la Fonia fissa (VoIP e analogica) e la Fonia mobile;

- ✓ **Sistemi periferici**: include i Sistemi decentrati e le dotazioni individuali (es. personal computer, stampanti, tablet, tavolette grafometriche), gli ATM (sportelli automatici, come distributori di banconote e chioschi multifunzione) e i POS;
- ✓ **Applicazioni**: include l'acquisto, lo sviluppo e la manutenzione di software applicativo.

In alcune analisi di dettaglio, con il termine "aree tematiche" si fa riferimento direttamente alle singole sottoaree (es. Mainframe e Server farm sono considerate sottoaree dell'area Data center).

La voce "**Sicurezza IT**" comprende tutti i costi di sicurezza informatica relativi ai seguenti ambiti: sicurezza perimetrale, Identity Management, sistemi antifrode, server farm security, end point security, security analytics, code/application security, data security, iniziative di security awareness, partecipazione a comunità di sicurezza/infosharing. Sono inclusi anche i costi connessi con la gestione dei processi di sicurezza (es. gestione degli incidenti di sicurezza, vulnerability e patch management, CERTFin). Non sono invece compresi i costi relativi alla sicurezza fisica né quelli per Business Continuity e Disaster Recovery.

Capitolo 1. Gruppi bancari: profili economici

Il presente paragrafo analizza l'andamento complessivo dei costi IT con un focus sui costi di integrazione[9]. Le grandezze economiche IT complessivamente segnalate per l'esercizio 2024 dai 23 gruppi partecipanti alla Rilevazione sono:

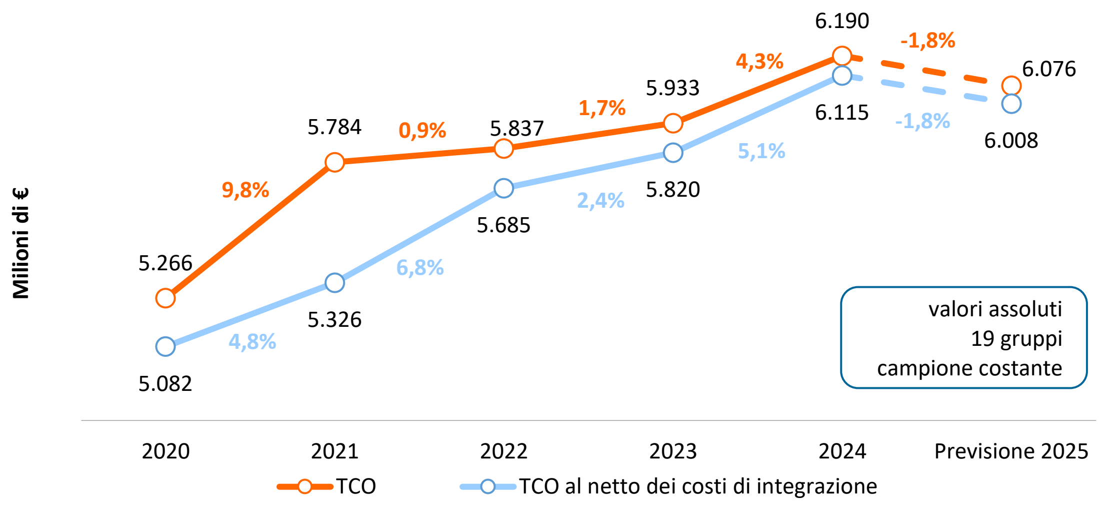
- ✓ **TCO lordo** (spese correnti più ammortamenti): 6.334 milioni di euro;
- ✓ **Cash out** (spese correnti più investimenti): 6.618 milioni di euro;
- ✓ **Spese correnti**: 4.478 milioni di euro;
- ✓ **Investimenti**: 2.140 milioni di euro;
- ✓ **Ammortamenti**: 1.857 milioni di euro.

1.1 Total cost of ownership (TCO)

1.1.1 Andamenti complessivi e variazioni individuali

La Figura 3 mostra l'andamento del TCO, complessivo e al netto dei costi di integrazione, con riferimento a un campione costante di 19 gruppi bancari[10], per i quali si registra, nell'esercizio 2024, un incremento rispetto all'esercizio precedente del TCO complessivo pari al 4,3%, per un totale di 6.190 milioni di euro. Al netto dei costi di integrazione, il TCO si attesta a 6.115 milioni di euro, con una crescita del 5,1%. Per il 2025 è previsto un decremento, sempre a campione costante, dell'1,8%.

Figura 3 - TCO: andamento 2020-2024 e previsione

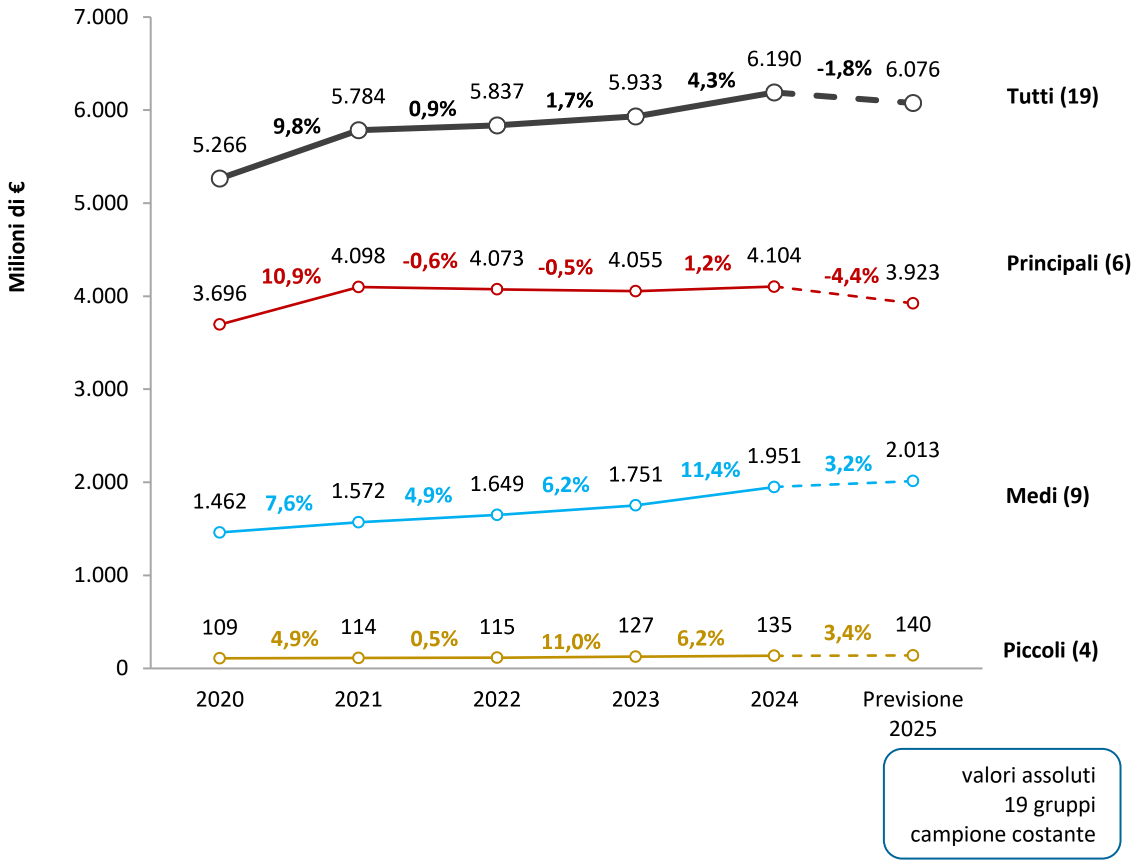


[9] Costi IT sostenuti per esigenze di integrazione/ristrutturazione dei sistemi informativi aziendali connesse con operazioni di integrazione con altre entità (fusioni, acquisizioni, acquisizione di rami d'azienda e/o di sportelli).
[10] Gruppi che hanno fornito il TCO per tutti gli anni dal 2020 al 2024.

In Appendice, la Figura 113 confronta il TCO complessivo dell'esercizio 2024 rilevato a consuntivo (linea continua) alla corrispondente previsione fatta l'anno precedente (linea tratteggiata), a campione costante.

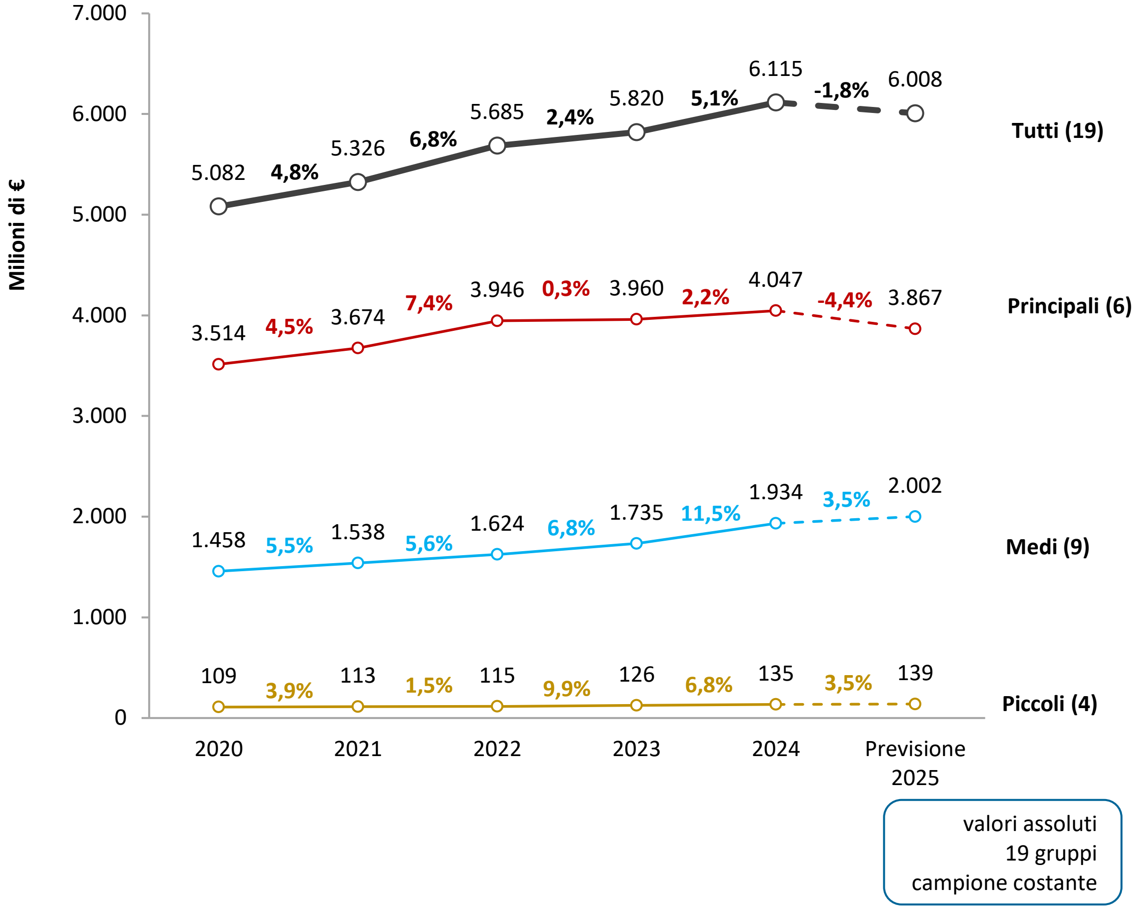
Dall'andamento a campione costante del TCO per classe dimensionale riportato in Figura 4 si evidenzia per i gruppi Principali, che assorbono circa i due terzi dei costi totali, una minore crescita percentuale negli ultimi anni (1,2% nell'esercizio 2024 dopo due anni di variazione negativa) rispetto ai gruppi Medi e Piccoli (rispettivamente 11,4% e 6,2% nell'esercizio 2024).

Figura 4 - TCO per classe dimensionale: andamento 2020-2024 e previsione



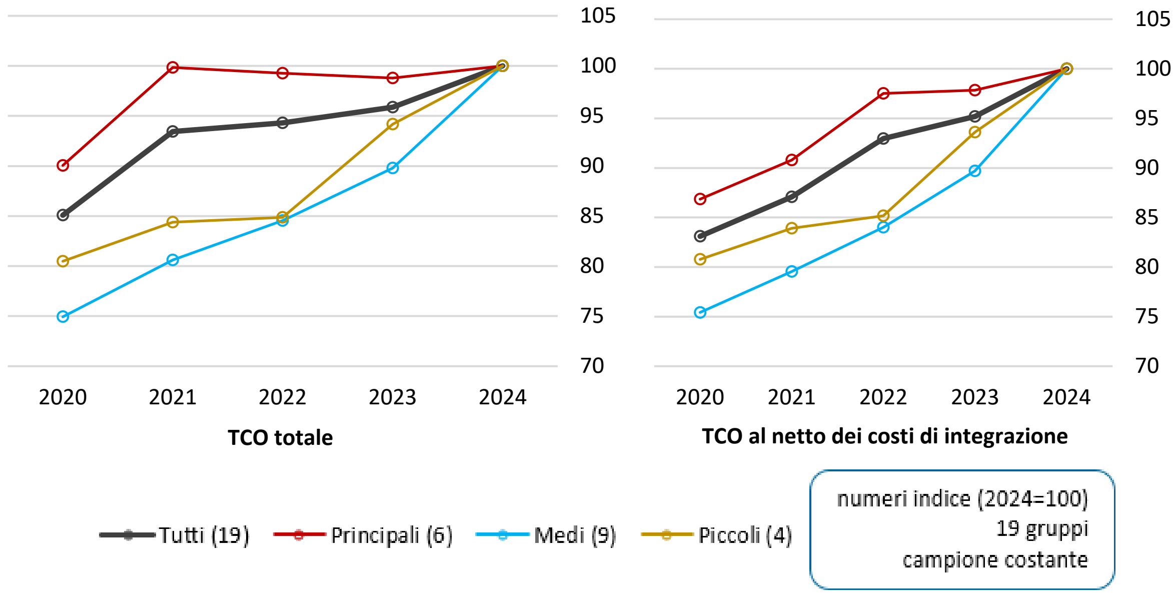
L'analoga analisi, svolta al netto dei costi di integrazione, è mostrata in Figura 5.

Figura 5 - TCO al netto dei costi di integrazione, per classe dimensionale: andamento 2020-2024 e previsione



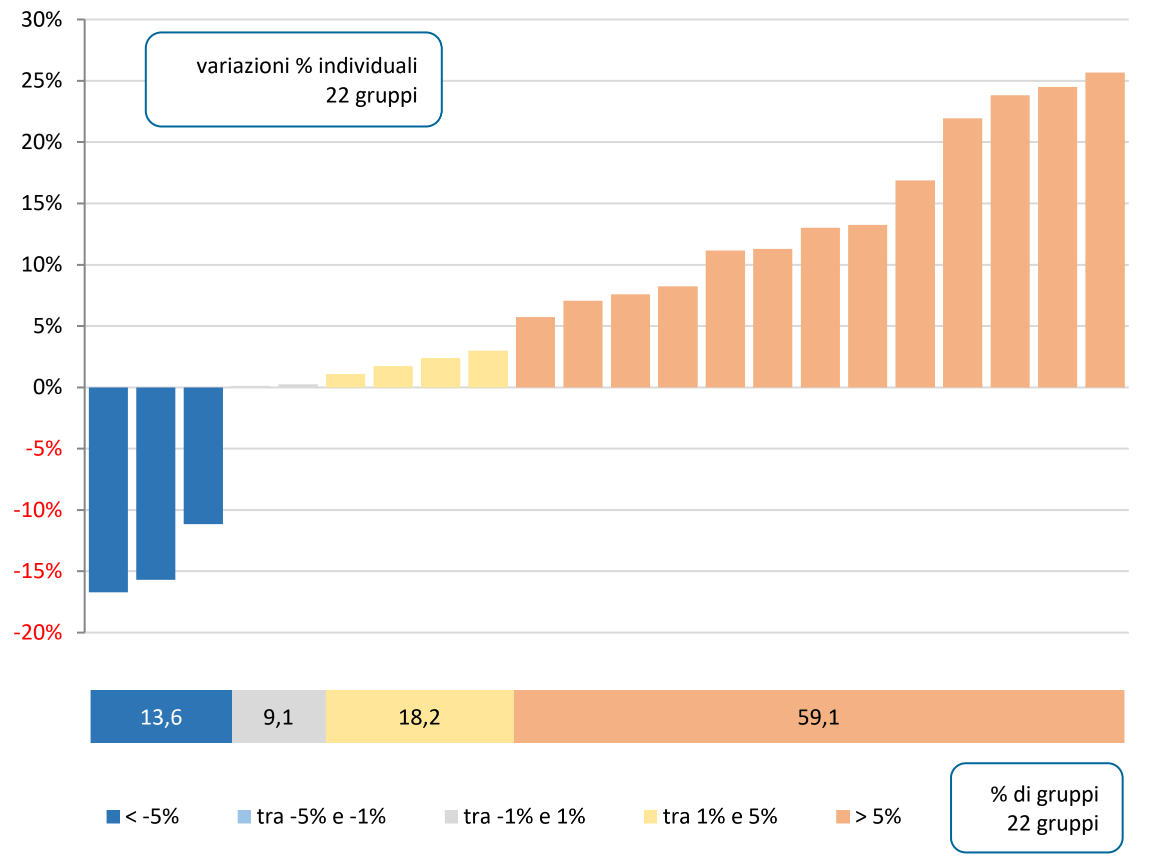
La Figura 6 fornisce un'altra vista dell'andamento del TCO per classe dimensionale, utilizzando i numeri indice per lo stesso campione costante e medesimo periodo di osservazione. L'anno preso a riferimento è il 2024, in cui il TCO totale di ciascuna classe è fatto corrispondere al valore 100. I valori degli anni precedenti sono ottenuti come rapporto percentuale tra il relativo TCO e quello dell'anno di riferimento per la stessa classe. Si può notare la costante crescita dei costi per le classi Medi e Piccoli, pur con intensità differenti. Per i gruppi Principali, il picco del 2021 è attribuibile ai costi di integrazione.

Figura 6 - TCO per classe dimensionale: numeri indice 2020-2024



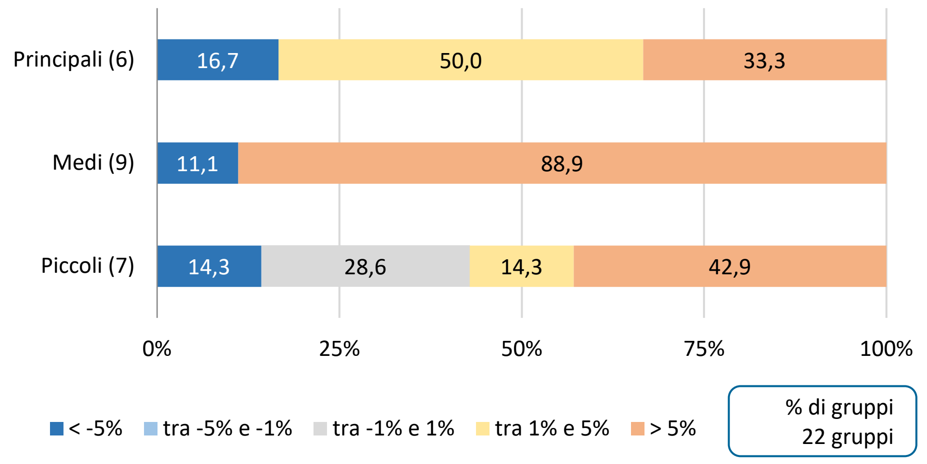
Con riferimento ai 22 gruppi bancari partecipanti alla Rilevazione in entrambi gli esercizi 2023 e 2024, le variazioni percentuali del TCO 2024 rispetto al TCO 2023 si collocano all'interno di un range che va dal -16,7% al +25,7% e oltre i tre quarti dei gruppi registrano un aumento dei costi IT superiore all'1% (Figura 7).

Figura 7 - Variazione individuale del TCO 2024/2023



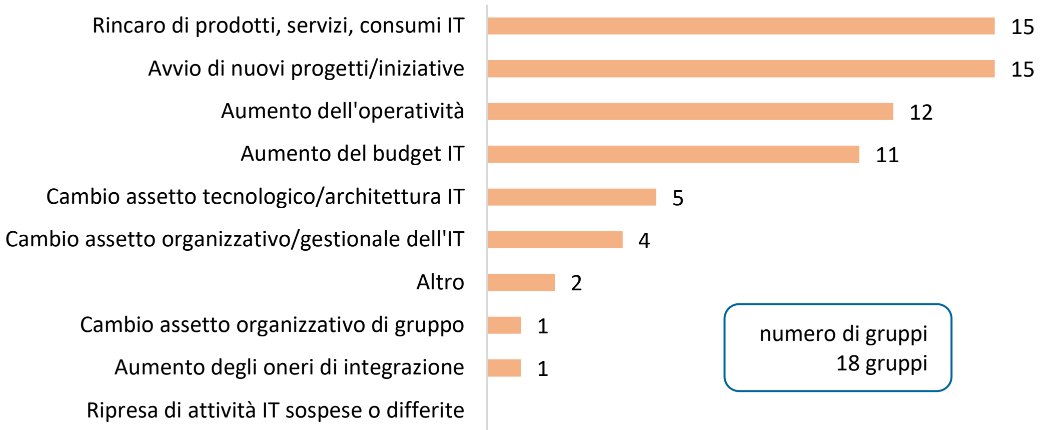
La Figura 8 analizza le fasce di variazione per classe dimensionale.

Figura 8 - Variazione individuale del TCO 2024/2023, per classe dimensionale



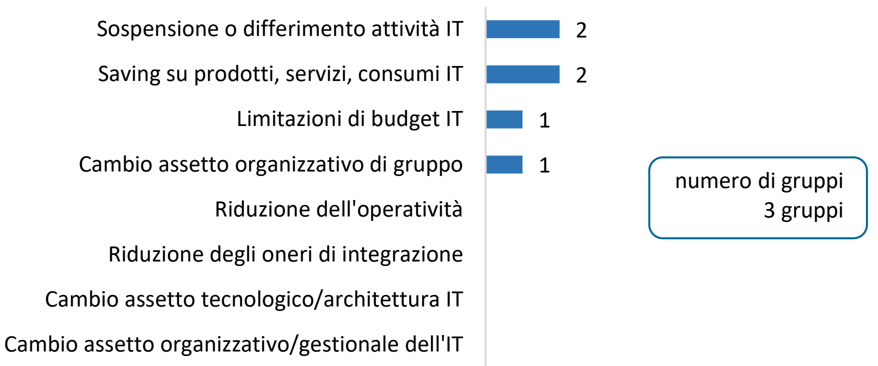
Segue un'analisi delle principali cause di aumento e di riduzione del TCO totale segnalate dai gruppi. L'aumento del TCO risulta prevalentemente connesso con l'avvio di nuove iniziative e con il rincaro di prodotti e servizi IT (15 gruppi su 18) (Figura 9).

Figura 9 - Cause di aumento del TCO



Tra le cause più rilevanti di riduzione dei costi IT totali figurano, per due gruppi su tre, la sospensione o differimento delle attività IT e il risparmio su prodotti, servizi e consumi IT (Figura 10).

Figura 10 - Cause di riduzione del TCO

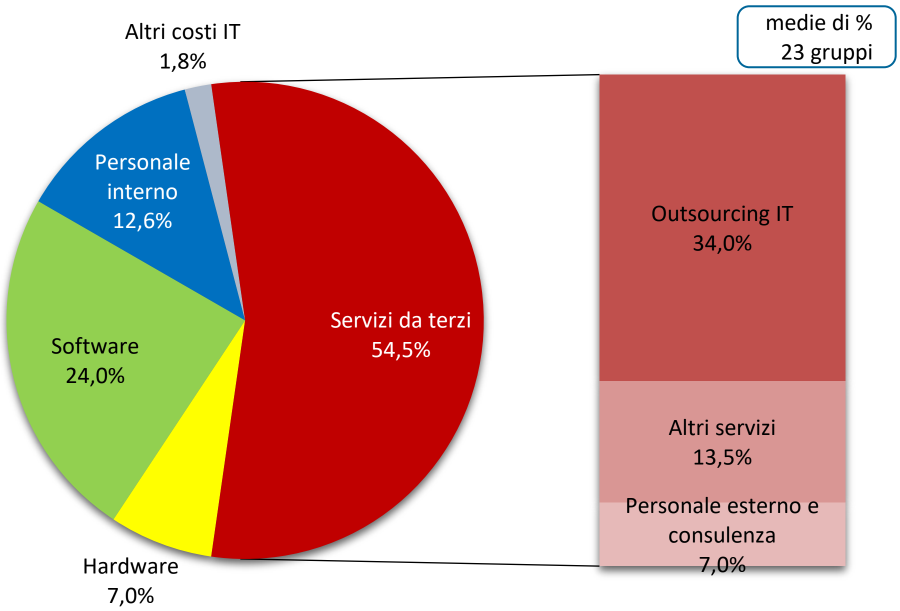


1.1.2 Fattori produttivi

Il modello di analisi adottato prevede la ripartizione dei costi IT per aree tematiche e per fattori produttivi, favorendo una migliore comprensione dei costi sostenuti dai gruppi bancari per i servizi informatici a supporto dell'attività bancaria.

Il TCO dei 23 gruppi partecipanti, pari a 6.334 milioni di euro, ripartito per fattori produttivi in medie di percentuali, risulta per il 54,5% dedicato a Servizi ricevuti da terzi, suddivisi tra Outsourcing IT (34%), Personale esterno e consulenza (7%) e Altri servizi[11] (13,5%). Guardando ai costi IT sostenuti direttamente dai gruppi, il Software assorbe la quota preponderante, pari al 24% del TCO complessivo, il Personale interno il 12,6% e l'Hardware il 7% (Figura 11).

Figura 11 - TCO per fattori produttivi



La ripartizione del TCO per classe dimensionale (Figura 12) mostra che la quota dei costi per Servizi da terzi (gradazioni di rosso), pari al 30,5% per i gruppi Principali, sale al 57,4% dei Medi fino a oltre il 69% per i gruppi Piccoli, andando a erodere progressivamente tutte le altre voci. Il fenomeno è spiegabile dalla maggior tendenza dei gruppi a ricorrere all'outsourcing al decrescere della dimensione. Risultati analoghi, analizzati dal punto di vista del modello di sourcing IT, sono mostrati in Figura 13.

[11] La voce "Altri servizi" comprende canoni per servizi di rete, traffico di fonia, progetti chiavi in mano, servizi di help desk tecnologico esternalizzato, servizio di Disaster Recovery.

Figura 12 - TCO per fattori produttivi e classe dimensionale

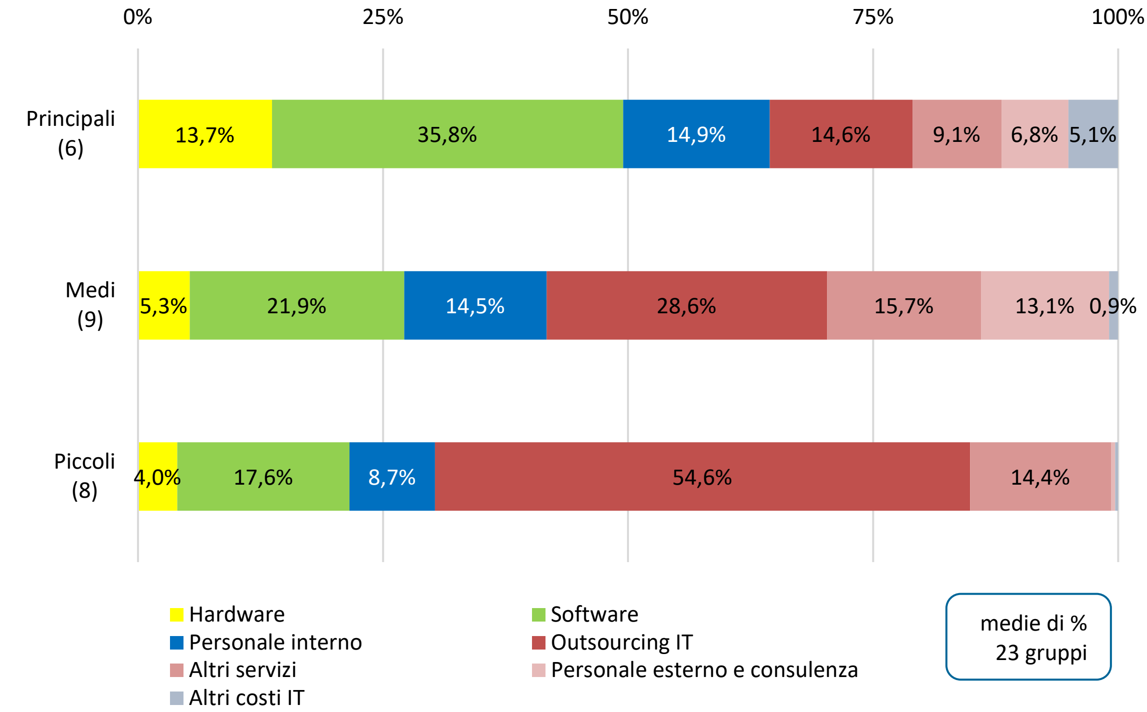
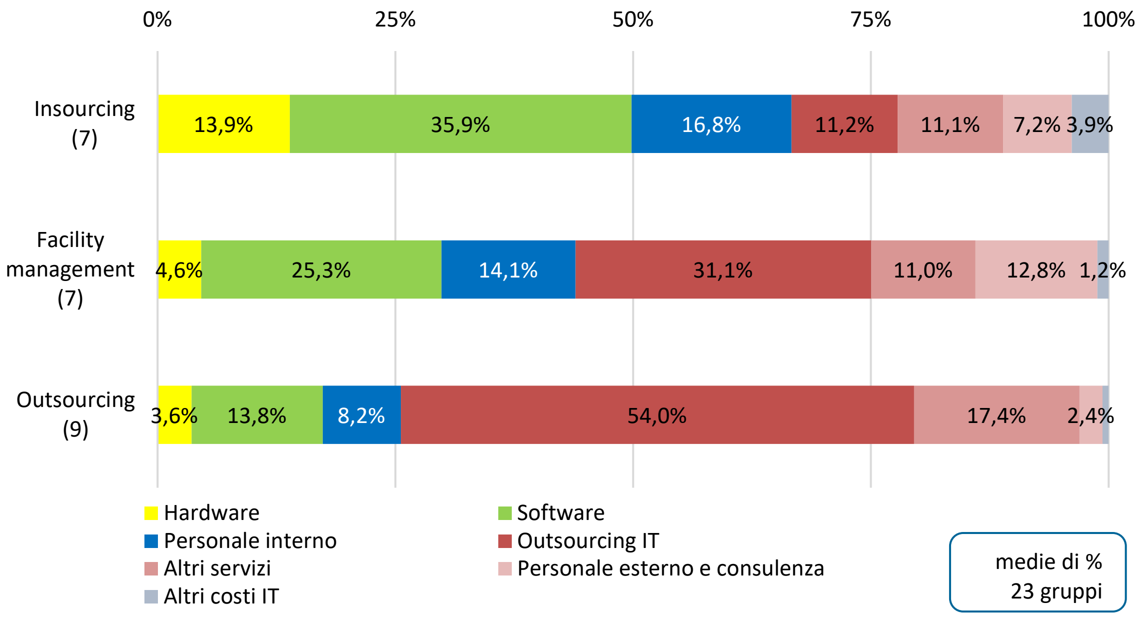
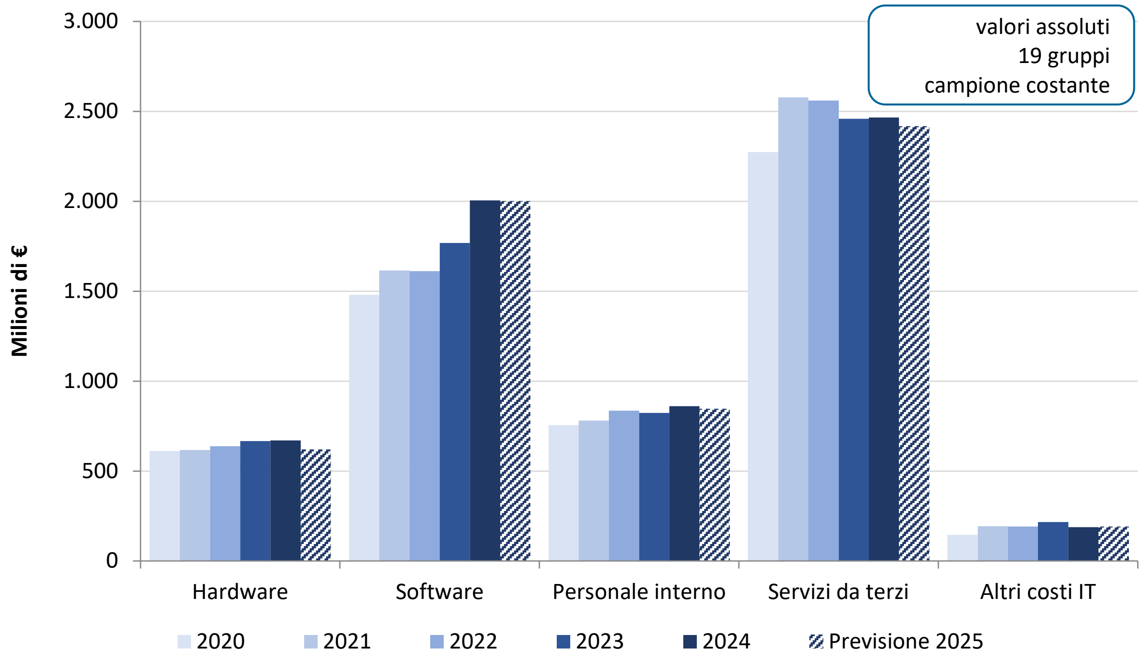


Figura 13 - TCO per fattori produttivi e modello di sourcing



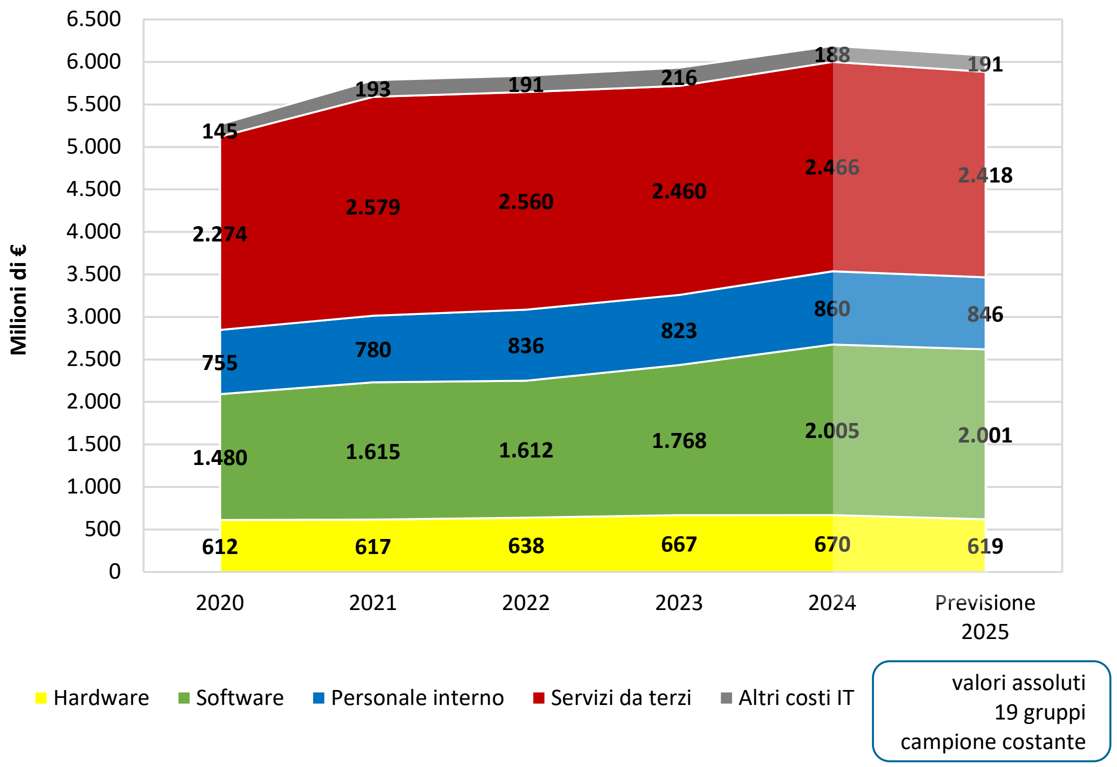
La Figura 14 rappresenta, a consuntivo e in valori assoluti, l'evoluzione del TCO per fattori produttivi nel quinquennio 2020-2024 e in previsione per l'esercizio 2025, per un campione costante di 19 gruppi bancari. Nel Software si registra una crescita importante, passando da meno di 1,5 miliardi di euro nel 2020 a più di 2 miliardi di euro nel 2024, con un forte incremento nel 2023 e un balzo ancora più significativo nel 2024; prosegue, anche se in maniera molto lieve, l'incremento del TCO per l'Hardware. Le previsioni per il 2025 vedono per tutti i fattori produttivi un decremento o una sostanziale stabilità dei costi.

Figura 14 - TCO per fattori produttivi: andamento 2020-2024 e previsione - valori assoluti



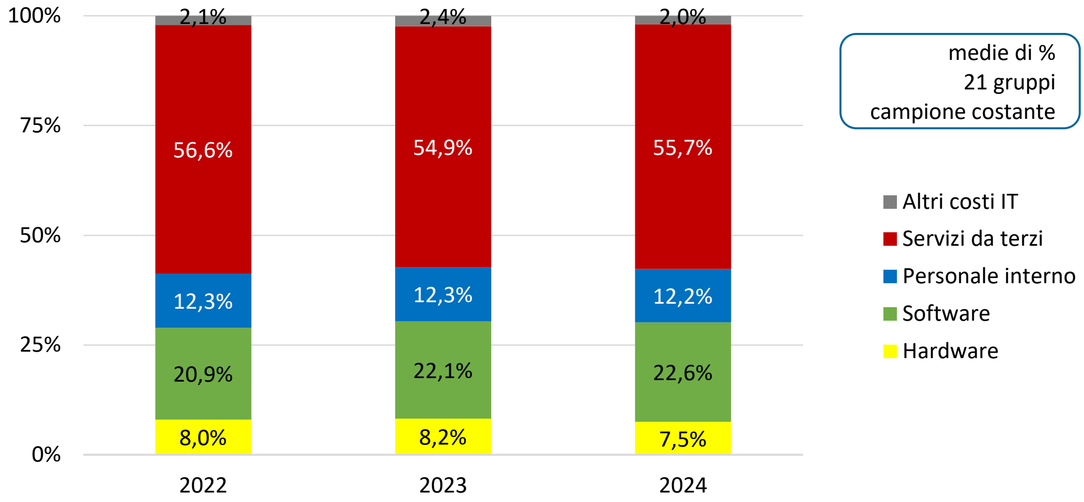
La Figura 15 mostra l'andamento del TCO in valore assoluto sul medesimo orizzonte temporale e con lo stesso campione di 19 gruppi, sovrapponendo i fattori produttivi in una vista cumulativa per ciascun esercizio analizzato.

Figura 15 - TCO per fattori produttivi: andamento 2020-2024 e previsione - valori assoluti (vista 2)



Una simile analisi, condotta in percentuale sul triennio 2022-2024, consente di evidenziare i fattori produttivi il cui TCO acquisisce maggiore o minor rilievo per un campione costante di 21 gruppi (Figura 16).

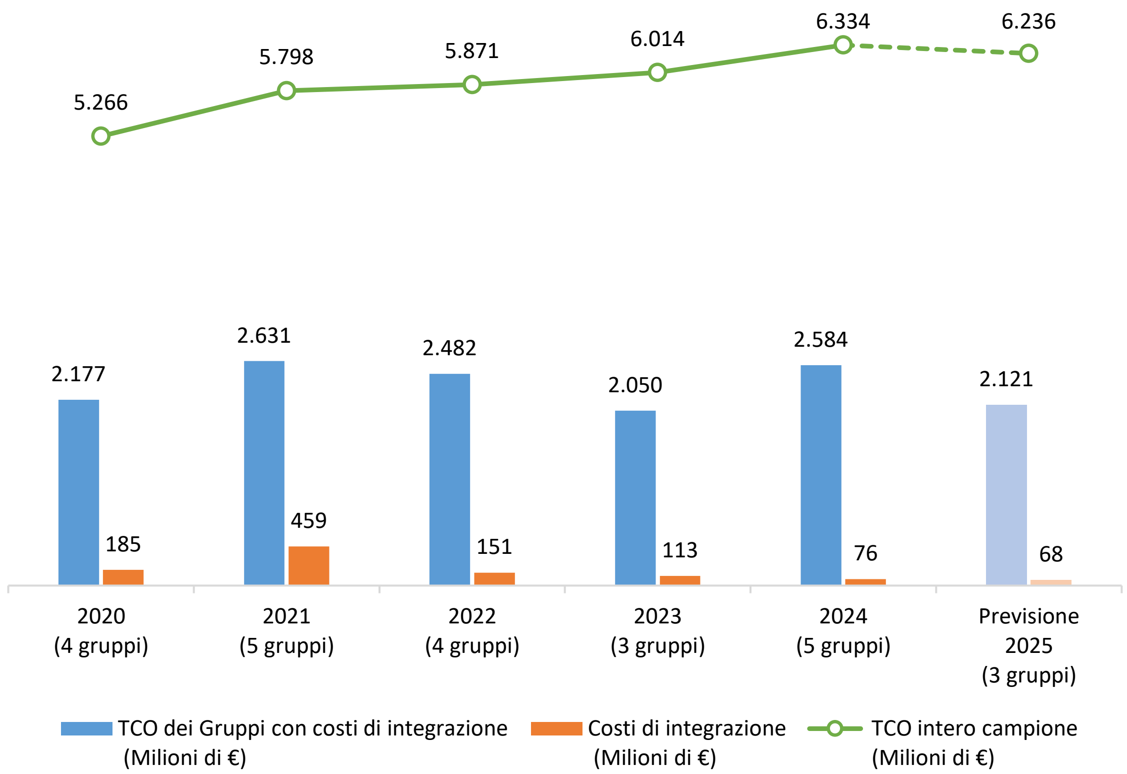
Figura 16 - TCO per fattori produttivi: andamento 2022-2024 - valori %



1.1.3 Costi di integrazione

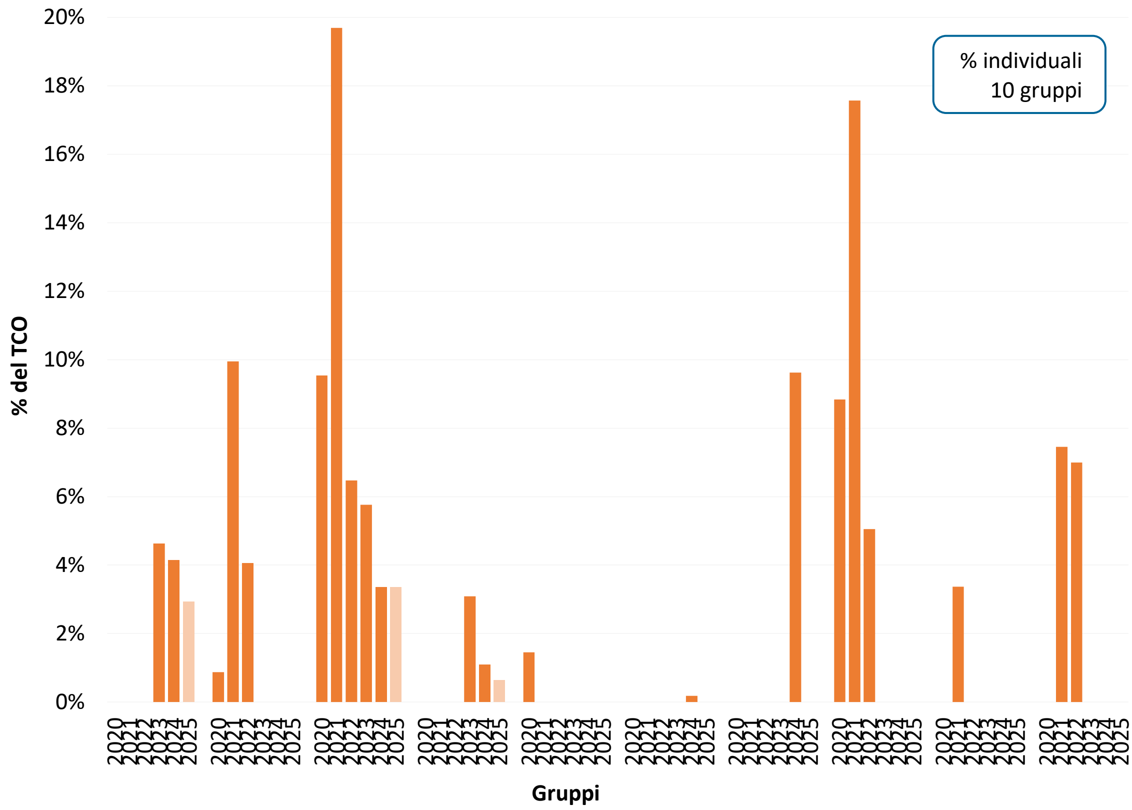
Il grafico di Figura 17 mostra, su un orizzonte temporale di cinque anni, il consuntivo dei costi di integrazione[9] (barra arancione) per quei gruppi bancari che li hanno dichiarati, unitamente al TCO complessivo di tali gruppi (barra blu); nelle ascisse è riportato, per ciascun anno, il numero di gruppi che ha dichiarato di aver sostenuto costi IT di integrazione. Sono rappresentati inoltre i costi totali di tutti i gruppi che, anno per anno, hanno partecipato alla Rilevazione (linea verde). Per le grandezze citate sono forniti anche i valori previsionali per l'esercizio 2025.

Figura 17 - Costi di integrazione complessivi: andamento 2020-2024 e previsione



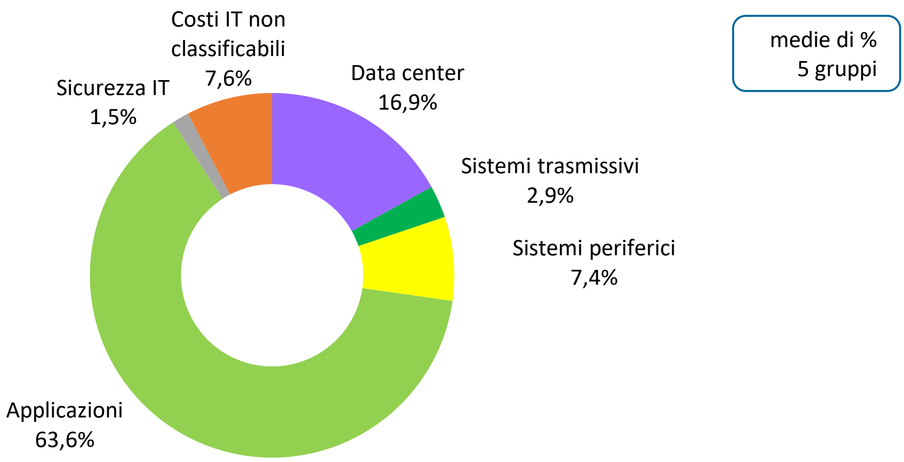
Con riferimento al medesimo intervallo temporale, la Figura 18 riporta, in termini percentuali rispetto al TCO individuale, l'andamento dei costi di integrazione per i dieci gruppi che nel periodo in esame hanno segnalato almeno una volta questa tipologia di costi.

Figura 18 - Costi di integrazione individuali: andamento 2020-2024 e previsione



Disaggregando i costi di integrazione dell'esercizio 2024 per aree tematiche ed esprimendoli in medie di percentuali, si osserva che i cinque gruppi che li hanno sostenuti hanno destinato la maggior quota all'area Applicazioni (63,6%) (Figura 19).

Figura 19 - Costi di integrazione per aree tematiche

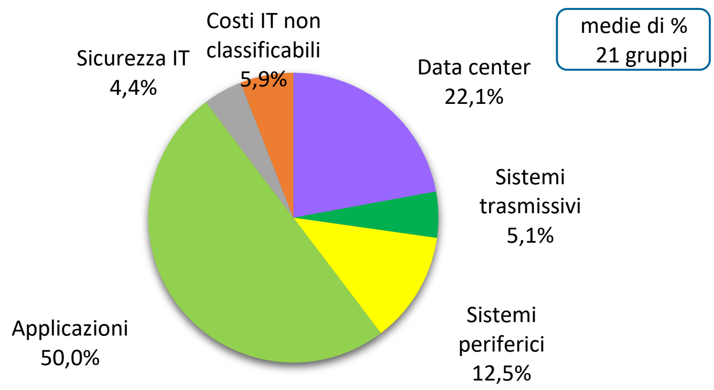


1.2 TCO e cash out IT

1.2.1 Aree tematiche

Questo paragrafo analizza il TCO e il cash out IT (spese correnti più investimenti) dal punto di vista delle aree tematiche. Tali analisi riguardano i costi sostenuti dai gruppi sia direttamente che nei confronti di terzi e vengono elaborate con riferimento a un campione di 21 gruppi[12]. Come si evince dalla Figura 20, le aree Applicazioni e Data center assorbono le maggiori quote di costi IT, rispettivamente il 50% e il 22,1% del TCO. I costi per la Sicurezza IT si attestano al 4,4%, valore che potrebbe essere sottorappresentato a causa della difficoltà di isolare questa tipologia di costo.

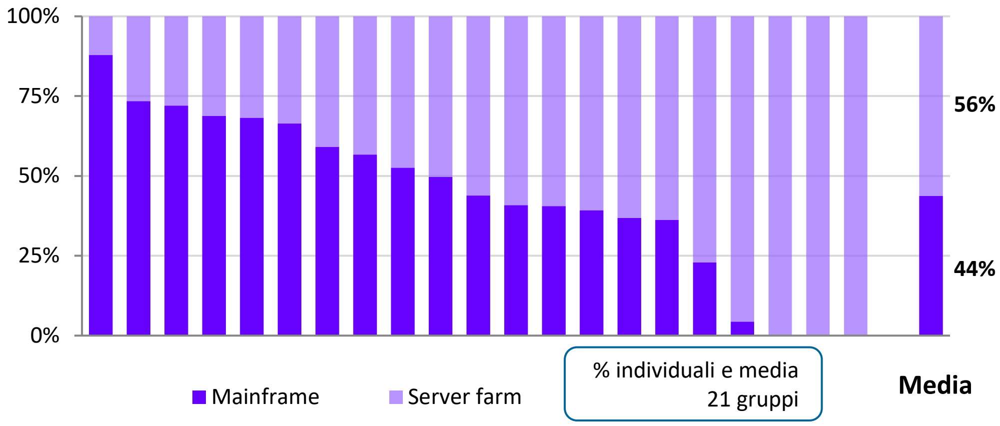
Figura 20 - TCO per aree tematiche



In Appendice sono riportati i risultati delle analisi per classe dimensionale (Figura 114) e per modello di sourcing IT (Figura 115).

La Figura 21 si focalizza sul TCO del Data center mostrando, per ciascun gruppo, la suddivisione percentuale tra la quota per il Mainframe e quella per la Server farm. Si osserva una situazione del tutto eterogenea, con 18 gruppi che sostengono costi per entrambe le tipologie di sistemi e tre che dichiarano soltanto costi per la Server farm. In media di percentuali, la maggior quota di costi per il Data center è dedicata alla Server farm (56%).

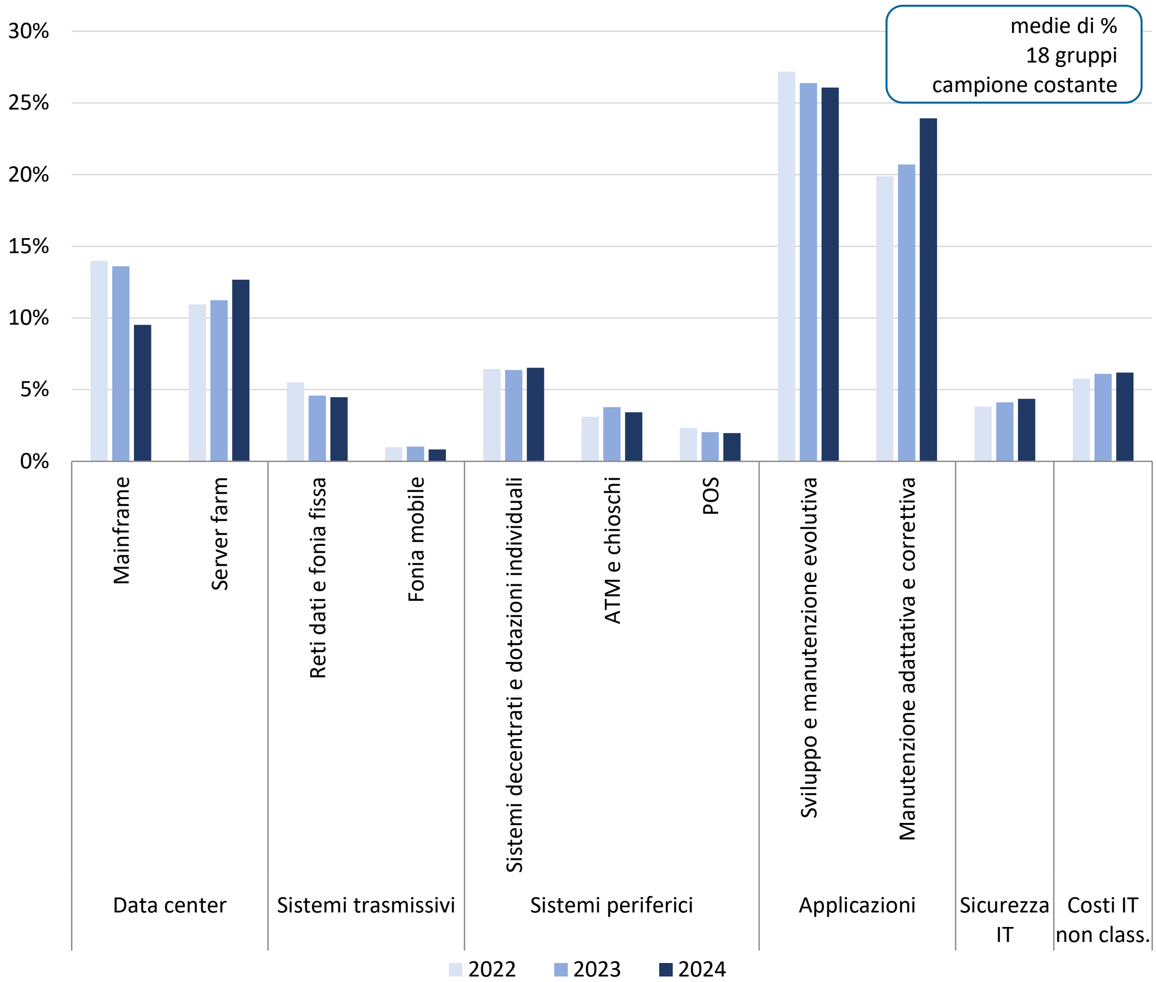
Figura 21 - TCO del Data center: ripartizione individuale tra Mainframe e Server farm



[12] Per una significativa rappresentazione dei fenomeni, dalle analisi per aree tematiche in medie di percentuali vengono esclusi i gruppi - solitamente in Outsourcing - che hanno attribuito alla voce “Costi IT non classificabili” più del 30% del TCO totale.

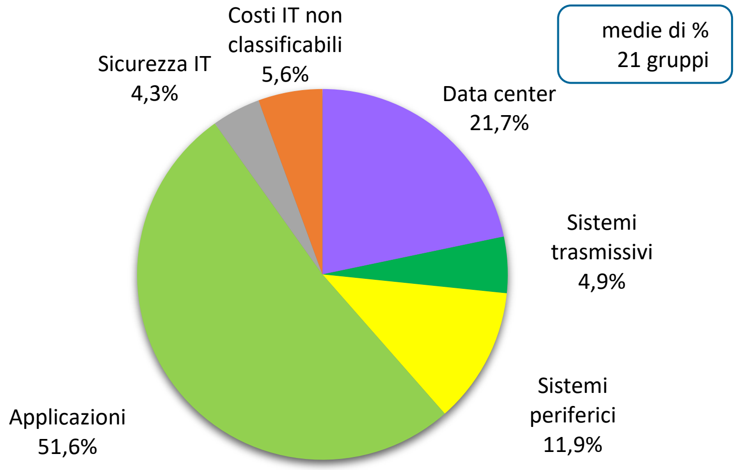
La Figura 22 mostra l'andamento del TCO per aree tematiche in medie di percentuali su un campione costante di 18 gruppi che hanno ripartito i costi con sufficiente granularità nel periodo 2022-2024. In particolare, nell'esercizio 2024 si possono notare variazioni cospicue per Manutenzione adattativa e correttiva e per Server farm, con trend in aumento, e per Mainframe, con trend in diminuzione.

Figura 22 - TCO per aree tematiche: andamento 2022-2024



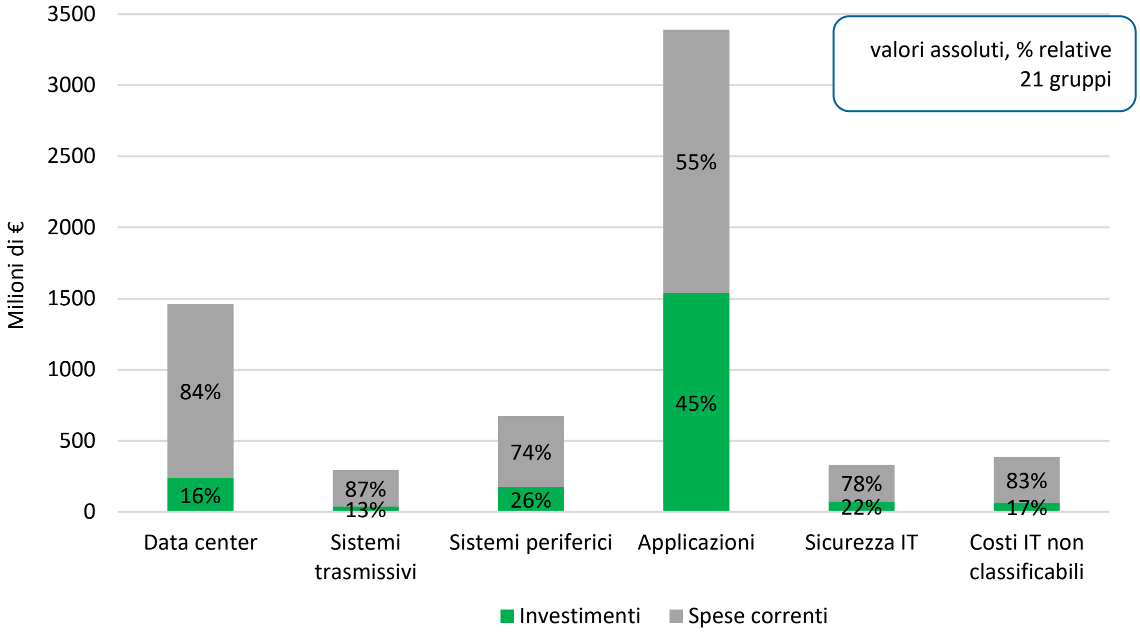
Il cash out IT per aree tematiche, espresso in medie di percentuali sui 21 gruppi che lo ripartiscono in modo sufficientemente dettagliato (Figura 23), presenta una suddivisione molto simile a quella del TCO.

Figura 23 - Cash out IT per aree tematiche



La Figura 24 mostra la ripartizione in valore assoluto del cash out IT tra le aree tematiche - per i 21 gruppi che lo hanno fornito con sufficiente granularità - unitamente alla sua suddivisione, all'interno di ogni area, tra investimenti e spese correnti, ovvero le due grandezze che lo costituiscono. Tale suddivisione può essere confrontata con quella complessiva riguardante l'intero cash out IT dei 23 gruppi, le cui quote di spese correnti e investimenti sono rispettivamente del 67,7% e 32,3%.

Figura 24 - Cash out IT per aree tematiche: spese correnti vs. investimenti



In Appendice, da Tabella 16 a Tabella 23, è riportata la ripartizione tra aree tematiche e fattori produttivi delle grandezze economiche sopra trattate, relativamente ai 21 gruppi che ripartiscono il TCO con sufficiente dettaglio. Tutti i valori sono espressi in medie di percentuali, anche con riferimento ai diversi modelli di sourcing IT e classi dimensionali.

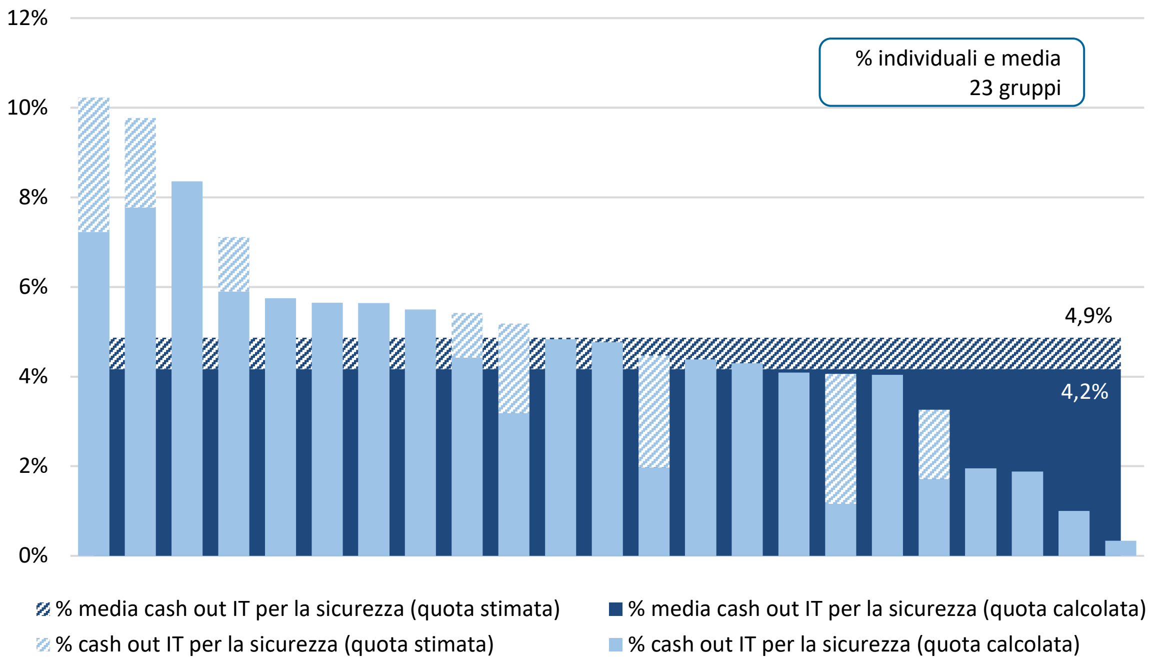
1.2.2 Sicurezza IT

Le variabili economiche relative alla Sicurezza IT[13] sono rilevate e rappresentate separatamente dalle aree tematiche, pertanto le quote attribuite alle varie aree sono da considerarsi, in linea di massima e fatti salvi quei casi in cui i gruppi abbiano difficoltà a isolarli, al netto di questa componente.

La Figura 25 riporta le percentuali individuali del cash out dedicato alla Sicurezza IT, valori che variano tra lo 0,3% e l'8,4% e che, mediamente, sono pari al 4,2%. Otto gruppi hanno integrato il valore fornito con una stima percentuale relativa a spese per la Sicurezza IT non rilevabili in maniera analitica (le quote stimate sono rappresentate nel grafico dalle aree tratteggiate). Comprendendo i valori stimati, la media sale al 4,9%.

In valore assoluto, il cash out che i 23 gruppi hanno complessivamente destinato alla Sicurezza IT nell'esercizio 2024 ammonta a 365,7 milioni di euro, incluse le componenti stimate.

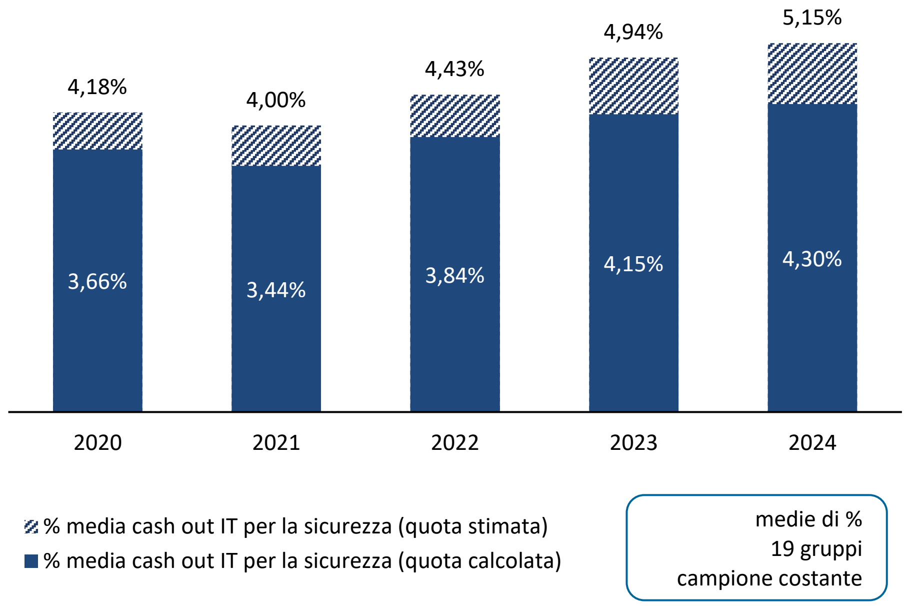
Figura 25 - Cash out individuale per la Sicurezza IT



La Figura 26 mostra l'andamento del cash out per la Sicurezza IT, in medie di percentuali sul cash out IT totale, nel quinquiennio 2020-2024 a campione costante (19 gruppi), documentando un impegno economico sempre crescente a partire dal 2021.

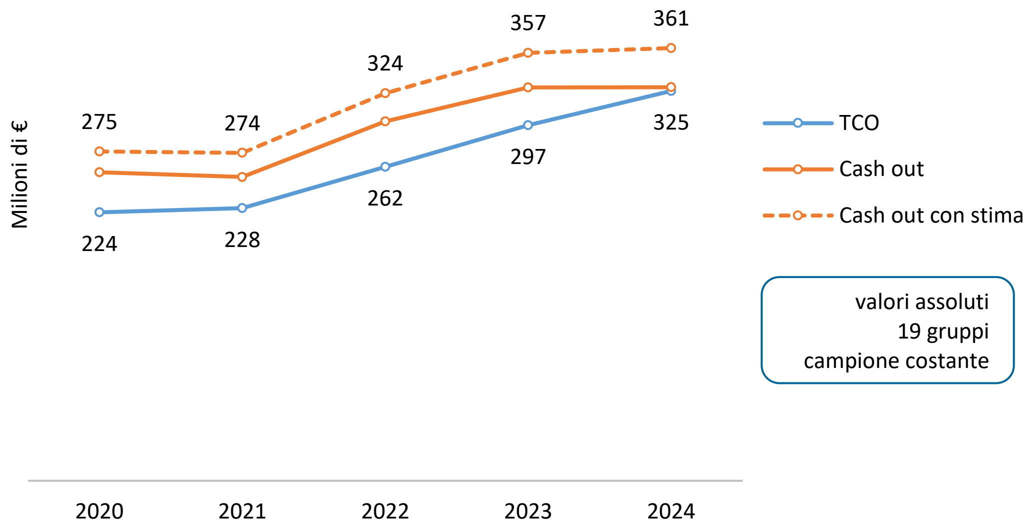
[13] L'elenco delle voci di costo ricomprese nella Sicurezza IT è riportato nel paragrafo "Fattori produttivi e aree tematiche" del Capitolo "Campione e note metodologiche".

Figura 26 - Cash out per la Sicurezza IT: andamento 2020-2024



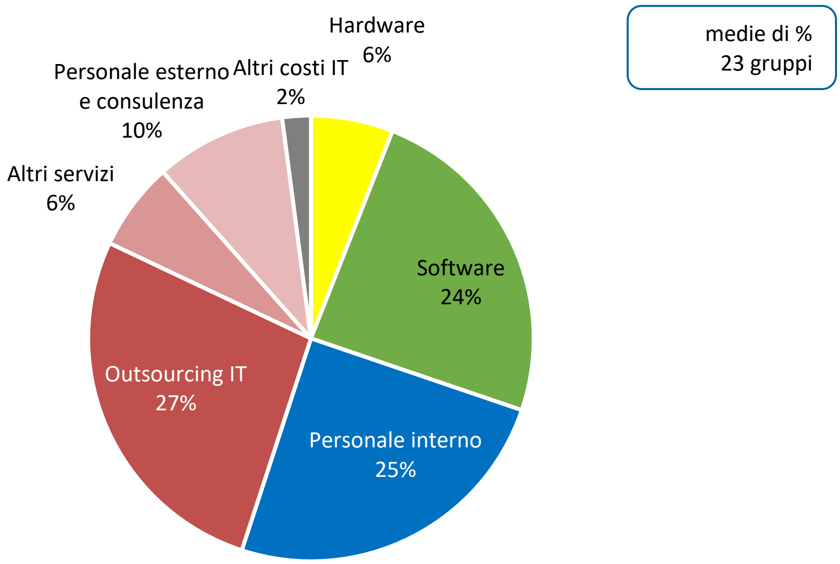
La Figura 27 confronta i trend in valore assoluto del TCO e del cash out, quest'ultimo sia al netto che comprensivo delle quote stimate, destinati alla Sicurezza IT per il medesimo periodo e campione. Si evidenzia una tendenza generale in aumento per entrambe le curve, con il cash out posto stabilmente al di sopra del TCO.

Figura 27 - TCO e cash out per la Sicurezza IT: andamento 2020-2024



La Figura 28 analizza il TCO per la Sicurezza IT ripartito tra i fattori produttivi. Si osserva che tali costi sono prevalentemente destinati a Servizi da terzi (spicchi con gradazioni di rosso, 43%), seguiti da Personale interno (25%), Software (24%) e Hardware (6%).

Figura 28 - TCO per la Sicurezza IT, per fattori produttivi



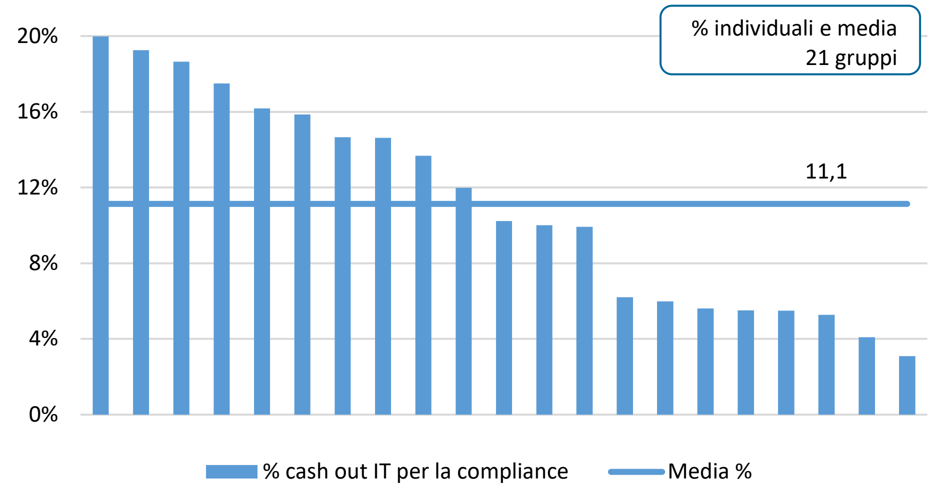
1.3 Cash out IT

1.3.1 Compliance

Questo paragrafo rileva la spesa sostenuta nel 2024 per la compliance, ossia per gli interventi IT effettuati per soddisfare i requisiti della normativa nazionale ed europea, nonché di principi e standard internazionali di riferimento, che impongono interventi obbligatori per il gruppo bancario (esclusi gli interventi rivenienti da normative o policy interne e i costi ricorrenti per interventi di compliance realizzati in anni precedenti). In valore assoluto, il cash out IT complessivamente destinato a interventi di compliance dai 21 gruppi rispondenti ammonta a 780,9 milioni di euro.

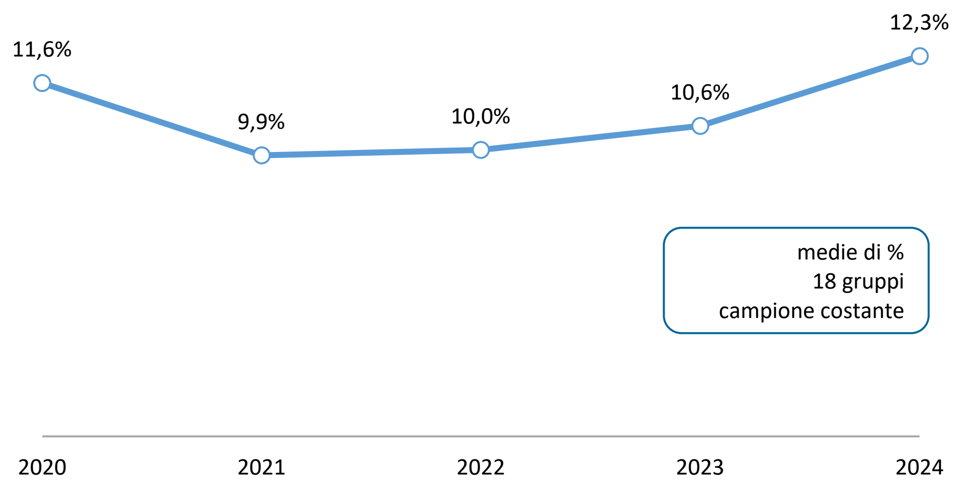
La Figura 29 riporta le percentuali individuali di cash out IT dedicate da ognuno dei gruppi a interventi di compliance, che vanno dal 3,1% al 20%, con valor medio pari all’11,1%. La variabilità tra i valori individuali, riscontrata anche nei precedenti esercizi, appare in parte riconducibile alle differenti modalità di imputazione dei costi di compliance adottate dai gruppi, al diverso periodo temporale di attuazione degli interventi, nonché, più in generale, alle difficoltà rilevate nell’isolare i costi di compliance nell’ambito della complessiva spesa IT.

Figura 29 - Cash out IT individuale per la compliance



La Figura 30 mostra l'andamento della percentuale media di cash out IT per la compliance nel periodo 2020-2024 su un campione costante di 18 gruppi, in costante crescita negli ultimi anni.

Figura 30 - Cash out IT per la compliance: andamento 2020-2024



Tornando al campione dei 21 gruppi, gli ambiti che mediamente hanno richiesto il maggiore impegno economico per gli adeguamenti alla normativa sono, anche nel 2024, quello della vigilanza Banca d'Italia/BCE/EBA/ESMA (2,78% del cash out IT totale), della normativa sui mercati finanziari (1,15%) e sui servizi di pagamento (1,04%), ai quali si aggiunge quello di resilienza operativa digitale (1,2%); gli altri ambiti si attestano tutti su valori inferiori all'1% (Figura 31).

Figura 31 - Cash out IT per la compliance: media per ambito

In Appendice, la Figura 121 mostra nel dettaglio, per ciascun ambito, la distribuzione della quota del cash out IT destinata alla compliance.

La Tabella 4 riporta gli ambiti della figura precedente con i valori medi percentuali dei gruppi suddivisi in classi dimensionali.

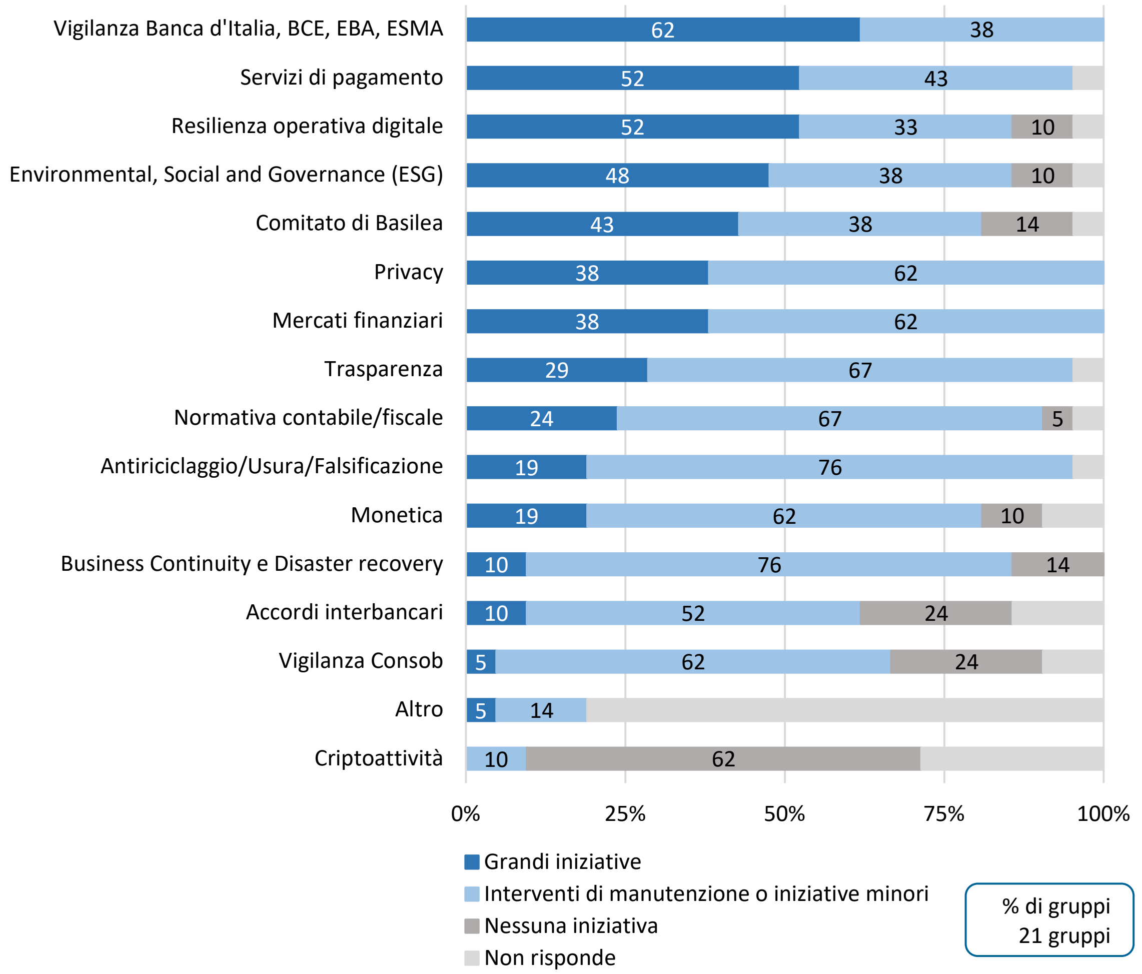
Tabella 4 - Cash out IT per la compliance: ripartizione per ambito e classe dimensionale

Ambito	Principali(5)	Medi(9)	Piccoli(7)
Vigilanza Banca d'Italia, BCE, EBA, ESMA	3,95	2,55	2,24
Resilienza operativa digitale	0,95	1,50	0,99
Mercati finanziari	1,78	1,03	0,86
Servizi di pagamento	0,96	0,76	1,47
Comitato di Basilea	1,85	0,45	0,27
Antiriciclaggio/Usura/Falsificazione	0,94	0,86	0,38
Trasparenza	0,22	0,95	0,46
Environmental, Social and Governance (ESG)	0,46	0,77	0,29
Normativa contabile/fiscale	0,58	0,64	0,20
Altro	0,11	0,75	0,00
Business Continuity e Disaster recovery	0,19	0,39	0,40
Privacy	0,50	0,32	0,26
Monetica	0,22	0,34	0,42
Vigilanza Consob	0,48	0,38	0,13
Accordi interbancari	0,01	0,19	0,30
Criptoattività	0,00	0,00	0,03
Tot.	**13,2%**	**11,9%**	**8,7%**

A completamento dell'analisi sulla compliance, viene rilevata la portata delle iniziative progettuali IT intraprese nel 2024 nei medesimi ambiti normativi. Queste sono classificate in grandi iniziative progettuali (es. avvio o prosecuzione di progetti di portata significativa a seguito di normative nuove o modificate in maniera sostanziale) e interventi di manutenzione o iniziative progettuali minori (es. interventi limitati su applicazioni esistenti, progetti con scarso impatto sull'IT).

Oltre la metà del campione ha condotto grandi iniziative progettuali IT in ambiti che riguardano la normativa sulla vigilanza e sui servizi di pagamento, la resilienza operativa digitale e cybersecurity. Gli ambiti che impegnano in interventi IT (di qualunque portata) almeno il 90% dei gruppi rispondenti riguardano la normativa sulla vigilanza, sui mercati finanziari e sui servizi di pagamento, la privacy, la trasparenza e l'antiriciclaggio/usura/falsificazione (Figura 32).

Figura 32 - Iniziative progettuali per la compliance



Le analisi sulle iniziative progettuali per interventi di compliance riferite ai gruppi suddivisi in classi dimensionali sono riportate in Appendice (da Figura 122 a Figura 124).

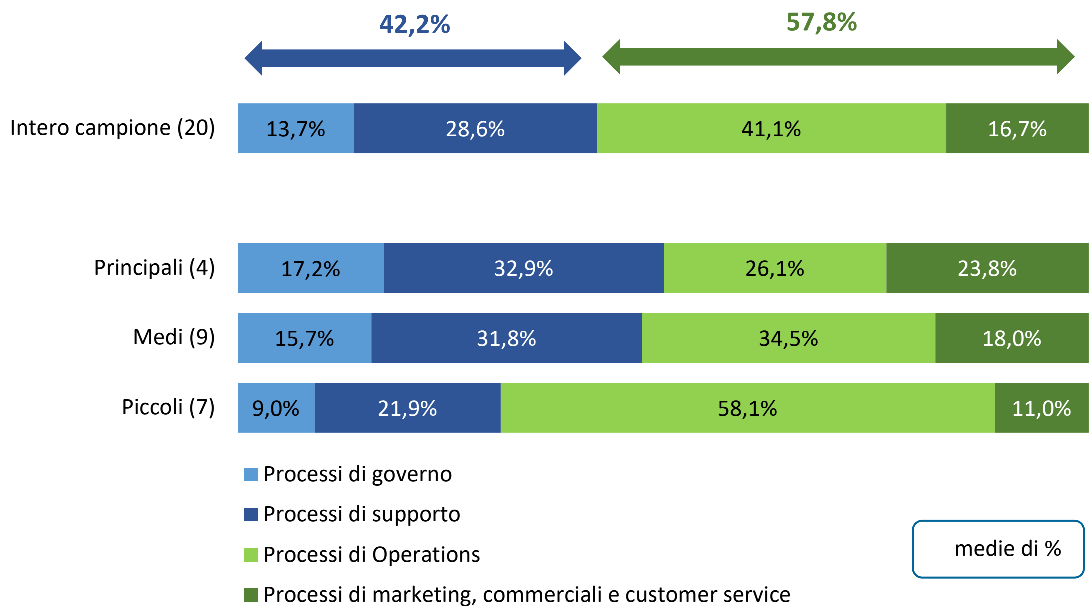
1.3.2 Processi e aree funzionali

L'analisi della ripartizione della spesa IT per aree funzionali e processi fa riferimento alla tassonomia dei processi bancari ABI Lab, che prevede una composizione dei processi articolata all'interno di quattro aree funzionali: processi di governo, processi di supporto, processi di Operations, processi di marketing, commerciali e customer service[14].

[14] L'elenco dei processi ricompresi nelle quattro aree funzionali è riportato in Figura 34.

Con riferimento al cash out IT si osserva in Figura 33 che, per 20 gruppi rispondenti, i processi di Operations assorbono in medie di percentuali il 41,1% della spesa; seguono i processi di supporto (28,6%), di marketing, commerciali e customer service (16,7%) e di governo (13,7%). Le attività orientate al business assorbono nel complesso il 57,8% del cash out IT e quelle dedicate al supporto funzionale, indicate come functions[15], si attestano al 42,2%. Il rapporto tra le quote business e functions nel 2024 risulta pari a 1,37, inferiore a quello dell'anno precedente (1,42). La figura ripartisce le medesime quote anche per classe dimensionale.

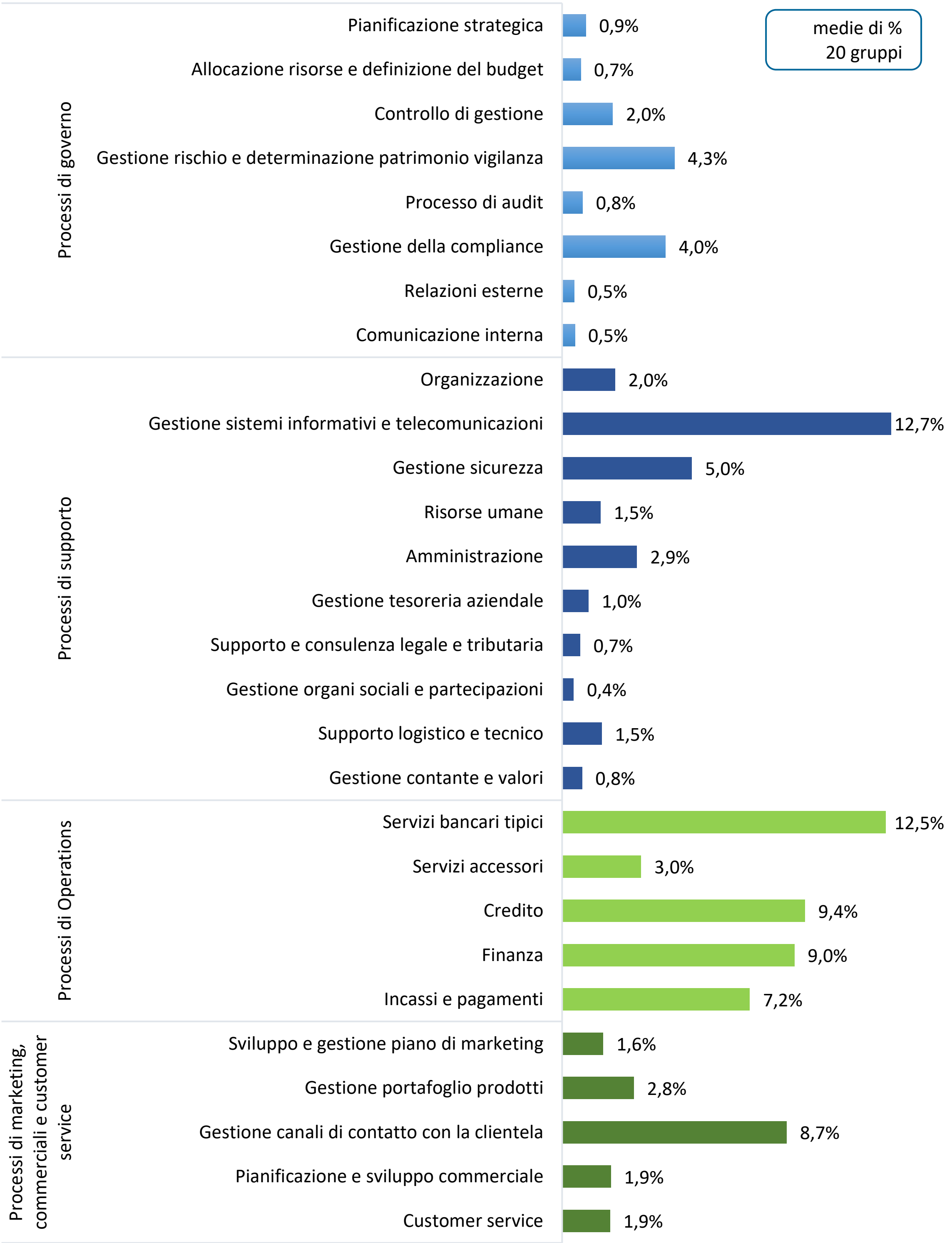
Figura 33 - Cash out IT per aree funzionali



La Figura 34 analizza in dettaglio, per lo stesso campione, la ripartizione del cash out IT in medie di percentuali all'interno dei singoli processi afferenti alle quattro aree funzionali. Nell'area dei processi di governo le maggiori quote sono assorbite dalla gestione del rischio e determinazione del patrimonio di vigilanza (4,3%) e gestione della compliance (4%). Nei processi di supporto il peso maggiore è costituito dalla gestione dei sistemi informativi e telecomunicazioni (12,7%), seguito dalla gestione della sicurezza (5%). Nei processi core dell'area Operations si registrano le quote maggiori, passando dal 7,2% di incassi e pagamenti al 12,5% dei servizi bancari tipici. Nell'area dei processi di marketing, commerciali e customer service ha un peso preponderante sul cash out IT totale la gestione dei canali di contatto con la clientela (8,7%).

[15] L'ambito Business è composto dalle aree funzionali "Processi di Operations" e "Processi di marketing, commerciali e customer service". L'ambito Functions è composto dalle aree funzionali "Processi di governo" e "Processi di supporto".

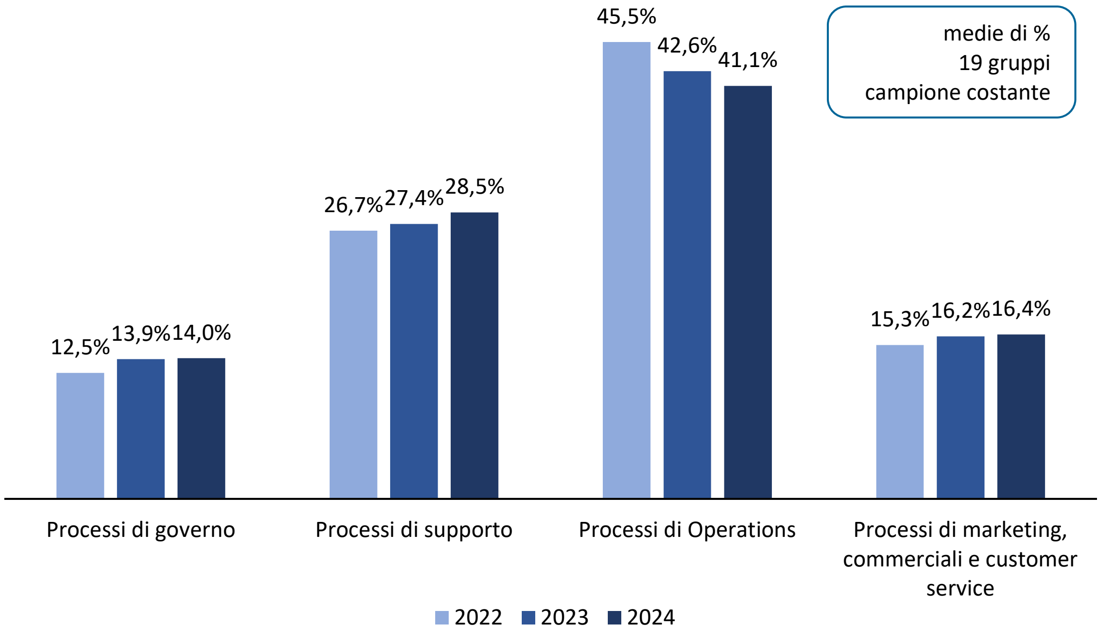
Figura 34 - Cash out IT per processi



In Appendice sono riportate le analisi di ripartizione del cash out IT per aree funzionali e processi, riferite ai gruppi suddivisi in classi dimensionali (da Figura 116 a Figura 118).

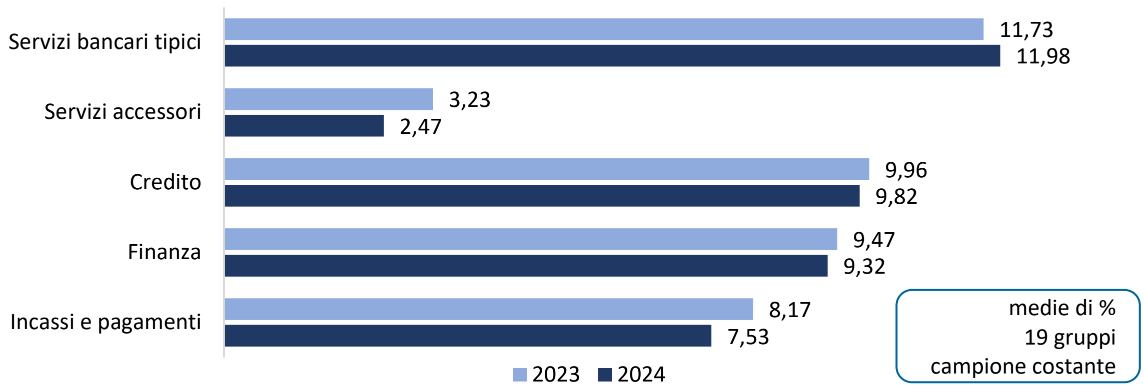
L'andamento in medie di percentuali del cash out IT per aree funzionali, nel triennio 2022-2024 e con riferimento a un campione costante di 19 gruppi, mostra un trend in calo nei processi di Operations (-4,4 % in tre anni), a fronte di un trend in aumento per tutte le altre aree (Figura 35).

Figura 35 - Cash out IT per aree funzionali: andamento 2022-2024



In Figura 36 viene proposto un approfondimento del fenomeno sopra menzionato: l'analisi si riferisce allo stesso campione costante della figura precedente e raffronta il cash out dedicato ai singoli processi dell'area Operations, negli ultimi due esercizi.

Figura 36 - Cash out IT dell'area Operations: raffronto 2023-2024



1.3.3 Run e change

Il cash out IT viene di seguito analizzato separatamente tra due componenti, distinte a seconda della finalità e indipendentemente dal regime contabile:

- ✓ **Run**: cash out IT (es. acquisti, canoni, personale interno/esterno, outsourcing) impiegato per il mantenimento dell'operatività corrente (run the business), inclusa la manutenzione correttiva/adattativa e gli adeguamenti normativi e organizzativi di portata contenuta.
- ✓ **Change**: cash out IT (es. acquisti, canoni, personale interno/esterno, outsourcing) destinato a progetti o iniziative tese a migliorare e/o innovare l'operatività bancaria (change the business), inclusi gli adeguamenti normativi e organizzativi di ampia portata e la manutenzione evolutiva.

Per i 20 gruppi che hanno fornito la ripartizione per il 2024, mediamente il 67,2% del cash out IT è dedicato al run e il 32,8% al change (Tabella 5). Complessivamente, il cash out IT da essi destinato al run e al change è pari, rispettivamente, a 3.138 e 2.101 milioni di euro. Partendo dalla quota dedicata al change, può essere interessante rideterminare la stessa al netto delle spese connesse a interventi derivanti da obblighi normativi (compliance) ottenendo, per i 20 gruppi in parola, un cash out IT pari a 1.376 milioni di euro (possibile indicazione indiretta della spesa destinata a implementare le strategie di innovazione del business).

Analizzata all'interno delle aree funzionali, la spesa per il change ha un impatto maggiore sui processi di governo (5,6% su 13,7%). Viceversa, la gestione corrente pesa maggiormente sui processi di Operations (29,5% su 41,1%).

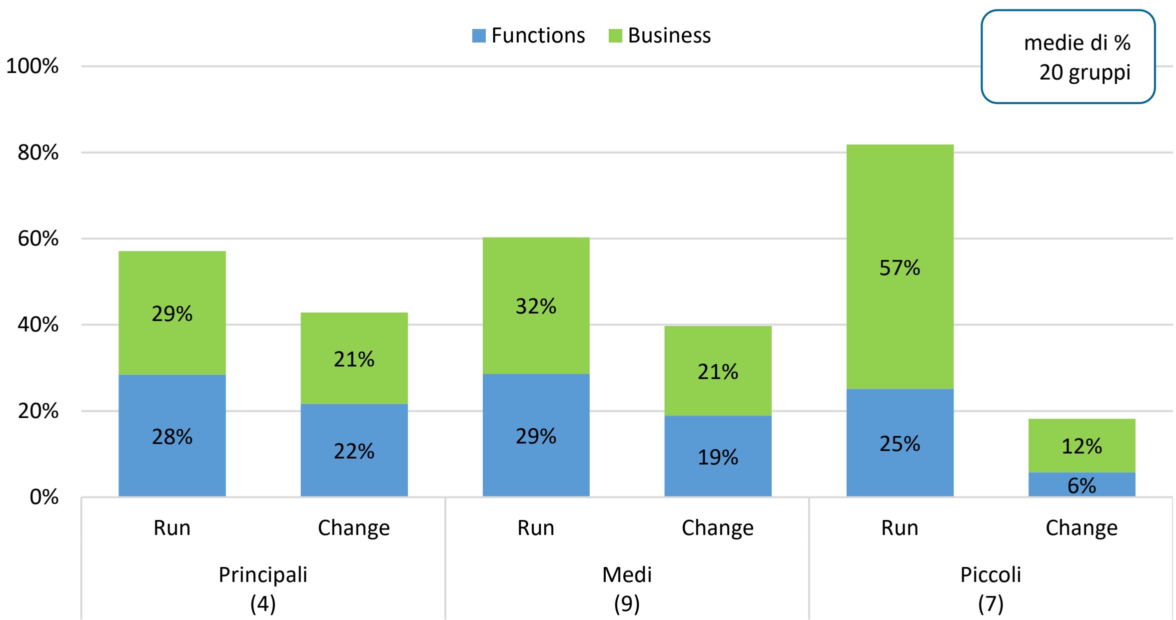
Tabella 5 - Cash out IT per aree funzionali e run/change

medie di % 20 gruppi

	% del cash out IT		Run		Change		
Processi di governo	13,7%	=	8,0%	+	5,6%	Functions	42,2%
Processi di supporto	28,6%	=	19,3%	+	9,2%		
Processi di Operations	41,1%	=	29,5%	+	11,6%	Business	57,8%
Processi di marketing, commerciali e customer service	16,7%	=	10,4%	+	6,4%		
Totale	100,0%	=	67,2%	+	32,8%		

La Figura 37 affianca, per ciascuna classe dimensionale, la barra del cash out IT dedicato al run a quella del change (in totale ogni coppia di barre rappresenta il 100%), suddivise ulteriormente nelle componenti functions e business. La quota del cash out IT dedicata al change cresce con l'aumentare della dimensione operativa dei gruppi bancari, passando dal 18% dei gruppi Piccoli al 43% dei gruppi Principali.

Figura 37 - Cash out IT per run/change e classe dimensionale



È interessante posizionare individualmente i gruppi bancari, differenziati per classe dimensionale, in un diagramma i cui lati orizzontali rappresentano le percentuali di run e change e i verticali quelle di business e functions (Figura 38).

Tutti i gruppi presi in esame, ad eccezione di uno tra i Principali, risultano posizionati nella metà sinistra del quadrato, caratterizzata dalla prevalenza del run rispetto al change. Su 20 gruppi, 14 si collocano nella metà superiore, in cui prevale la spesa per il business. I gruppi tendono a raggrupparsi in cluster sulla base delle classi dimensionali, i cui valori medi si collocano approssimativamente lungo una diagonale: i gruppi più grandi dedicano tendenzialmente maggiori quote di cash out IT al change e alle aree di supporto funzionale rispetto ai più piccoli che, viceversa, orientano le spese soprattutto al run e alle aree di business.

Figura 38 - Cash out IT per business/functions e run/change: valori individuali e per classe dimensionale

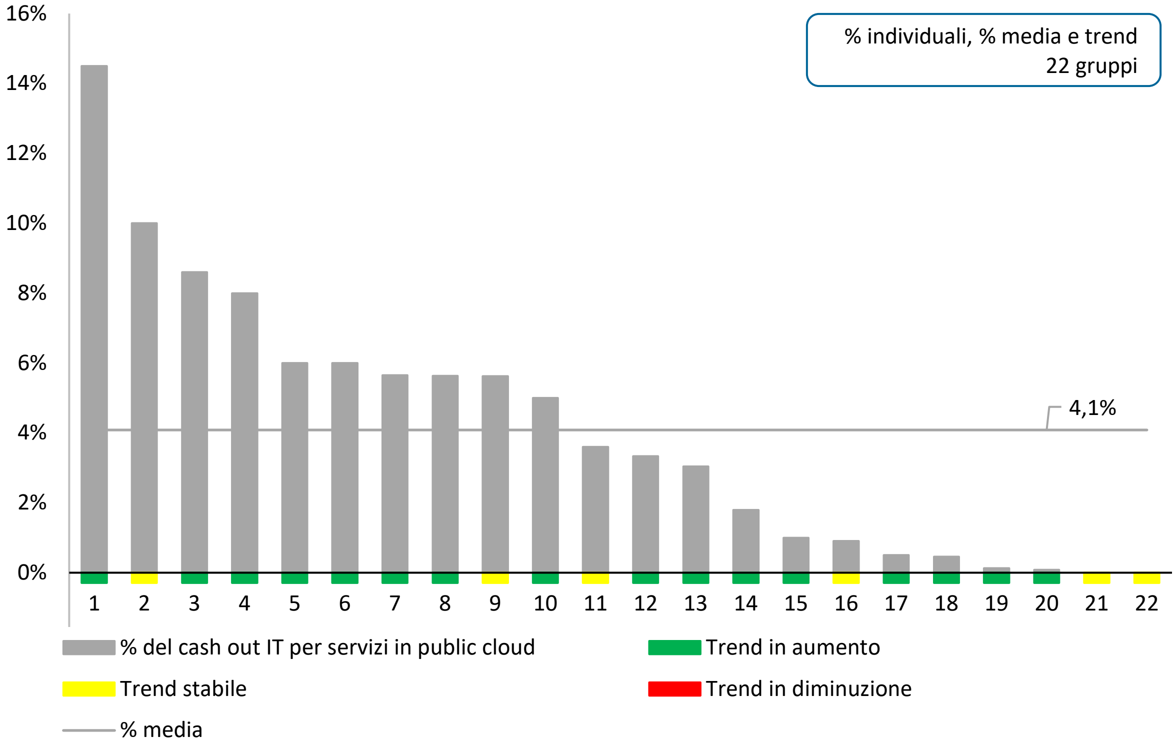
In Appendice sono riportati analoghi grafici basati sui modelli di sourcing IT (Figura 119 e Figura 120).

1.3.4 Public cloud

Questa sezione analizza la spesa destinata dai gruppi bancari a servizi fruiti in public cloud, rapportata al cash out IT complessivo. In valore assoluto, nell’esercizio 2024 il cash out totale destinato da 22 gruppi al public cloud ammonta a 239,9 milioni di euro.

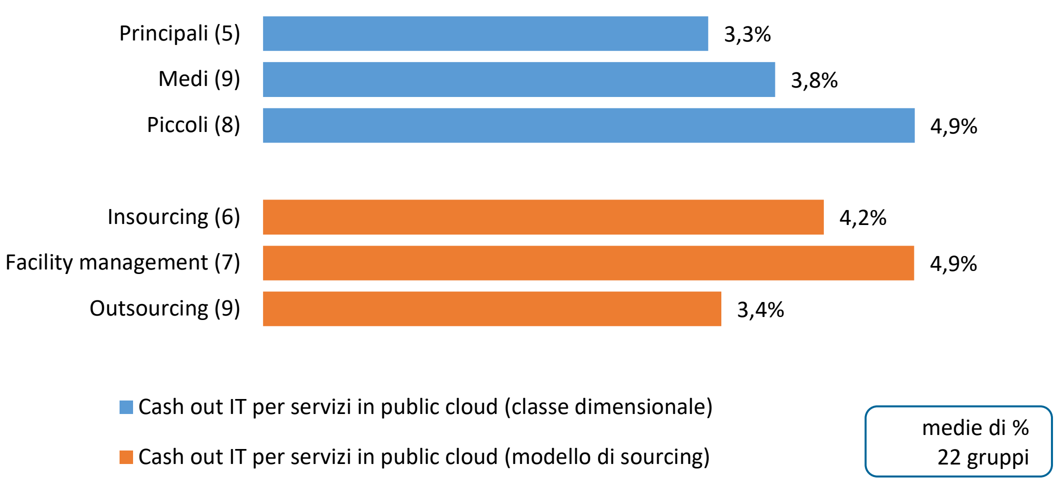
Il grafico di Figura 39 mostra, nelle barre in grigio, le percentuali individuali relative al 2024, che vanno fino a un massimo del 14,5%. Mediamente, la quota del cash out IT destinata al public cloud è pari al 4,1%, in linea con il dato del 2023. Il trend previsionale per il biennio 2025-2026 risulta in aumento per 16 gruppi su 22.

Figura 39 - Cash out IT individuale per servizi in public cloud



La Figura 40 aggrega le percentuali di cui sopra per classe dimensionale e per modello di sourcing IT del gruppo. Le medie per classe dimensionale confermano lo stesso fenomeno dell'esercizio precedente, per il quale la classe con percentuale minima è quella dei gruppi Principali (3,3%), mentre i gruppi Piccoli sono quelli con percentuale massima (4,9%).

Figura 40 - Cash out IT per servizi in public cloud: ripartizione per classe dimensionale e modello di sourcing

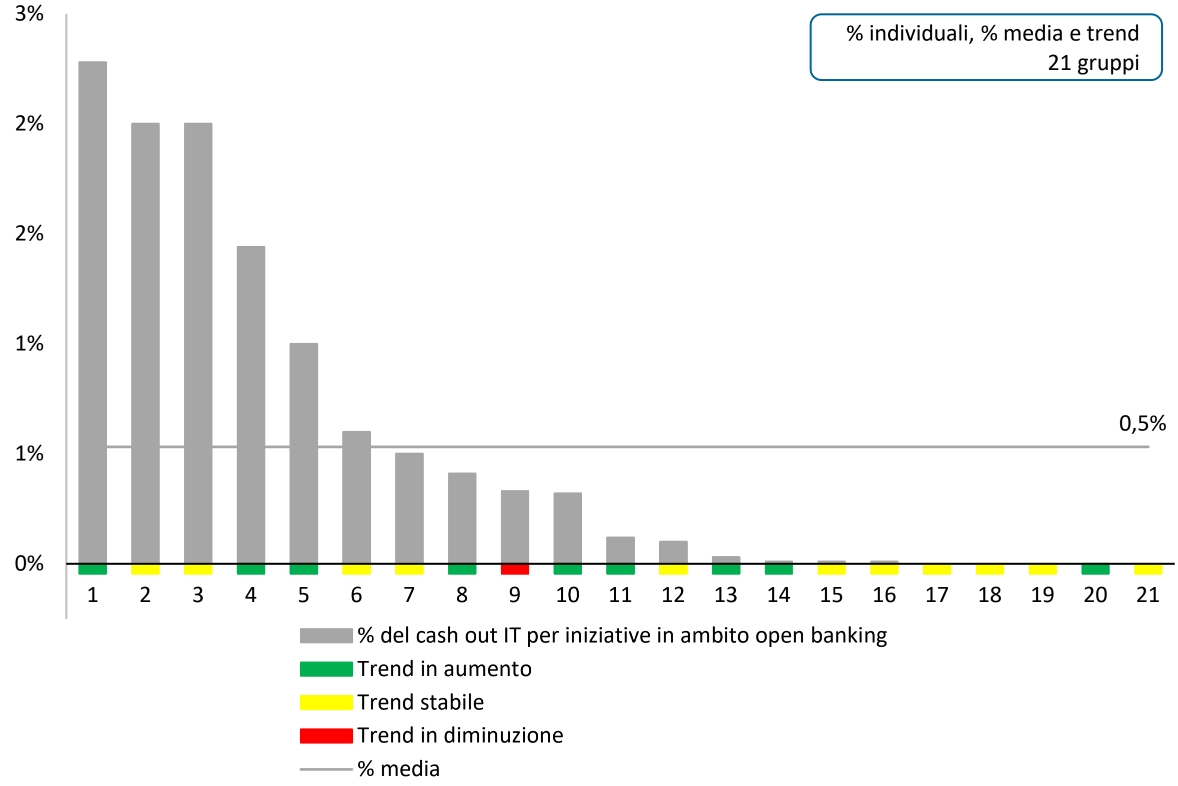


1.3.5 Open banking

L'analisi riportata di seguito si concentra sul cash out IT che 21 gruppi bancari hanno destinato nell'esercizio 2024 a iniziative in ambito open banking e che, in valore assoluto, ammonta nel complesso a 24,7 milioni di euro.

La percentuale media del cash out IT totale dedicata all'open banking appare contenuta, pari allo 0,5%. A livello individuale la percentuale massima si attesta al 2,3%, ma 15 gruppi spendono meno della media e nove di questi dichiarano percentuali di spesa pressoché nulle. Osservando i trend previsionali, nove gruppi, soprattutto quelli già attivi in questo ambito, prevedono un incremento della propria quota percentuale nel biennio 2025-2026 (Figura 41).

Figura 41 - Cash out IT individuale per l'open banking



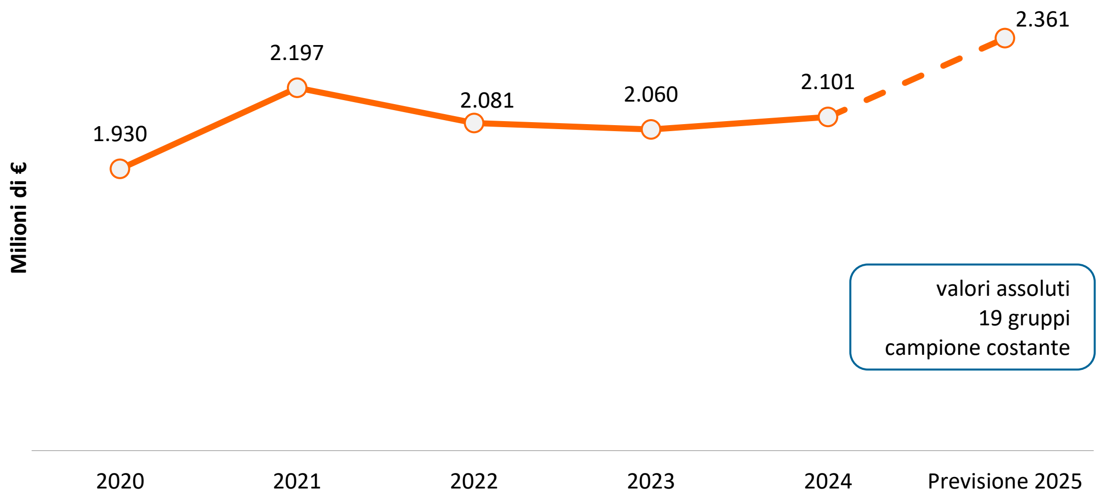
La Figura 125 in Appendice aggrega le percentuali di cui sopra per classe dimensionale e per modello di sourcing IT.

1.4 Investimenti IT e innovazione tecnologica

Questo paragrafo fornisce un focus sugli investimenti IT dei 23 gruppi bancari che, nel 2024, ammontano complessivamente a 2.140 milioni di euro.

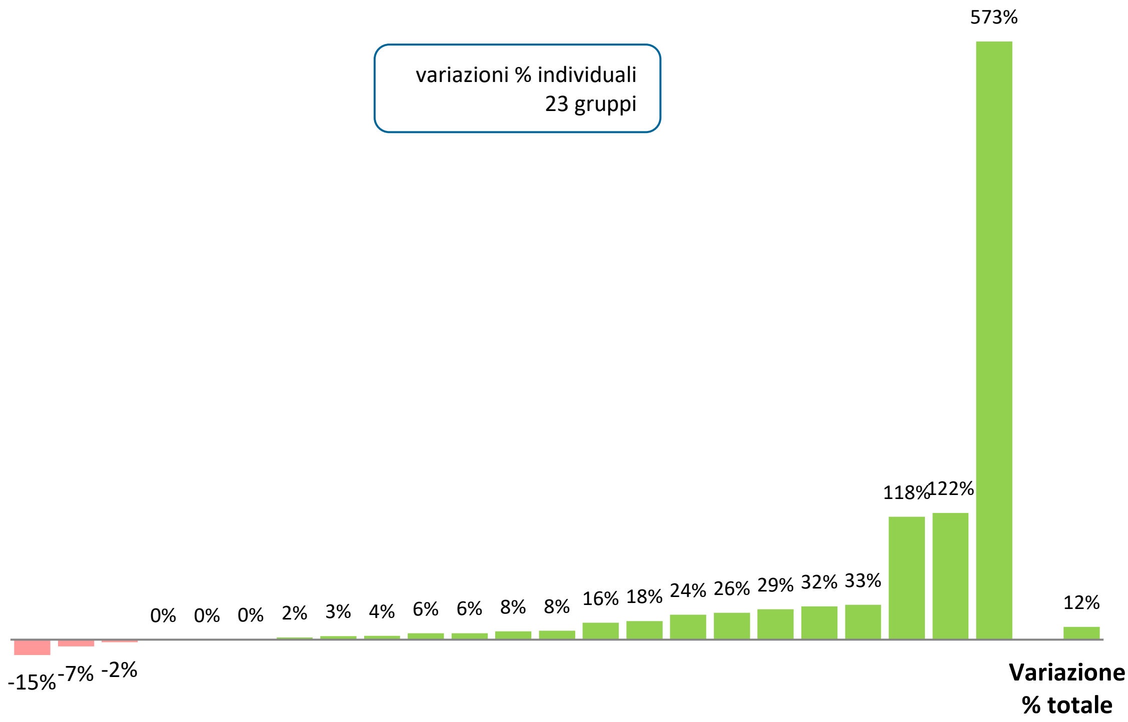
La Figura 42 mostra l'andamento del totale degli investimenti IT registrato a consuntivo da un campione costante di 19 gruppi nel quinquennio 2020-2024, unitamente al totale previsionale indicato per il 2025.

Figura 42 - Investimenti IT: andamento 2020-2024 e previsione



La Figura 43 riporta le variazioni percentuali, riferite ai singoli gruppi, tra gli investimenti IT registrati nell'esercizio 2024 e quelli previsti per il 2025, rispetto ai valori del 2024. Tra tutti i gruppi, solo tre prevedono una riduzione; in alcuni casi le percentuali di incremento sono rilevanti. Nominalmente, l'ammontare degli investimenti IT previsti per il 2025 dai 23 gruppi è del 12% superiore a quello rilevato nel consuntivo 2024.

Figura 43 - Investimenti IT: variazione della previsione 2025 rispetto al consuntivo 2024

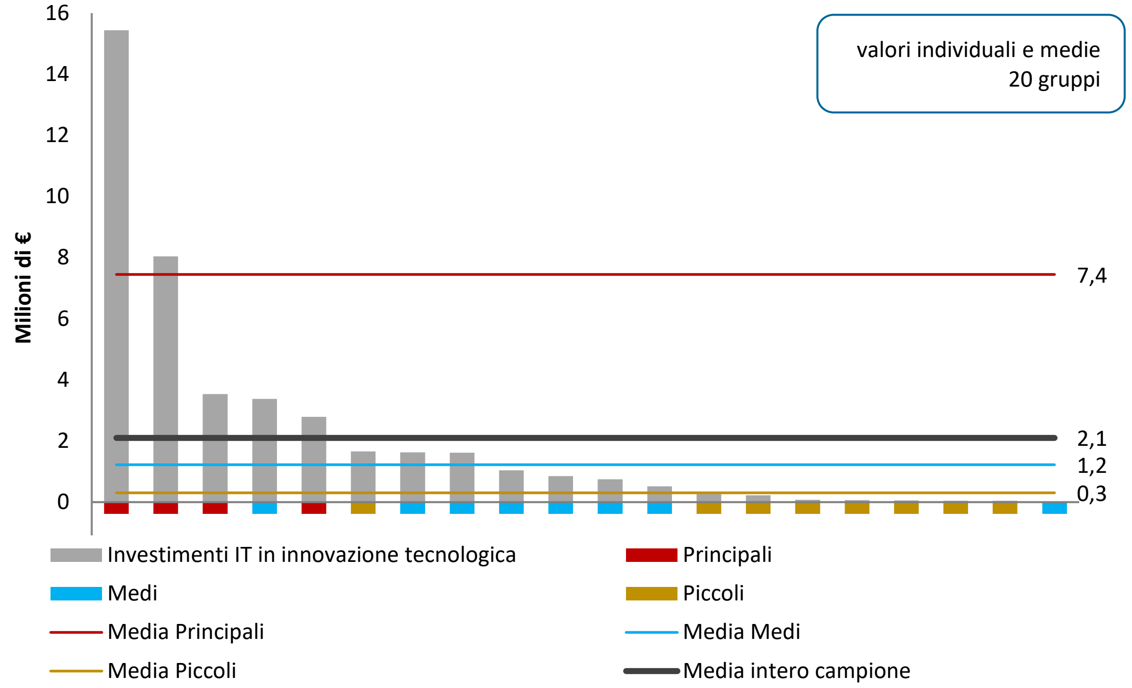


La Figura 44 mostra il valore assoluto degli investimenti IT che ciascun gruppo ha destinato, nel 2024, ai seguenti ambiti tecnologici innovativi:

- ✓ Intelligenza artificiale (inclusa IA generativa e machine learning);
- ✓ API - application programming interface (al netto degli interventi di compliance);
- ✓ RPA - robotic process automation;
- ✓ DLT - distributed ledger technology (inclusa Spunta);
- ✓ Quantum computing.

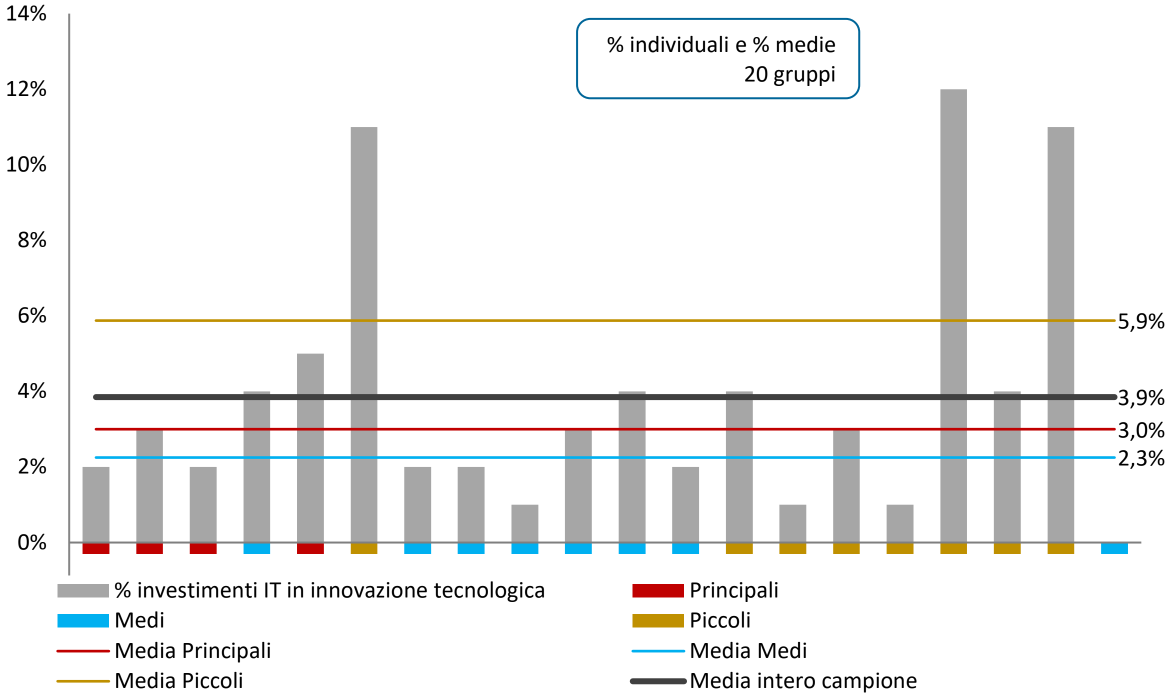
Oltre ai valori individuali, in corrispondenza dei quali è indicata, con apposito colore, la classe dimensionale di appartenenza, il grafico mostra i valori medi delle singole classi e dell'intero campione. Mediamente, 20 gruppi investono 2,1 milioni di euro in questi ambiti innovativi, media che sale a 7,4 milioni di euro per i gruppi Principali.

Figura 44 - Investimenti IT destinati ad ambiti tecnologici innovativi - valori assoluti



A completamento dell'analisi precedente, la Figura 45 riporta i valori percentuali degli investimenti IT dedicati dai gruppi agli ambiti tecnologici innovativi sopra elencati, unitamente alle medie per classi dimensionali e intero campione. Per consentire i raffronti individuali tra gli importi assoluti e relativi, l'ordine dei gruppi rappresentati nelle barre verticali è il medesimo di quello riportato nella figura precedente. In media, nel 2024, i 20 gruppi rispondenti hanno destinato il 3,9% degli investimenti IT a iniziative afferenti a queste tecnologie innovative. La maggior percentuale riguardante in media i gruppi Piccoli (5,9%) tiene conto del fenomeno dell'outsourcing, che vede alcuni di essi beneficiare indirettamente degli investimenti IT effettuati dal fornitore e investire risorse in via diretta prevalentemente verso iniziative sperimentali o ambiti innovativi.

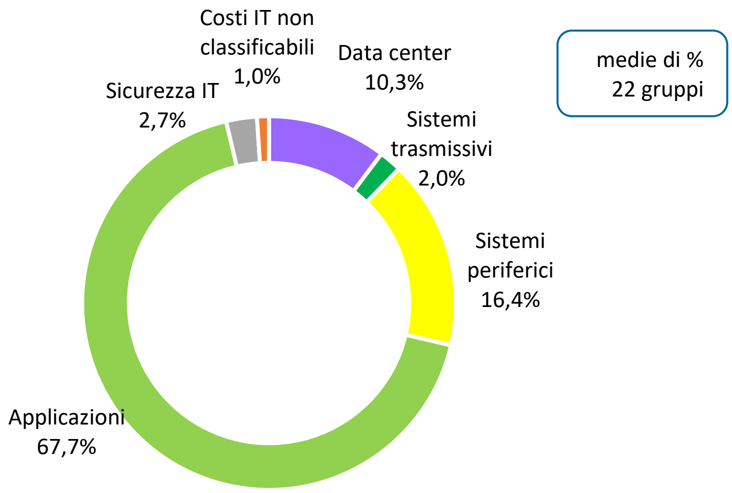
Figura 45 - Investimenti IT destinati ad ambiti tecnologici innovativi - valori %



Prendendo a riferimento la Figura 24 riportata nelle sezioni precedenti, relativa a un campione di 21 gruppi che ripartiscono con sufficiente granularità il cash out IT tra le aree tematiche, essa distingue in percentuale, all'interno di ciascuna area, la componente del cash out relativa alle spese correnti da quella per gli investimenti. Questi risultano inferiori alle spese correnti in tutte le aree. Nell'area Applicazioni (sviluppo e manutenzione) gli investimenti sono preponderanti rispetto a quelli delle altre aree, sia in valore assoluto (circa 1.500 milioni) sia come quota relativa (45%).

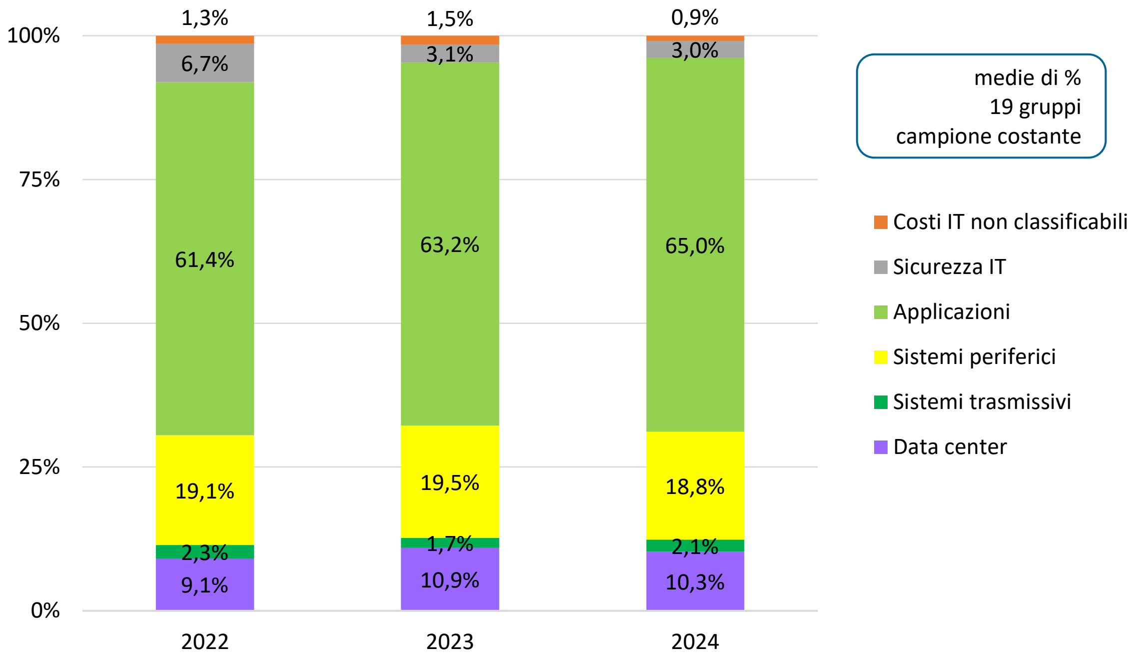
Anche la ripartizione in medie di percentuali degli investimenti IT tra le aree tematiche, calcolata su un campione di 22 gruppi che li suddivide con sufficiente dettaglio, mostra in Figura 46 una prevalenza della quota dedicata alle Applicazioni (67,7%). Volendo fare un parallelo con il TCO suddiviso per aree tematiche (cfr. Figura 20, con campione leggermente diverso) è interessante notare che la quota degli investimenti per le Applicazioni è sensibilmente superiore anche a quella analoga del TCO (50%).

Figura 46 - Investimenti IT per aree tematiche



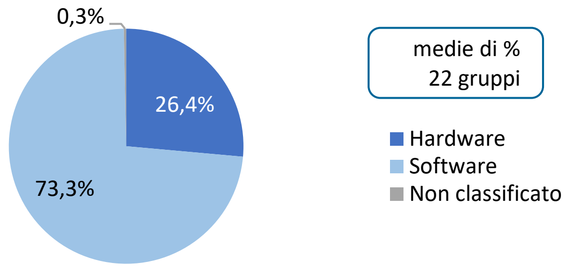
Analizzando gli investimenti IT per area tematica sul triennio 2022-2024 di un campione di 19 gruppi che li indica stabilmente con sufficiente granularità, si osserva che la percentuale dedicata alle Applicazioni si mantiene negli anni maggioritaria e in crescita, seguita dagli investimenti sui Sistemi periferici e sul Data center (Figura 47).

Figura 47 - Investimenti IT per aree tematiche: andamento 2022-2024



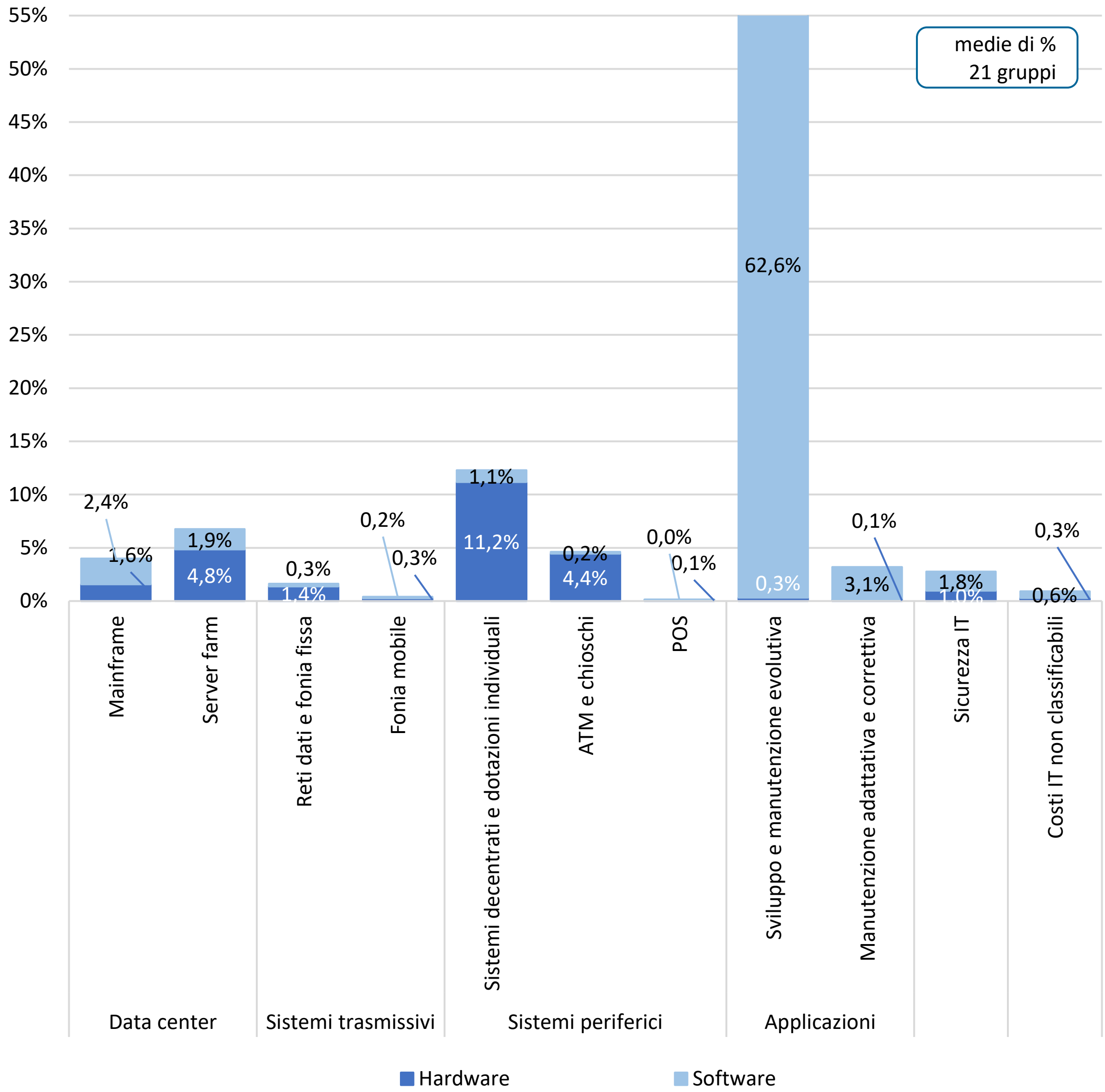
In Figura 48 sono rappresentati gli investimenti IT ripartiti tra Hardware e Software in medie di percentuali su 22 gruppi. Gli investimenti nel Software sono nel complesso fortemente preponderanti (73,3%).

Figura 48 - Investimenti IT in HW e SW



La Figura 49 mostra analoga suddivisione, all'interno delle aree tematiche, per i 21 gruppi che ripartiscono gli investimenti con sufficiente dettaglio.

Figura 49 - Investimenti IT in HW e SW per aree tematiche



Analoghe ripartizioni, riferite ai gruppi suddivisi per classe dimensionale e per modello di sourcing IT, sono riportate in Appendice, da Figura 126 a Figura 137.

1.5 Indicatori economici

Sono di seguito riportati alcuni indicatori calcolati rapportando tra loro le principali grandezze di conto economico e operative. Essi sono stati elaborati per un campione costante di 21 gruppi che hanno partecipato alla Rilevazione nell'ultimo triennio (Tabella 6), per classe dimensionale (da Tabella 7 a Tabella 9) e per modello di sourcing IT (da Tabella 10 a Tabella 12).

Per le voci "costi IT"[16], "cash out IT", "investimenti IT"[17], "ammortamenti IT"[18], "numero dipendenti totali" e "numero dipendenti al netto IT" (il numero di dipendenti è calcolato come media di valori mensili) sono utilizzati i valori segnalati dai gruppi nel questionario; anche i valori "totale attivo", "costi operativi", "margine di intermediazione", "utile netto di esercizio" e "risultato di gestione"[19] sono segnalati dai gruppi nel questionario e fanno riferimento ai valori di bilancio riclassificato consolidato. Tutte le grandezze menzionate si riferiscono al perimetro CIPA.

Le voci "numero di sportelli"[20], "numero dei rapporti di impieghi e depositi"[21] e "prodotto bancario lordo"[22] sono ricavate dalle segnalazioni di matrice dei conti individuale effettuate dalle componenti bancarie del gruppo residenti in Italia.

Nella determinazione degli indicatori calcolati a partire dall'utile netto di esercizio o dal risultato di gestione vengono eliminati i valori dei gruppi aventi risultato di gestione o utile netto negativi. In generale, dagli indicatori vengono eliminati i valori outlier.

Gli indicatori economici riportati nelle tabelle, necessariamente dipendenti dalla composizione del campione esaminato e dalla metodologia di calcolo utilizzata, hanno un valore statistico e non rappresentano una valutazione di merito sulle scelte tecniche e organizzative IT adottate dai gruppi.

La Figura 50 contiene la rappresentazione grafica di alcuni indicatori (medie) tra quelli ricompresi nella Tabella 6. È interessante notare la presenza di alcune tendenze costanti nel triennio 2022-2024.

[16] TCO al netto dei ricavi IT posti a rettifica.
[17] Include investimenti in hardware e software.
[18] Quota degli ammortamenti a valere sul TCO.
[19] Differenza tra margine di intermediazione e costi operativi.
[20] Media dei valori trimestrali dell'anno tratti dagli archivi della Banca d'Italia.
[21] Aggregato costituito dalla somma delle voci "impieghi: numero dei rapporti" e "depositi: numero dei rapporti".
[22] Aggregato costituito dalla somma delle voci "raccolta diretta", "raccolta indiretta" e "impieghi totali".

Figura 50 - Andamento di alcuni indicatori a campione costante (estratto da Tabella 6)

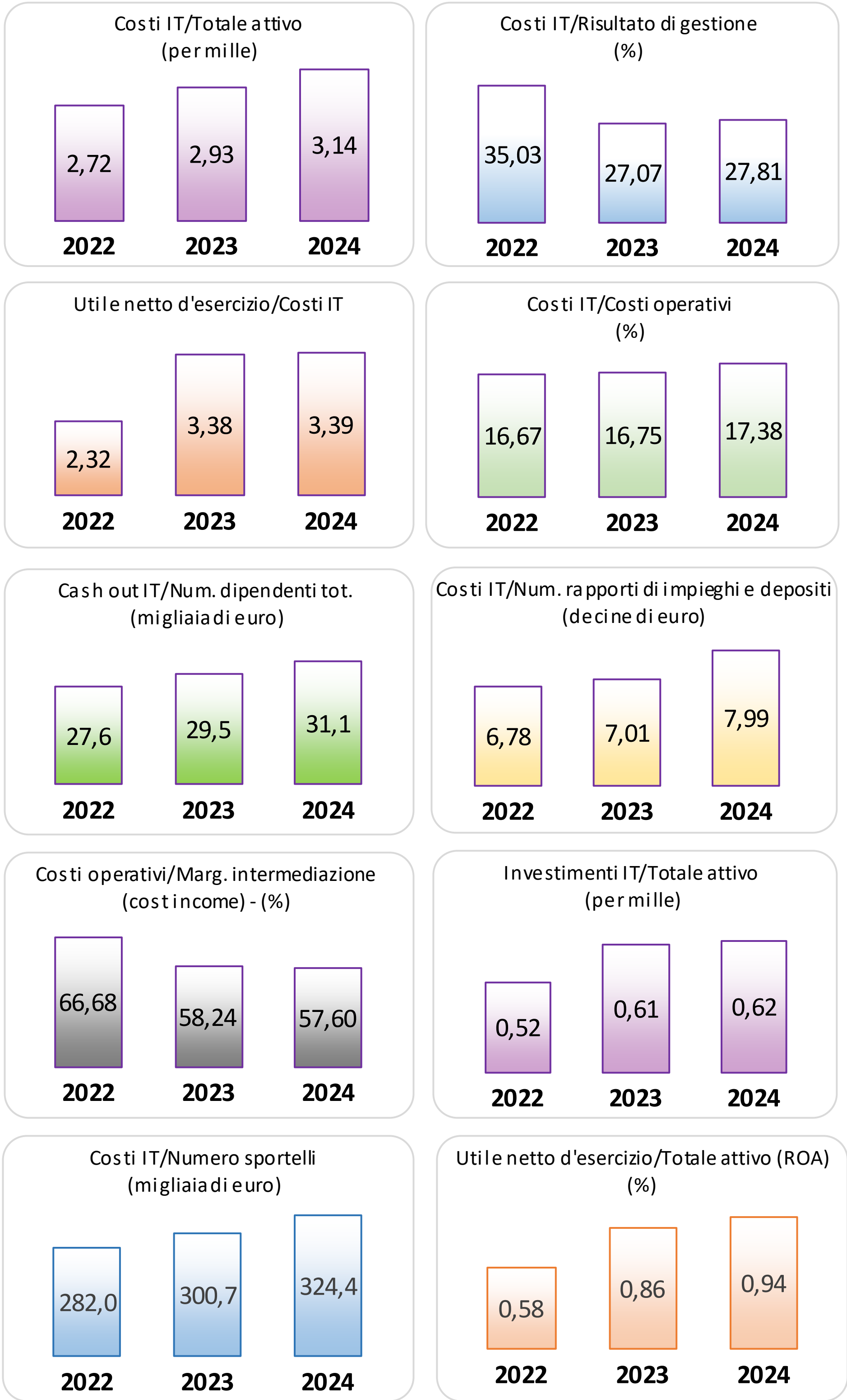


Tabella 6 - Indicatori con dati di bilancio riclassificato: campione costante di 21 gruppi

Indicatori di costo IT*	Medie			Coefficienti di variazione			Mediane		
	2022	**2023**	**2024**	**2022**	**2023**	**2024**	**2022**	**2023**	**2024**
Costi IT/Totale attivo (per mille)	2,72	2,93	3,14	0,42	0,39	0,38	2,42	2,44	2,72
Costi IT/Margine di intermediazione (%)	11,27	9,81	10,03	0,44	0,36	0,34	10,24	8,48	9,00
Costi IT/Risultato di gestione (%)	35,03	27,07	27,81	0,74	0,66	0,69	26,72	21,35	22,44
Costi IT/Costi operativi (%)	16,67	16,75	17,38	0,30	0,27	0,24	15,79	15,00	15,94
Costi IT/Numero sportelli (migliaia di euro)	281,96	300,71	324,39	0,58	0,61	0,59	220,94	216,75	266,17
Costi IT/Numero dipendenti al netto IT (migliaia di euro)	27,53	29,23	31,30	0,52	0,50	0,46	22,72	24,26	25,40
Costi IT/Numero dipendenti totali (migliaia di euro)	26,10	27,66	29,52	0,50	0,47	0,43	22,18	23,11	24,83
Costi IT/Numero rapporti di impieghi e depositi (decine di euro)	6,78	7,01	7,99	0,26	0,29	0,52	6,77	6,51	7,01
Costi IT/Prodotto bancario lordo (per mille)	1,47	1,47	1,54	0,44	0,44	0,45	1,29	1,18	1,28
Investimenti IT/Ammortamenti IT	1,14	1,43	1,38	0,34	0,51	0,55	1,09	1,13	1,21
Investimenti IT/Totale attivo (per mille)	0,52	0,61	0,62	0,73	0,64	0,71	0,41	0,58	0,51
Investimenti IT/Costi operativi (%)	3,99	4,14	4,07	0,83	0,71	0,74	3,10	3,92	3,59
Cashout IT/Margine di intermediazione (%)	11,95	10,51	10,63	0,43	0,37	0,36	10,39	9,53	9,36
Cashout IT/Numero dipendenti al netto IT (migliaia di euro)	29,14	31,17	33,00	0,50	0,49	0,45	23,39	25,82	27,91
Cashout IT/Numero dipendenti totali (migliaia di euro)	27,59	29,46	31,08	0,47	0,46	0,42	22,60	24,80	26,86
Altri indicatori*	**Medie**			**Coefficienti di variazione**			**Mediane**		
	2022	**2023**	**2024**	**2022**	**2023**	**2024**	**2022**	**2023**	**2024**
Margine di intermediazione/Totale attivo (%)	2,48	3,02	3,16	0,22	0,17	0,16	2,38	3,03	3,20
Risultato di gestione/Totale attivo (%)	0,88	1,26	1,33	0,30	0,27	0,30	0,82	1,26	1,24
Utile netto d'esercizio/Costi IT	2,32	3,38	3,39	0,62	0,61	0,60	1,99	2,89	3,12
Utile netto d'esercizio/Totale attivo (ROA) (%)	0,58	0,86	0,94	0,54	0,54	0,61	0,50	0,77	0,90
Costi operativi/Totale attivo (%)	1,65	1,77	1,82	0,30	0,28	0,30	1,63	1,68	1,83
Costi operativi/Margine d'intermediazione (*cost income*) (%)	66,68	58,24	57,60	0,19	0,18	0,20	65,58	56,91	57,72
Costi operativi/Numero sportelli (centinaia di migliaia di euro)	17,25	18,19	19,00	0,52	0,54	0,59	15,34	15,42	15,27
Totale attivo/Numero dipendenti al netto IT (milioni di euro)	10,51	10,20	10,33	0,42	0,38	0,42	9,40	9,62	9,52
Totale attivo/Numero dipendenti totali (milioni di euro)	10,00	9,69	9,78	0,40	0,36	0,40	9,06	9,41	9,15
Totale attivo/Numero sportelli (milioni di euro)	109,97	108,78	111,00	0,57	0,60	0,65	93,98	87,74	89,09

**** gli indicatori sono calcolati eliminando gli outlier.***

Tabella 7 - Indicatori con dati di bilancio riclassificato: 6 gruppi Principali

Indicatori di costo IT*	Medie			Coefficienti di variazione			Mediane		
	2022	2023	2024	2022	2023	2024	2022	2023	2024
Costi IT/Totale attivo (per mille)	2,25	2,25	2,39	0,24	0,12	0,15	2,11	2,28	2,38
Costi IT/Margine di intermediazione (%)	9,73	7,72	7,62	0,30	0,20	0,17	9,35	7,53	8,21
Costi IT/Risultato di gestione (%)	28,82	16,48	16,09	0,46	0,23	0,29	24,91	16,38	15,29
Costi IT/Costi operativi (%)	15,88	15,50	15,45	0,43	0,39	0,29	13,57	13,92	14,56
Costi IT/Numero sportelli (migliaia di euro)	297,35	297,62	311,70	0,51	0,54	0,52	266,66	242,75	279,45
Costi IT/Numero dipendenti al netto IT (migliaia di euro)	21,44	21,59	22,53	0,41	0,35	0,28	20,60	19,83	23,32
Costi IT/Numero dipendenti totali (migliaia di euro)	20,43	20,55	21,44	0,39	0,33	0,27	19,71	19,12	22,44
Costi IT/Numero rapporti di impieghi e depositi (decine di euro)	6,67	6,57	7,02	0,20	0,22	0,24	6,82	6,53	6,70
Costi IT/Prodotto bancario lordo (per mille)	1,23	1,15	1,13	0,27	0,23	0,17	1,11	1,05	1,07
Investimenti IT/Ammortamenti IT	1,17	1,28	1,20	0,27	0,48	0,31	1,28	1,10	1,15
Investimenti IT/Totale attivo (per mille)	0,81	0,86	0,93	0,54	0,57	0,52	0,79	0,73	0,83
Investimenti IT/Costi operativi (%)	5,55	5,50	5,62	4,63	4,01	4,69	6,70	5,62	5,79
Cashout IT/Margine di intermediazione (%)	10,34	8,43	8,11	0,35	0,20	0,19	10,50	8,86	8,56
Cashout IT/Numero dipendenti al netto IT (migliaia di euro)	22,95	23,47	23,93	0,44	0,32	0,27	23,14	23,75	25,27
Cashout IT/Numero dipendenti totali (migliaia di euro)	21,86	22,35	22,79	0,43	0,30	0,26	22,14	22,66	23,89
Altri indicatori*	**Medie**			**Coefficienti di variazione**			**Mediane**		
	2022	**2023**	**2024**	**2022**	**2023**	**2024**	**2022**	**2023**	**2024**
Margine di intermediazione/Totale attivo (%)	2,37	2,96	3,17	0,13	0,11	0,10	2,31	2,91	3,10
Risultato di gestione/Totale attivo (%)	0,86	1,40	1,55	0,30	0,17	0,18	0,79	1,40	1,63
Utile netto d'esercizio/Costi IT	2,96	4,68	4,80	0,70	0,48	0,36	2,77	4,19	4,27
Utile netto d'esercizio/Totale attivo (ROA) (%)	0,65	1,02	1,11	0,56	0,39	0,22	0,84	1,01	1,05
Costi operativi/Totale attivo (%)	1,51	1,55	1,62	0,20	0,23	0,22	1,58	1,55	1,70
Costi operativi/Margine d'intermediazione (*cost income*) (%)	63,61	52,30	50,97	0,17	0,17	0,18	66,48	54,51	53,48
Costi operativi/Numero sportelli (centinaia di migliaia di euro)	18,83	19,17	20,21	0,43	0,46	0,51	16,14	17,07	17,00
Totale attivo/Numero dipendenti al netto IT (milioni di euro)	9,38	9,42	9,37	0,27	0,23	0,24	8,74	8,88	8,79
Totale attivo/Numero dipendenti totali (milioni di euro)	8,95	8,98	8,92	0,25	0,21	0,23	8,45	8,60	8,46
Totale attivo/Numero sportelli (milioni di euro)	130,00	128,40	128,32	0,45	0,47	0,47	107,84	107,52	108,48

**** gli indicatori sono calcolati eliminando gli outlier.***

Tabella 8 - Indicatori con dati di bilancio riclassificato: 9 gruppi Medi

Indicatori di costo IT*	Medie			Coefficienti di variazione			Mediane		
	2022	2023	2024	2022	2023	2024	2022	2023	2024
Costi IT/Totale attivo (per mille)	3,21	3,42	3,74	0,49	0,44	0,41	2,94	2,77	3,22
Costi IT/Margine di intermediazione (%)	13,34	11,65	12,00	0,50	0,40	0,34	11,50	9,28	10,69
Costi IT/Risultato di gestione (%)	43,90	36,89	37,47	0,87	0,64	0,68	29,62	23,22	26,59
Costi IT/Costi operativi (%)	18,41	18,46	19,81	0,27	0,24	0,20	18,03	18,78	19,66
Costi IT/Numero sportelli (migliaia di euro)	359,81	398,90	446,24	0,53	0,54	0,47	289,61	330,20	391,05
Costi IT/Numero dipendenti al netto IT (migliaia di euro)	36,26	38,57	42,45	0,49	0,46	0,37	31,78	36,75	42,00
Costi IT/Numero dipendenti totali (migliaia di euro)	33,81	35,85	39,28	0,48	0,44	0,35	30,42	34,58	40,00
Costi IT/Numero rapporti di impieghi e depositi (decine di euro)	7,13	7,56	9,49	0,33	0,36	0,63	7,04	7,17	7,65
Costi IT/Prodotto bancario lordo (per mille)	1,59	1,62	1,80	0,54	0,53	0,51	1,29	1,22	1,34
Investimenti IT/Ammortamenti IT	1,17	1,39	1,33	0,42	0,29	0,42	1,00	1,37	1,23
Investimenti IT/Totale attivo (per mille)	0,55	0,67	0,67	0,53	0,38	0,54	0,48	0,73	0,69
Investimenti IT/Costi operativi (%)	4,80	4,99	4,94	0,78	0,62	0,67	3,65	4,01	4,69
Cashout IT/Margine di intermediazione (%)	14,40	12,63	12,95	0,46	0,40	0,36	12,72	10,15	11,80
Cashout IT/Numero dipendenti al netto IT (migliaia di euro)	38,78	41,34	45,20	0,42	0,44	0,34	37,58	38,84	48,24
Cashout IT/Numero dipendenti totali (migliaia di euro)	36,12	38,38	41,76	0,41	0,42	0,31	35,28	36,54	45,09
Altri indicatori*	**Medie**			**Coefficienti di variazione**			**Mediane**		
	2022	**2023**	**2024**	**2022**	**2023**	**2024**	**2022**	**2023**	**2024**
Margine di intermediazione/Totale attivo (%)	2,54	2,99	3,16	0,32	0,24	0,22	2,59	2,97	2,97
Risultato di gestione/Totale attivo (%)	0,89	1,15	1,26	0,40	0,41	0,40	0,82	1,13	1,08
Utile netto d'esercizio/Costi IT	2,32	2,89	3,17	0,58	0,67	0,73	2,07	2,79	2,98
Utile netto d'esercizio/Totale attivo (ROA) (%)	0,66	0,84	1,03	0,53	0,70	0,78	0,51	0,77	0,90
Costi operativi/Totale attivo (%)	1,75	1,84	1,90	0,40	0,34	0,38	1,63	1,71	1,83
Costi operativi/Margine d'intermediazione (*cost income*) (%)	69,65	61,57	60,02	0,25	0,21	0,24	65,56	64,65	62,75
Costi operativi/Numero sportelli (centinaia di migliaia di euro)	20,68	22,58	23,91	0,53	0,53	0,56	17,81	18,46	20,45
Totale attivo/Numero dipendenti al netto IT (milioni di euro)	12,42	12,11	12,49	0,47	0,41	0,45	10,06	11,28	11,54
Totale attivo/Numero dipendenti totali (milioni di euro)	11,62	11,30	11,61	0,47	0,40	0,44	9,57	10,66	10,91
Totale attivo/Numero sportelli (milioni di euro)	126,41	129,66	136,34	0,61	0,61	0,66	113,85	117,65	117,20

**** gli indicatori sono calcolati eliminando gli outlier.***

Tabella 9 - Indicatori con dati di bilancio riclassificato: gruppi Piccoli

Indicatori di costo IT*	Medie 2022 (6 gruppi)	Medie 2023 (7 gruppi)	Medie 2024 (8 gruppi)	Coefficienti di variazione 2022 (6 gruppi)	Coefficienti di variazione 2023 (7 gruppi)	Coefficienti di variazione 2024 (8 gruppi)	Mediane 2022 (6 gruppi)	Mediane 2023 (7 gruppi)	Mediane 2024 (8 gruppi)
Costi IT/Totale attivo (per mille)	2,45	3,37	3,32	0,24	0,43	0,27	2,26	2,87	2,88
Costi IT/Margine di intermediazione (%)	9,71	10,22	9,49	0,19	0,31	0,17	9,56	9,64	9,51
Costi IT/Risultato di gestione (%)	29,41	27,04	23,98	0,37	0,45	0,32	25,45	22,22	23,14
Costi IT/Costi operativi (%)	14,83	16,74	16,35	0,14	0,24	0,13	14,49	16,93	16,83
Costi IT/Numero sportelli (migliaia di euro)	162,76	172,88	174,63	0,11	0,15	0,13	161,56	180,19	170,50
Costi IT/Numero dipendenti al netto IT (migliaia di euro)	20,53	28,11	32,78	0,11	0,51	0,57	20,63	23,21	25,47
Costi IT/Numero dipendenti totali (migliaia di euro)	20,21	26,34	30,93	0,11	0,41	0,54	20,37	23,11	24,96
Costi IT/Numero rapporti di impieghi e depositi (decine di euro)	6,37	7,49	8,49	0,13	0,35	0,45	6,18	6,51	6,88
Costi IT/Prodotto bancario lordo (per mille)	1,53	2,02	1,77	0,34	0,62	0,50	1,42	1,55	1,49
Investimenti IT/Ammortamenti IT	1,06	1,74	1,52	0,30	0,66	0,74	1,02	1,56	1,08
Investimenti IT/Totale attivo (per mille)	0,21	0,28	0,34	0,71	0,60	0,88	0,20	0,26	0,25
Investimenti IT/Costi operativi (%)	1,23	1,50	1,61	0,70	0,69	0,78	1,17	1,34	1,30
Cashout IT/Margine di intermediazione (%)	9,90	11,20	9,77	0,21	0,44	0,19	9,51	9,53	9,52
Cashout IT/Numero dipendenti al netto IT (migliaia di euro)	20,87	23,60	33,76	0,10	0,19	0,58	20,94	22,54	25,53
Cashout IT/Numero dipendenti totali (migliaia di euro)	20,54	23,21	31,81	0,10	0,18	0,54	20,73	22,36	25,02
Altri indicatori*	**Medie 2022 (6 gruppi)**	**Medie 2023 (7 gruppi)**	**Medie 2024 (8 gruppi)**	**Coefficienti di variazione 2022 (6 gruppi)**	**Coefficienti di variazione 2023 (7 gruppi)**	**Coefficienti di variazione 2024 (8 gruppi)**	**Mediane 2022 (6 gruppi)**	**Mediane 2023 (7 gruppi)**	**Mediane 2024 (8 gruppi)**
Margine di intermediazione/Totale attivo (%)	2,52	3,23	3,52	0,10	0,14	0,25	2,51	3,11	3,29
Risultato di gestione/Totale attivo (%)	0,87	1,26	1,50	0,16	0,08	0,45	0,89	1,25	1,25
Utile netto d'esercizio/Costi IT	1,78	2,74	2,83	0,47	0,58	0,61	1,71	2,27	2,79
Utile netto d'esercizio/Totale attivo (ROA) (%)	0,40	0,83	0,91	0,32	0,46	0,81	0,40	0,68	0,69
Costi operativi/Totale attivo (%)	1,65	1,97	2,02	0,16	0,23	0,18	1,68	1,87	1,98
Costi operativi/Margine d'intermediazione (*cost income*) (%)	65,30	60,44	58,35	0,10	0,09	0,14	65,32	60,29	60,43
Costi operativi/Numero sportelli (centinaia di migliaia di euro)	11,09	11,36	11,24	0,12	0,20	0,13	11,26	10,98	11,75
Totale attivo/Numero dipendenti al netto IT (milioni di euro)	8,76	8,31	9,58	0,25	0,17	0,37	8,69	7,87	8,79
Totale attivo/Numero dipendenti totali (milioni di euro)	8,62	7,97	9,12	0,25	0,16	0,35	8,56	7,74	8,48
Totale attivo/Numero sportelli (milioni di euro)	68,03	61,32	59,91	0,13	0,13	0,12	68,29	62,50	61,07

**** gli indicatori sono calcolati eliminando gli outlier.***

Tabella 10 - Indicatori con dati di bilancio riclassificato: 7 gruppi Insourcing

Indicatori di costo IT*	Medie			Coefficienti di variazione			Mediane		
	2022	2023	2024	2022	2023	2024	2022	2023	2024
Costi IT/Totale attivo (per mille)	2,56	2,77	3,21	0,47	0,53	0,57	2,01	2,37	2,56
Costi IT/Margine di intermediazione (%)	9,43	8,36	8,98	0,30	0,32	0,36	8,68	8,05	8,46
Costi IT/Risultato di gestione (%)	33,47	22,84	26,63	0,52	0,62	0,84	25,79	17,37	19,15
Costi IT/Costi operativi (%)	13,48	13,87	14,85	0,22	0,19	0,18	13,10	13,13	14,71
Costi IT/Numero sportelli (migliaia di euro)	246,73	263,16	296,89	0,52	0,55	0,53	240,14	208,35	261,62
Costi IT/Numero dipendenti al netto IT (migliaia di euro)	19,53	20,95	23,84	0,29	0,30	0,33	18,91	19,17	23,89
Costi IT/Numero dipendenti totali (migliaia di euro)	18,52	19,74	22,30	0,28	0,27	0,29	18,22	17,90	22,99
Costi IT/Numero rapporti di impieghi e depositi (decine di euro)	5,93	6,21	7,15	0,15	0,17	0,22	5,35	6,11	7,01
Costi IT/Prodotto bancario lordo (per mille)	1,10	1,07	1,13	0,18	0,07	0,14	1,09	1,06	1,13
Investimenti IT/Ammortamenti IT	1,21	1,43	1,40	0,30	0,42	0,33	1,26	1,14	1,40
Investimenti IT/Totale attivo (per mille)	0,78	0,88	1,00	0,58	0,54	0,44	0,70	0,76	0,97
Investimenti IT/Costi operativi (%)	5,97	6,18	6,42	0,68	0,57	0,50	5,67	5,01	6,02
Cashout IT/Margine di intermediazione (%)	10,97	9,88	10,39	0,43	0,42	0,48	9,65	9,53	9,03
Cashout IT/Numero dipendenti al netto IT (migliaia di euro)	22,95	24,70	27,51	0,45	0,39	0,44	21,00	23,69	25,87
Cashout IT/Numero dipendenti totali (migliaia di euro)	21,67	23,22	25,67	0,42	0,35	0,39	20,24	22,13	24,06

Altri indicatori*	Medie			Coefficienti di variazione			Mediane		
	2022	2023	2024	2022	2023	2024	2022	2023	2024
Margine di intermediazione/Totale attivo (%)	2,68	3,20	3,44	0,24	0,18	0,17	2,38	3,10	3,25
Risultato di gestione/Totale attivo (%)	0,82	1,27	1,37	0,24	0,17	0,22	0,79	1,26	1,34
Utile netto d'esercizio/Costi IT	2,52	4,08	4,07	0,79	0,62	0,54	1,97	3,24	3,53
Utile netto d'esercizio/Totale attivo (ROA) (%)	0,57	0,92	1,03	0,56	0,45	0,31	0,50	0,79	1,05
Costi operativi/Totale attivo (%)	1,86	1,93	2,07	0,32	0,32	0,36	1,69	1,77	1,88
Costi operativi/Margine d'intermediazione (*cost income*) (%)	68,91	59,47	59,07	0,10	0,14	0,18	66,63	59,46	55,82
Costi operativi/Numero sportelli (centinaia di migliaia di euro)	17,87	18,47	19,72	0,45	0,46	0,50	15,94	17,69	17,26
Totale attivo/Numero dipendenti al netto IT (milioni di euro)	8,06	8,08	7,96	0,20	0,20	0,19	8,07	7,86	7,72
Totale attivo/Numero dipendenti totali (milioni di euro)	7,69	7,69	7,54	0,21	0,21	0,20	7,84	7,42	7,39
Totale attivo/Numero sportelli (milioni di euro)	102,85	102,86	102,29	0,55	0,58	0,58	93,47	87,80	88,32

**** gli indicatori sono calcolati eliminando gli outlier.***

Tabella 11 - Indicatori con dati di bilancio riclassificato: gruppi Facility management

Indicatori di costo IT*	Medie 2022 (6 gruppi)	Medie 2023 (7 gruppi)	Medie 2024 (7 gruppi)	Coefficienti di variazione 2022 (6 gruppi)	Coefficienti di variazione 2023 (7 gruppi)	Coefficienti di variazione 2024 (7 gruppi)	Mediane 2022 (6 gruppi)	Mediane 2023 (7 gruppi)	Mediane 2024 (7 gruppi)
Costi IT/Totale attivo (per mille)	2,43	3,10	3,11	0,22	0,48	0,30	2,50	2,66	2,72
Costi IT/Margine di intermediazione (%)	10,64	10,51	9,89	0,22	0,38	0,30	10,99	9,28	9,00
Costi IT/Risultato di gestione (%)	26,60	27,74	21,87	0,42	0,75	0,54	25,61	18,75	18,84
Costi IT/Costi operativi (%)	19,11	19,58	20,00	0,26	0,26	0,21	18,59	19,61	18,99
Costi IT/Numero sportelli (migliaia di euro)	377,62	398,92	446,40	0,38	0,42	0,43	362,32	374,79	380,38
Costi IT/Numero dipendenti al netto IT (migliaia di euro)	31,29	36,51	38,78	0,22	0,33	0,26	33,78	36,75	42,00
Costi IT/Numero dipendenti totali (migliaia di euro)	29,56	33,49	35,76	0,21	0,28	0,24	31,86	34,58	40,00
Costi IT/Numero rapporti di impieghi e depositi (decine di euro)	7,81	8,79	10,59	0,34	0,40	0,63	8,37	8,33	7,65
Costi IT/Prodotto bancario lordo (per mille)	1,37	1,83	1,96	0,24	0,71	0,60	1,33	1,25	1,34
Investimenti IT/Ammortamenti IT	1,28	1,30	1,27	0,35	0,35	0,32	1,15	1,10	1,19
Investimenti IT/Totale attivo (per mille)	0,65	0,64	0,72	0,46	0,45	0,45	0,73	0,65	0,71
Investimenti IT/Costi operativi (%)	5,10	6,25	4,93	0,48	0,75	0,34	4,52	5,34	5,16
Cashout IT/Margine di intermediazione (%)	11,21	11,37	10,29	0,23	0,47	0,28	11,73	9,79	9,36
Cashout IT/Numero dipendenti al netto IT (migliaia di euro)	33,10	33,31	40,54	0,24	0,21	0,27	35,35	35,90	41,12
Cashout IT/Numero dipendenti totali (migliaia di euro)	31,26	31,45	37,35	0,23	0,20	0,24	33,49	33,82	39,15
Altri indicatori*	**Medie 2022 (6 gruppi)**	**Medie 2023 (7 gruppi)**	**Medie 2024 (7 gruppi)**	**Coefficienti di variazione 2022 (6 gruppi)**	**Coefficienti di variazione 2023 (7 gruppi)**	**Coefficienti di variazione 2024 (7 gruppi)**	**Mediane 2022 (6 gruppi)**	**Mediane 2023 (7 gruppi)**	**Mediane 2024 (7 gruppi)**
Margine di intermediazione/Totale attivo (%)	2,34	2,96	3,18	0,24	0,20	0,16	2,19	2,69	2,97
Risultato di gestione/Totale attivo (%)	1,02	1,37	1,59	0,37	0,35	0,26	0,91	1,46	1,61
Utile netto d'esercizio/Costi IT	2,57	3,00	3,45	0,55	0,51	0,50	2,13	2,79	3,38
Utile netto d'esercizio/Totale attivo (ROA) (%)	0,60	0,84	0,89	0,46	0,48	0,33	0,51	0,77	0,95
Costi operativi/Totale attivo (%)	1,33	1,59	1,59	0,30	0,34	0,30	1,36	1,54	1,55
Costi operativi/Margine d'intermediazione (*cost income*) (%)	56,58	53,61	49,93	0,19	0,27	0,24	56,17	54,88	53,42
Costi operativi/Numero sportelli (centinaia di migliaia di euro)	21,22	22,69	23,99	0,56	0,58	0,62	16,97	17,07	17,97
Totale attivo/Numero dipendenti al netto IT (milioni di euro)	13,85	12,71	13,27	0,41	0,33	0,38	12,37	11,51	11,54
Totale attivo/Numero dipendenti totali (milioni di euro)	13,07	11,83	12,31	0,40	0,34	0,38	11,60	10,90	10,91
Totale attivo/Numero sportelli (milioni di euro)	160,91	159,41	163,81	0,47	0,49	0,55	134,03	142,77	140,85

**** gli indicatori sono calcolati eliminando gli outlier.***

Tabella 12 - Indicatori con dati di bilancio riclassificato: gruppi Outsourcing

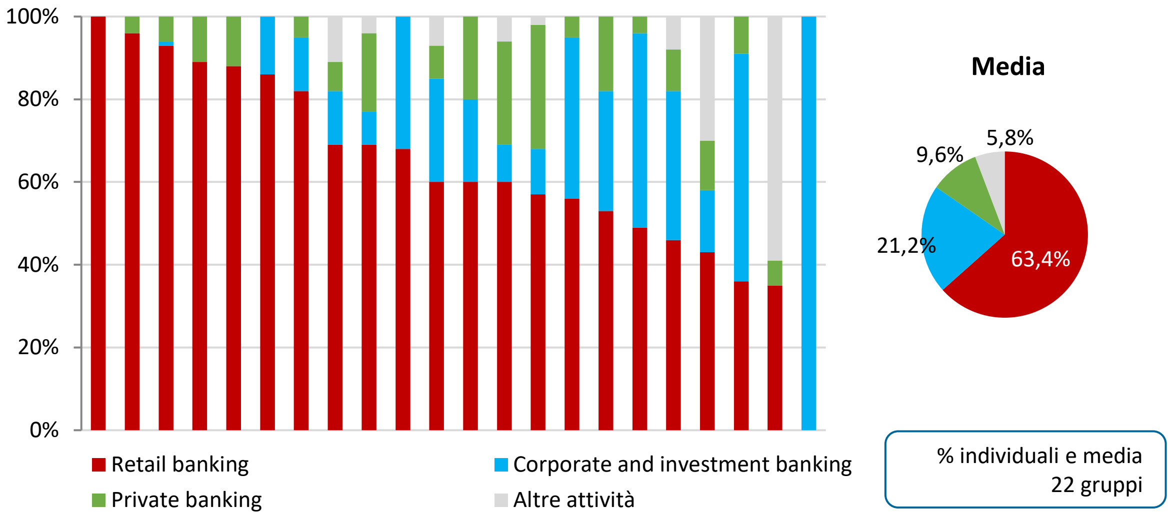
	Medie			Coefficienti di variazione			Mediane		
Indicatori di costo IT*	**2022 (8 gruppi)**	**2023 (8 gruppi)**	**2024 (9 gruppi)**	**2022 (8 gruppi)**	**2023 (8 gruppi)**	**2024 (9 gruppi)**	**2022 (8 gruppi)**	**2023 (8 gruppi)**	**2024 (9 gruppi)**
Costi IT/Totale attivo (per mille)	3,08	3,36	3,37	0,47	0,35	0,25	2,58	2,93	2,99
Costi IT/Margine di intermediazione (%)	13,35	11,32	10,84	0,53	0,37	0,33	9,97	9,76	9,81
Costi IT/Risultato di gestione (%)	43,82	33,27	31,79	0,90	0,60	0,64	27,65	22,29	23,85
Costi IT/Costi operativi (%)	17,62	17,77	17,54	0,31	0,26	0,21	15,42	17,26	17,73
Costi IT/Numero sportelli (migliaia di euro)	235,18	254,08	247,32	0,82	0,85	0,78	165,60	185,21	180,43
Costi IT/Numero dipendenti al netto IT (migliaia di euro)	31,71	33,90	37,91	0,66	0,61	0,60	22,06	24,85	25,94
Costi IT/Numero dipendenti totali (migliaia di euro)	30,14	32,20	35,90	0,61	0,57	0,56	21,69	24,34	25,09
Costi IT/Numero rapporti di impieghi e depositi (decine di euro)	6,76	6,86	7,92	0,17	0,17	0,45	6,70	6,64	6,57
Costi IT/Prodotto bancario lordo (per mille)	1,87	1,90	1,73	0,46	0,44	0,37	1,71	1,75	1,52
Investimenti IT/Ammortamenti IT	0,96	1,64	1,40	0,36	0,64	0,80	1,00	1,37	1,08
Investimenti IT/Totale attivo (per mille)	0,24	0,38	0,33	0,62	0,66	0,82	0,22	0,29	0,25
Investimenti IT/Costi operativi (%)	1,43	2,01	1,65	0,71	0,64	0,74	1,17	1,70	1,30
Cashout IT/Margine di intermediazione (%)	13,36	11,73	10,95	0,51	0,38	0,33	9,95	9,68	10,00
Cashout IT/Numero dipendenti al netto IT (migliaia di euro)	31,59	35,21	38,24	0,63	0,62	0,60	22,00	25,39	26,08
Cashout IT/Numero dipendenti totali (migliaia di euro)	30,03	33,44	36,21	0,59	0,58	0,56	21,84	24,87	36,21
	Medie			**Coefficienti di variazione**			**Mediane**		
Altri indicatori*	**2022 (8 gruppi)**	**2023 (8 gruppi)**	**2024 (9 gruppi)**	**2022 (8 gruppi)**	**2023 (8 gruppi)**	**2024 (9 gruppi)**	**2022 (8 gruppi)**	**2023 (8 gruppi)**	**2024 (9 gruppi)**
Margine di intermediazione/Totale attivo (%)	2,42	3,02	3,26	0,21	0,16	0,28	2,51	3,07	3,20
Risultato di gestione/Totale attivo (%)	0,81	1,13	1,33	0,24	0,24	0,54	0,88	1,24	1,18
Utile netto d'esercizio/Costi IT	1,98	2,97	3,10	0,52	0,66	0,73	1,71	2,26	2,79
Utile netto d'esercizio/Totale attivo (ROA) (%)	0,58	0,91	1,07	0,65	0,66	0,91	0,46	0,65	0,69
Costi operativi/Totale attivo (%)	1,72	1,89	1,93	0,23	0,21	0,17	1,68	1,78	1,90
Costi operativi/Margine d'intermediazione (*cost income*) (%)	72,30	62,43	61,09	0,21	0,12	0,17	68,55	61,82	61,33
Costi operativi/Numero sportelli (centinaia di migliaia di euro)	13,22	14,06	14,00	0,44	0,53	0,53	11,44	11,65	11,88
Totale attivo/Numero dipendenti al netto IT (milioni di euro)	10,14	9,77	10,74	0,39	0,39	0,41	9,35	8,75	9,65
Totale attivo/Numero dipendenti totali (milioni di euro)	9,72	9,34	10,23	0,34	0,34	0,37	9,03	8,66	9,33
Totale attivo/Numero sportelli (milioni di euro)	73,43	71,30	74,45	0,22	0,38	0,52	69,33	64,59	61,83

**** gli indicatori sono calcolati eliminando gli outlier.***

Capitolo 2. **Gruppi bancari: profili organizzativi**

Dall'analisi dell'attività bancaria dei gruppi[23] si rileva che, in media di percentuali, il retail banking costituisce il 63,4% dell'operatività complessiva, il corporate and investment banking il 21,2% e il private banking il 9,6%. La Figura 51 mostra le percentuali individuali e la media.

Figura 51 - Attività dei gruppi bancari



In Appendice è riportata l'analisi dell'attività bancaria differenziata per classe dimensionale (Figura 138).

2.1 Sourcing IT

L'analisi dei profili organizzativi si concentra in primo luogo sull'assetto adottato dai gruppi per il sourcing dell'IT, riconducibile con un criterio di prevalenza a quattro modelli:

- ✓ **Insourcing**: le infrastrutture del Data center (Hardware e Software di base) e le Applicazioni sono gestite all'interno del gruppo CIPA, indipendentemente dall'eventuale application management o ricorso a forme di outsourcing selettivo per singoli ambiti o iniziative;
- ✓ **Facility management**: le infrastrutture del Data center sono gestite da fornitore esterno al perimetro CIPA[24] mentre le Applicazioni sono gestite all'interno del perimetro, indipendentemente dall'eventuale ricorso a forme di outsourcing selettivo;

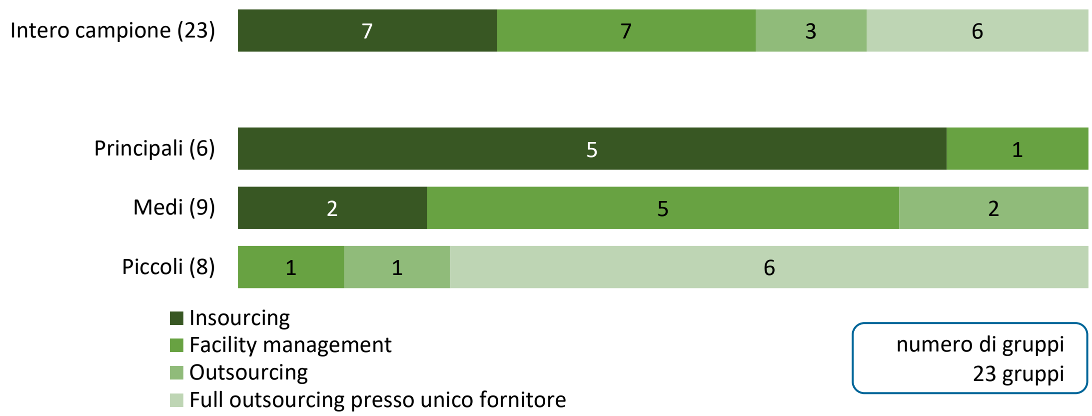
[23] Sulla base del margine di intermediazione riferito al perimetro CIPA.

[24] Componente del gruppo esterna al perimetro CIPA (compresa la casa madre estera), altra banca o altro gruppo bancario, consorzio di banche, vendor e joint venture tra vendor e componente del gruppo.

- ✓ **Outsourcing**: sia le infrastrutture del Data center che le Applicazioni sono gestite da fornitori esterni al perimetro CIPA;
- ✓ **Full outsourcing**: questo modello è un caso particolare dell'Outsourcing, da cui si distingue per il ricorso a un unico fornitore esterno prevalente, che gestisce sia le infrastrutture del Data center che le Applicazioni. A seconda del contesto, in questo documento il Full outsourcing viene talvolta equiparato e accorpato all'Outsourcing.

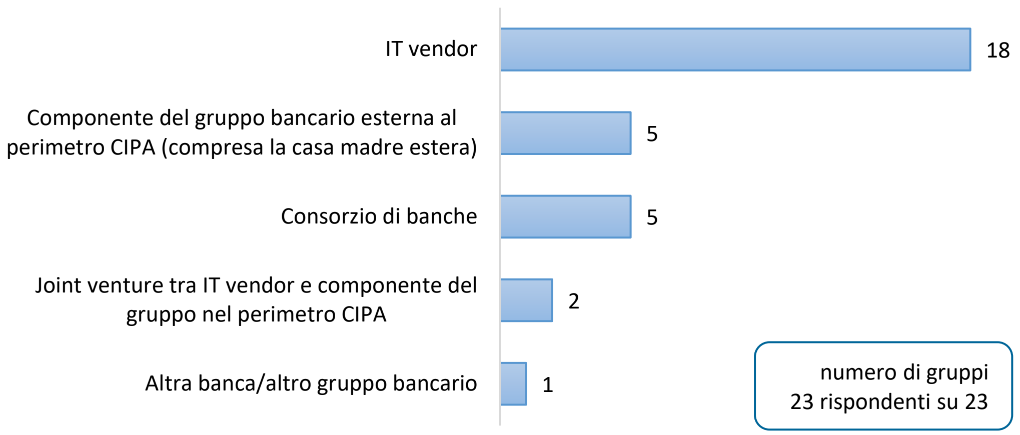
Dall'analisi dei dati ricevuti dai gruppi emerge che sette di essi mantengono internamente il governo delle infrastrutture e delle applicazioni, identificandosi nel modello Insourcing, sette si collocano nel modello Facility management e nove in Outsourcing, di cui sei in Full outsourcing. I gruppi Principali sono prevalentemente caratterizzati dall'Insourcing e i Piccoli ricorrono prevalentemente al Full outsourcing, mentre per i Medi si osserva una situazione differenziata (Figura 52).

Figura 52 - Modello di sourcing IT prevalente



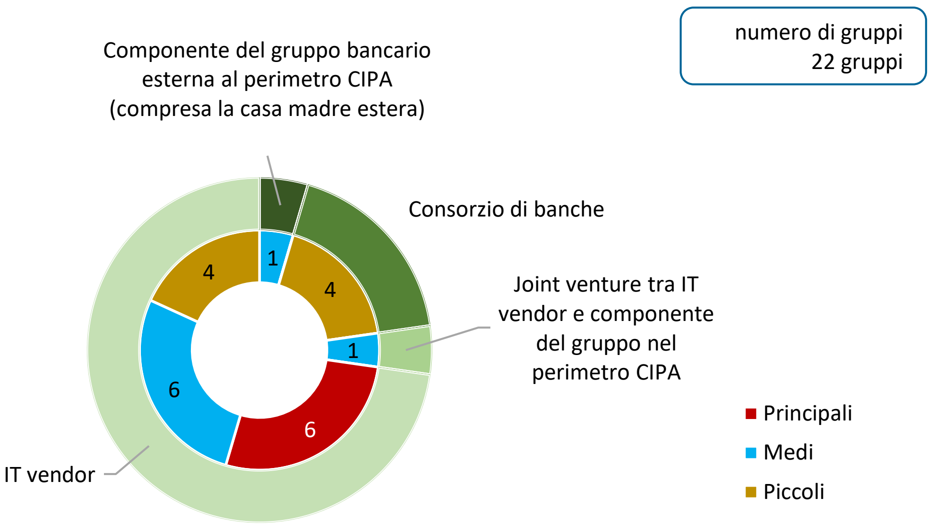
Analizzando le diverse tipologie di fornitore IT cui i gruppi (perimetro CIPA) fanno ricorso (Figura 53), si osserva che la maggior parte dei rispondenti si rivolge ai vendor (l'IT vendor ricomprende eventuale joint venture tra vendor e componente del gruppo bancario esterna al perimetro CIPA).

Figura 53 - Tipologie di fornitore IT



Restringendo l'analisi al fornitore prevalente (in termini di costi IT fatturati), la categoria più segnalata resta quella dei vendor, cui si rivolgono in via prevalente 16 gruppi. La Figura 54 espone questa suddivisione unitamente alla classe dimensionale.

Figura 54 - Fornitore IT prevalente

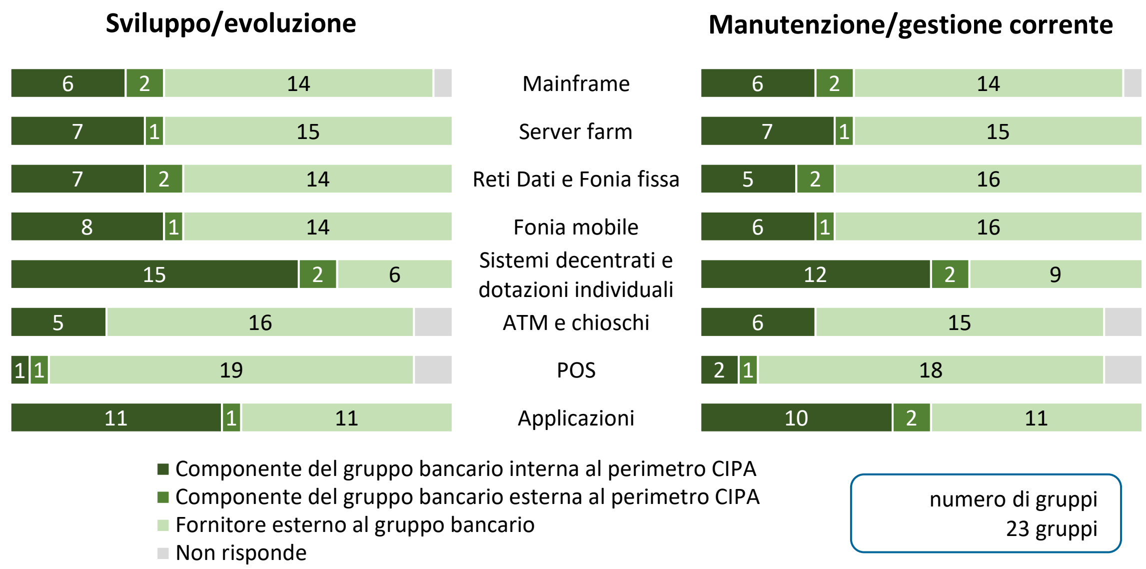


2.1.1 Sourcing IT per aree tematiche

Questo paragrafo analizza, con un criterio di prevalenza, le scelte di sourcing effettuate per lo sviluppo e l'evoluzione, nonché la manutenzione correttiva e la gestione corrente dei servizi IT, differenziati per area tematica. A tal fine viene distinto l'affidamento delle attività suddette tra le seguenti casistiche: i) componente del gruppo bancario interna al perimetro CIPA; ii) componente del gruppo bancario esterna al perimetro CIPA (inclusa la casa madre estera); iii) fornitore esterno al gruppo bancario (altro gruppo bancario, altra banca, consorzio di banche, IT vendor, joint venture con IT vendor).

Dal grafico di Figura 55 si nota che, nel complesso, il ricorso a componenti del gruppo avviene in meno della metà dei casi. Si conferma prevalente l'affido dei servizi al di fuori del gruppo bancario. L'approccio di sourcing per lo sviluppo e l'evoluzione è abbastanza in linea con quello adottato per la manutenzione e la gestione corrente, con una lieve prevalenza del fornitore esterno per quest'ultima. A livello di aree tematiche, i gruppi tendono a mantenere all'interno principalmente lo sviluppo e la gestione dei Sistemi decentrati e dotazioni individuali e delle Applicazioni.

Figura 55 - Collocazione attività di sviluppo e gestione dei servizi IT

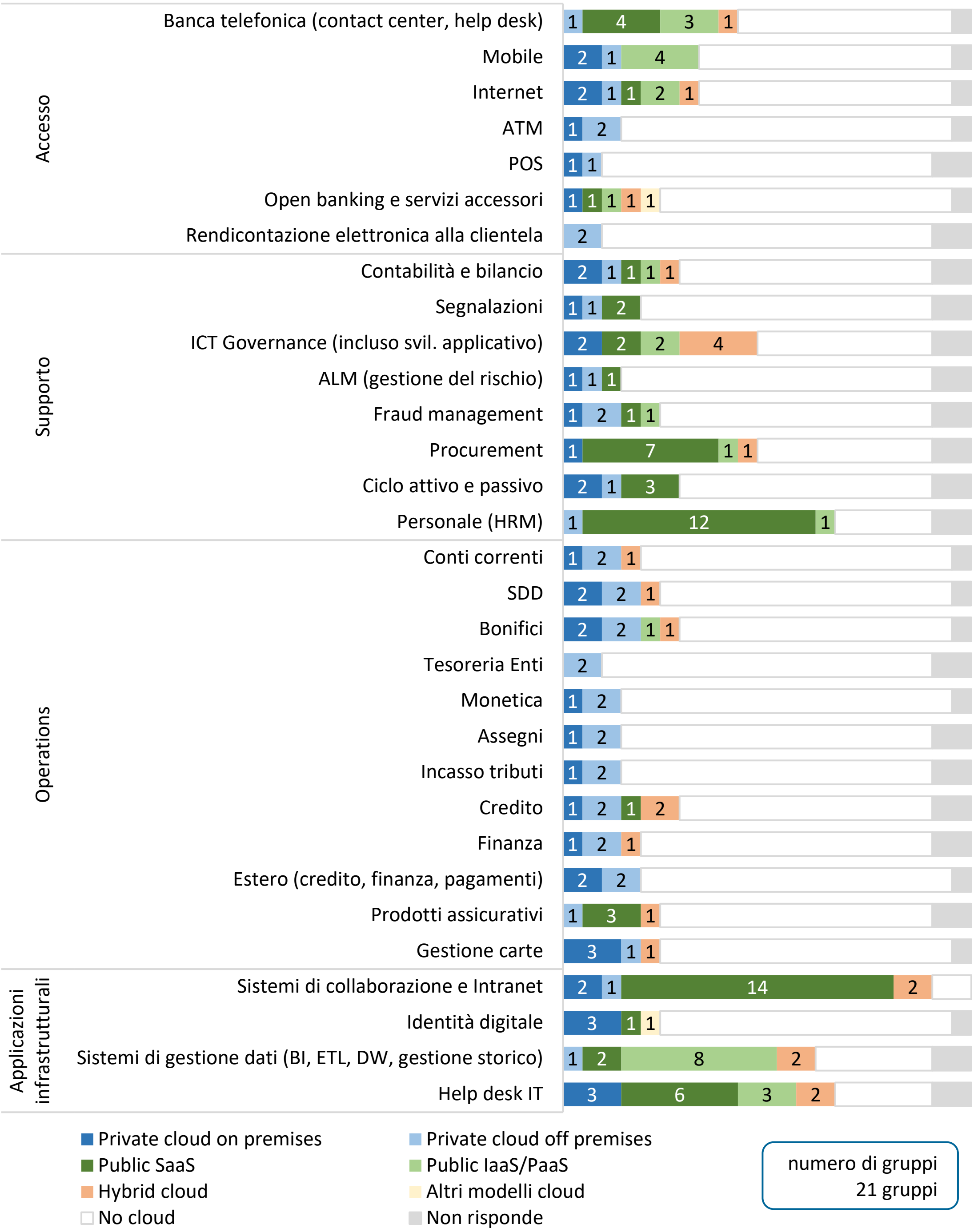


2.2 Cloud computing

Questa edizione affronta il tema del cloud computing partendo dalla Figura 56, che rileva il ricorso dei gruppi bancari ai diversi service model e deployment model per erogare i principali servizi applicativi (quelli esaminati in figura sono tratti, per la maggior parte, dalla mappa applicativa ABI Lab). Risultano erogati più frequentemente tramite cloud computing – soprattutto il modello pubblico – i servizi infrastrutturali, per la gestione del personale, il procurement e la banca telefonica. Di contro, i servizi di Operations, caratterizzati da un maggior livello di criticità, sperimentano un minor ricorso al cloud che, laddove presente, è sovente di tipo privato. Nell'ambito del private cloud emerge un ricorso sostanzialmente paritetico a soluzioni on premises e off premises. Per il cloud pubblico prevale il modello SaaS. È presente, generalmente in misura ridotta, ad eccezione dell'ICT governance, il ricorso al cloud ibrido[25].

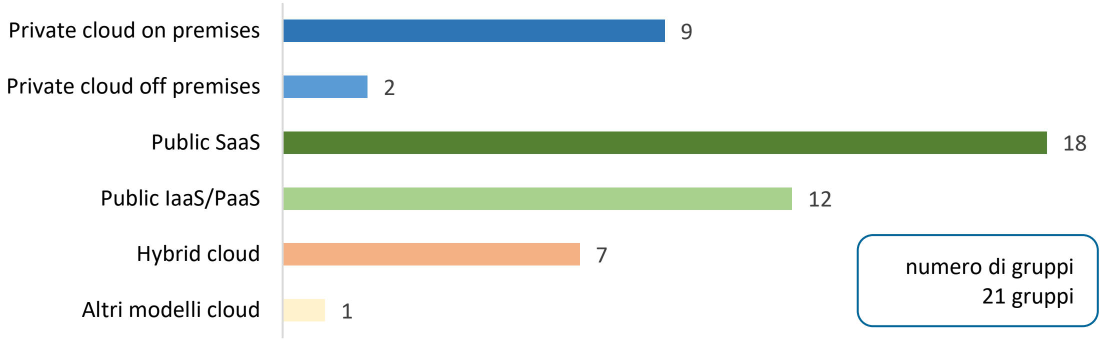
[25] Il cloud ibrido è inteso come combinazione dei modelli pubblico e privato, le cui infrastrutture sono collegate e consentono la portabilità dei dati e delle applicazioni.

Figura 56 - Cloud computing: servizi applicativi e modelli in uso



Per ciascuno dei modelli cloud presi in esame nel grafico precedente, la Figura 57 mostra il numero di gruppi che ricorrono a quel modello per almeno uno dei servizi sopra analizzati. Emerge che i modelli pubblici sono quelli più utilizzati, soprattutto il SaaS, segnalato da 18 gruppi su 21. Il modello privato è basato più di frequente su infrastrutture on premises e il ricorso al cloud ibrido è segnalato da sette gruppi.

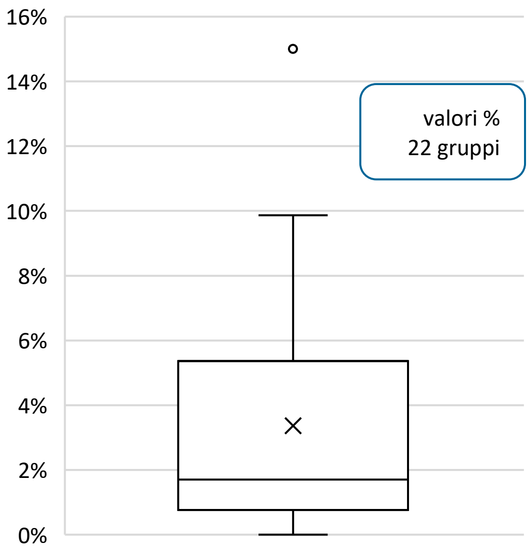
Figura 57 - Cloud computing: modelli in uso



Dall'analisi dei microdati[26] emerge inoltre che, nel complesso, 11 gruppi adottano soltanto il cloud pubblico, uno soltanto il cloud privato e i restanti ricorrono a più di un modello tra pubblico, privato e ibrido.

Sono inoltre rilevate le risorse umane impiegate, in termini di FTE (full time equivalent) dedicati al cloud a vario titolo (governance, centro di competenza, infrastruttura, sviluppo, gestione, ecc.). La Figura 58 mostra, mediante diagramma a scatole e baffi[27], la distribuzione degli FTE relativi, valori percentuali calcolati rapportando gli FTE dedicati al cloud agli FTE IT totali segnalati dai gruppi. Su 22 gruppi, risultano impiegati nel cloud mediamente il 3,4% degli FTE IT, fino a punte del 15%.

Figura 58 - Cloud computing: risorse FTE dedicate

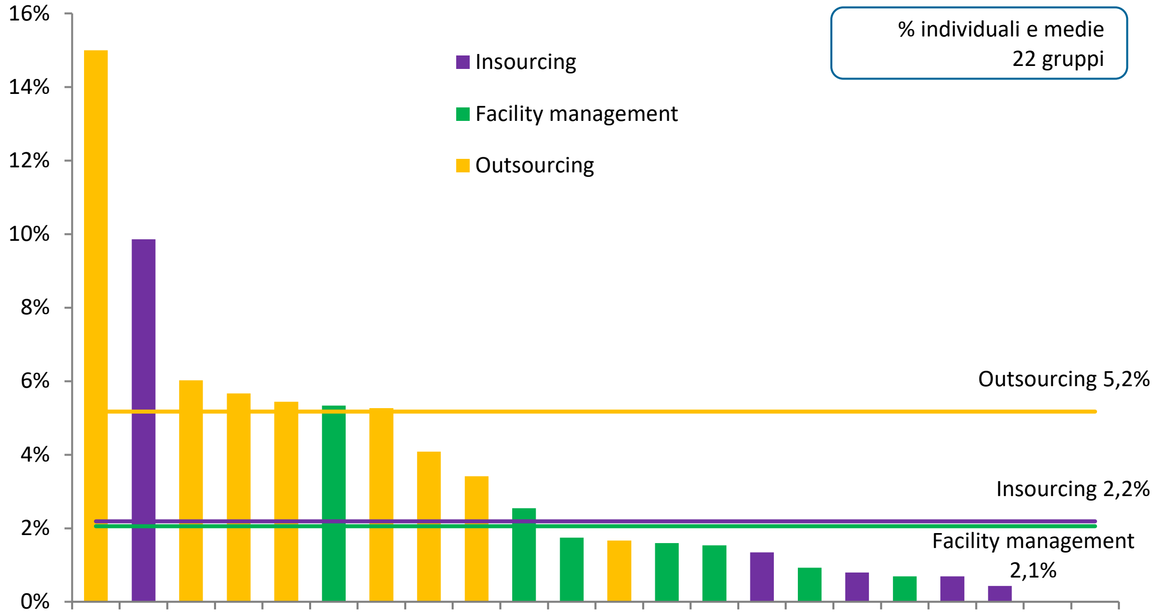


La Figura 59 mostra le percentuali individuali di FTE dedicati al cloud, distinte per modello di sourcing IT. Ogni barra rappresenta il valore di un gruppo e il colore identifica il relativo modello. Si noti come, mediamente, i gruppi in Outsourcing impegnino per il cloud una quota relativa di FTE pari al 5,2%, maggiore rispetto ad altri modelli di sourcing. Tale fenomeno è influenzato anche dalla numerosità delle risorse umane complessivamente impiegate dai gruppi nell'IT, che aumentano con l'aumentare delle attività informatiche curate direttamente dal gruppo.

[26] L'analisi trascura il dato residuale relativo alla voce "Altri modelli cloud".

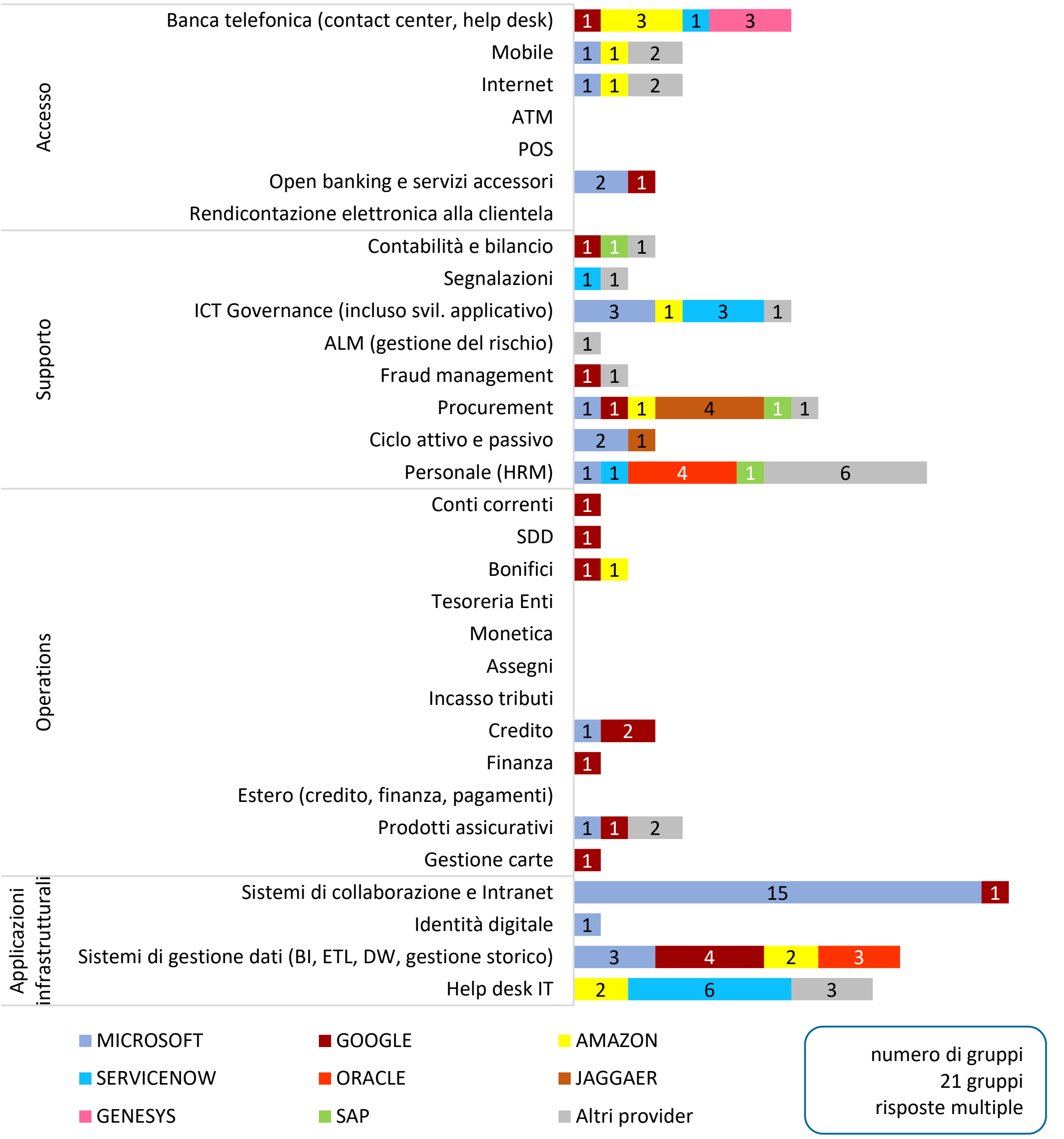
[27] "X" rappresenta la media.

Figura 59 - Cloud computing: risorse FTE dedicate - valori individuali



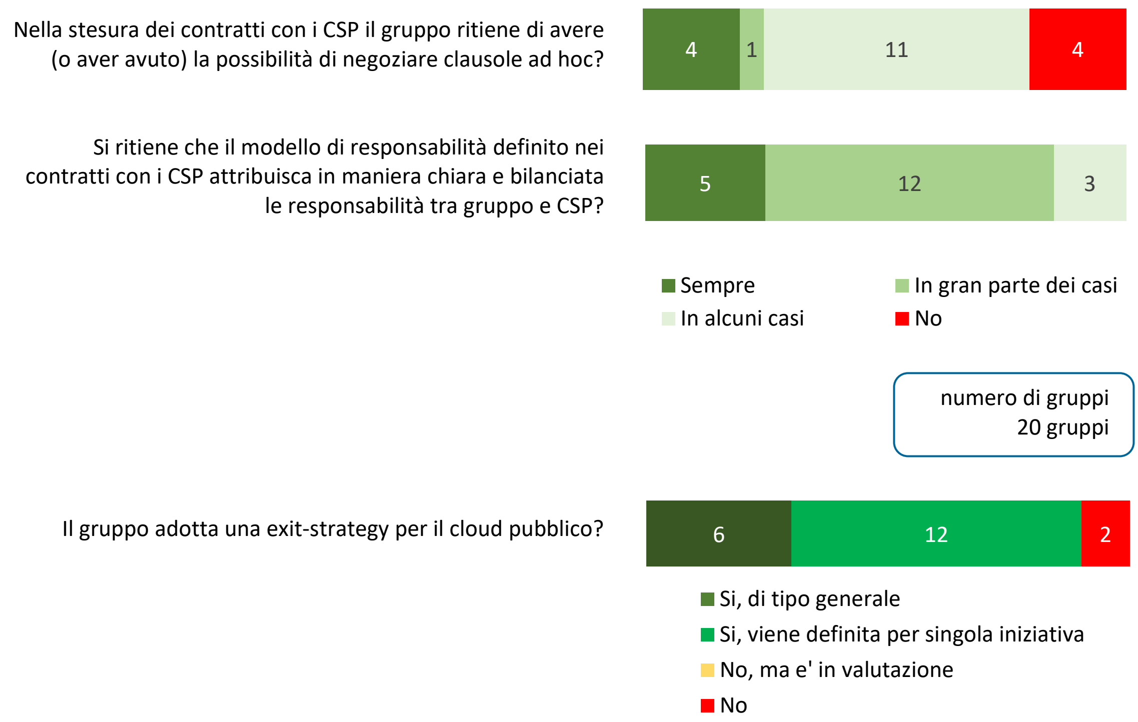
Per ciascuno dei servizi applicativi presi in esame, la Figura 60 riporta i CSP (cloud service provider) segnalati dai gruppi bancari e la relativa frequenza, ovvero il numero dei gruppi che ricorrono a quel provider all'interno dello specifico servizio. Sono identificati ed esplicitati i fornitori segnalati almeno tre volte tra tutti i gruppi e tutti i servizi, mentre i restanti sono raggruppati sotto l'unica voce "Altri provider". Sono all'incirca 30 i CSP menzionati dai gruppi e, tra questi, gli hyperscaler sono segnalati con frequenza maggiore.

Figura 60 - Cloud Service Providers



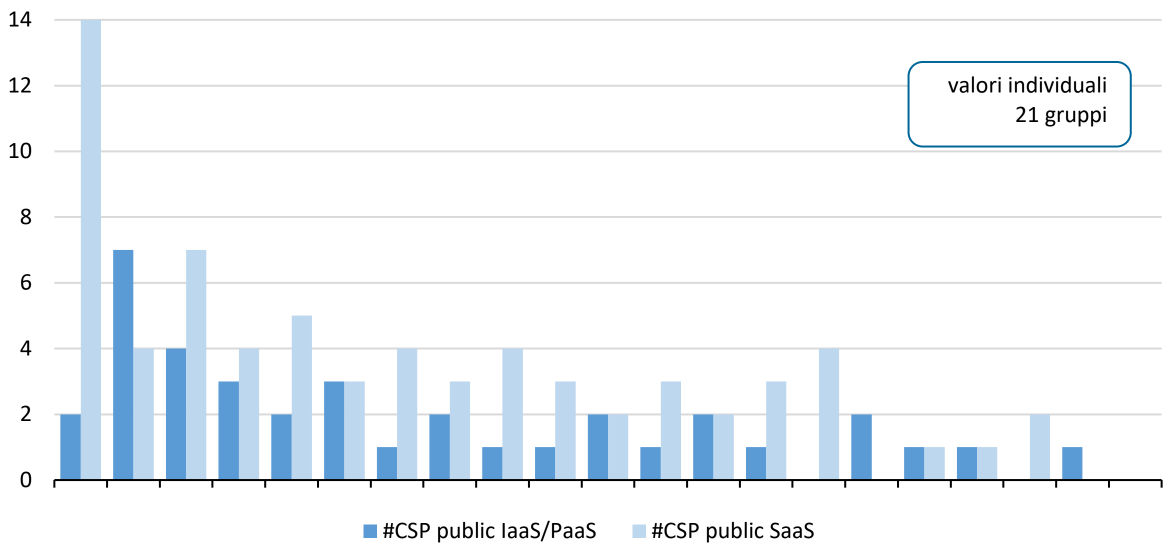
La Figura 61 si focalizza su alcuni temi di maggior rilievo afferenti al cloud pubblico e, in particolare, alla relazione che si instaura tra il gruppo bancario e il CSP. In tema di potere negoziale, in merito alla possibilità di negoziare clausole contrattuali ad hoc in fase di stesura dei contratti con i CSP, quattro gruppi ritengono di averla (o averla avuta) sempre mentre, all'opposto, altri quattro ritengono di non averla (o non averla avuta). A fronte di un gruppo che riferisce di aver avuto la possibilità di negoziare clausole ad hoc in gran parte dei casi, la maggioranza dei gruppi riporta di aver negoziato tali clausole solo in alcuni casi (11). Restando in tema contrattualistico, cinque gruppi ritengono che il modello di responsabilità definito nei contratti attribuisca sempre in maniera chiara e bilanciata le responsabilità tra gruppo bancario e CSP. In generale, il modello di responsabilità è ritenuto sostanzialmente adeguato, anche nei casi di limitata capacità negoziale. La definizione di una strategia di uscita dal cloud pubblico costituisce un altro tema oggetto di questo focus. Emerge che sei gruppi adottano una exit strategy di tipo generale, 12 dichiarano di definirla in relazione alle singole iniziative e due gruppi non possiedono una strategia di uscita definita.

Figura 61 - Cloud pubblico: capacità negoziale, responsabilità, exit strategy



L'utilizzo del cloud pubblico per l'erogazione dei servizi IT prevede il ricorso a uno o più CSP. La Figura 62 mostra, per ciascun gruppo, due barre che rappresentano il numero di CSP cui esso si affida per il modello SaaS (azzurro chiaro) e IaaS/PaaS (azzurro scuro). Mediamente, i gruppi ricorrono a 1,8 CSP per IaaS/PaaS, mentre si registra una maggiore diversificazione nel SaaS, con una media di 3,5 CSP. Nella lettura del grafico occorre tenere in considerazione che in alcuni casi può verificarsi che uno stesso CSP sia conteggiato in entrambe le barre, laddove eroghi al medesimo gruppo sia servizi SaaS che IaaS/PaaS.

Figura 62 - Cloud pubblico: numero di CSP - valori individuali



2.3 Elementi di Sicurezza IT

Questo paragrafo intende non tanto descrivere in modo esaustivo le iniziative organizzative intraprese dai gruppi in tema di Sicurezza IT quanto raccogliere in modo accentrato gli elementi ad essa connessi che emergono trasversalmente dalle analisi sui profili organizzativi dell'IT.

Dal punto di vista delle risorse umane, i gruppi con almeno 50 dipendenti IT allocano nella sicurezza informatica mediamente il 6,7% dei propri FTE IT. Tale media sale al 7,6% se si include il personale tecnico dedicato alla Business Continuity e al Disaster Recovery. Da analoghe analisi svolte sui gruppi che hanno meno di 50 dipendenti IT emerge che, per questi, la media delle percentuali di FTE IT dedicati alla sicurezza è pari al 12,6%, che sale al 14,7% includendo la Business Continuity e il Disaster Recovery. La maggior percentuale, quasi doppia, che emerge dai gruppi con pochi dipendenti IT rispetto a quelli con maggior numerosità, comprova la grande attenzione rivolta al tema della sicurezza cibernetica da parte del mondo bancario, che spinge a mantenere tali risorse all'interno del perimetro aziendale pur nei casi di ricorso estensivo all'outsourcing dell'IT (cfr. Figura 85 e Figura 144).

Le strategie relative alle risorse umane sono strettamente connesse al tema delle competenze. Le competenze tecniche specializzate in Sicurezza IT trattate in questa Rilevazione riguardano prevalentemente due ambiti, per i quali è rilevato il livello di competenze presente nei gruppi bancari al 2024 (as is) e quello che essi prevedono di raggiungere nel biennio 2025-2026 (to be), oltre che le modalità di reperimento dei relativi skill. I due ambiti, presi in esame dalla Figura 88 e successive, sono i seguenti:

- ✓ **Security governance**: in questo ambito il livello[28] medio di competenze registrato nel 2024 è pari a 3,7 su 5, e aumenta passando a 4,2 in previsione per il biennio 2025-2026, con il 52% dei gruppi che segnala un gap di competenze da colmare. In questo ambito, più che in tutti gli altri analizzati, le competenze sono più spesso reperite tramite assunzione di personale IT, a ulteriore riprova di quanto sia ritenuto strategico il governo della sicurezza informatica;
- ✓ **Gestione operativa della sicurezza**: in questo ambito è presente un minor gap di competenze rispetto al precedente; è infatti previsto il passaggio da un livello medio pari a 3,8 del 2024 a 4,1 per il biennio successivo, gap segnalato dal 35% dei gruppi; la maggior parte di essi ricorre alla formazione del proprio personale IT per l'acquisizione delle necessarie competenze specialistiche.

In tema di innovazione tecnologica applicata alla Sicurezza IT, dieci gruppi segnalano rilevanti iniziative di innovazione nel 2024 e altri cinque prevedono di avviarne nel biennio 2025-2026 (cfr. Figura 71). Nel complesso, tali iniziative riguardano il rafforzamento dei presidi di protezione dei dati, il miglioramento dei sistemi antiintrusione sugli endpoint (es. laptop, server), la standardizzazione delle configurazioni di sicurezza dei servizi in cloud, il potenziamento dei motori antifrode, l'implementazione di modelli ZTNA (zero trust network access), l'attivazione del SOC (security operations center) e CTI (cyber threat intelligence) integrando monitoraggio continuo e analisi delle minacce.

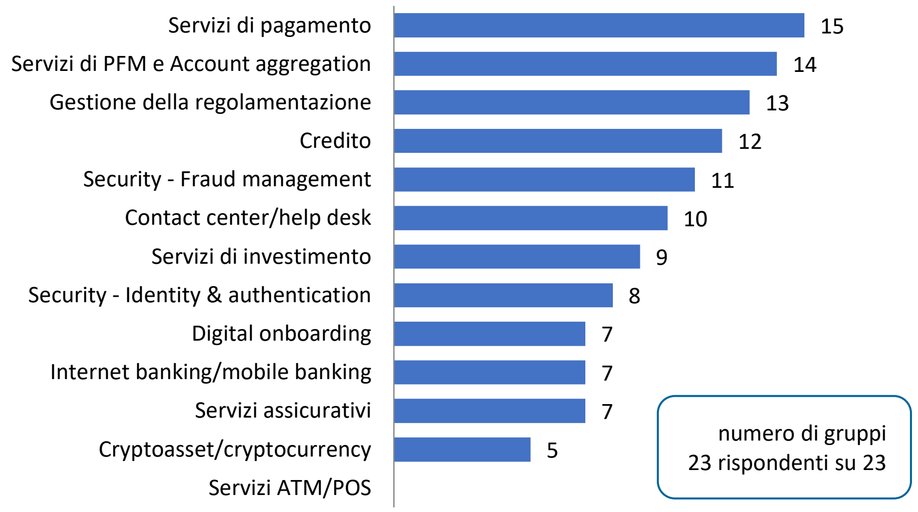
2.4 FinTech

Questa sezione si focalizza sul tema della collaborazione del mondo bancario con il FinTech, indagando in particolare gli ambiti e le tecnologie interessate.

[28] Determinato soggettivamente da ciascun gruppo bancario su una scala che va da un minimo di zero a un massimo di cinque.

Dei 23 gruppi partecipanti, tutti indicano forme di collaborazione a vario titolo con aziende operanti nel FinTech e ogni ambito indagato risulta interessato dal fenomeno, ad eccezione dei servizi ATM/POS; i più impattati sono i servizi di pagamento, di PFM (Personal Financial Management) e account aggregation, la gestione della regolamentazione e il credito, che vedono l'impegno di oltre la metà dei gruppi (Figura 63).

Figura 63 - Ambiti di collaborazione con FinTech



Sono di seguito esaminati i paradigmi tecnologici coinvolti nei vari ambiti. In particolare, i grafici di Figura 64 e Figura 65 forniscono due differenti viste dello stesso fenomeno e mostrano che le tecnologie utilizzate nel maggior numero di ambiti, mediante il ricorso al FinTech, sono RPA (robotic process automation), intelligenza artificiale e open API. L'ambito che meglio si presta all'impiego di più tecnologie è quello dei servizi PFM e account aggregation.

Figura 64 - Collaborazione con FinTech e tecnologie

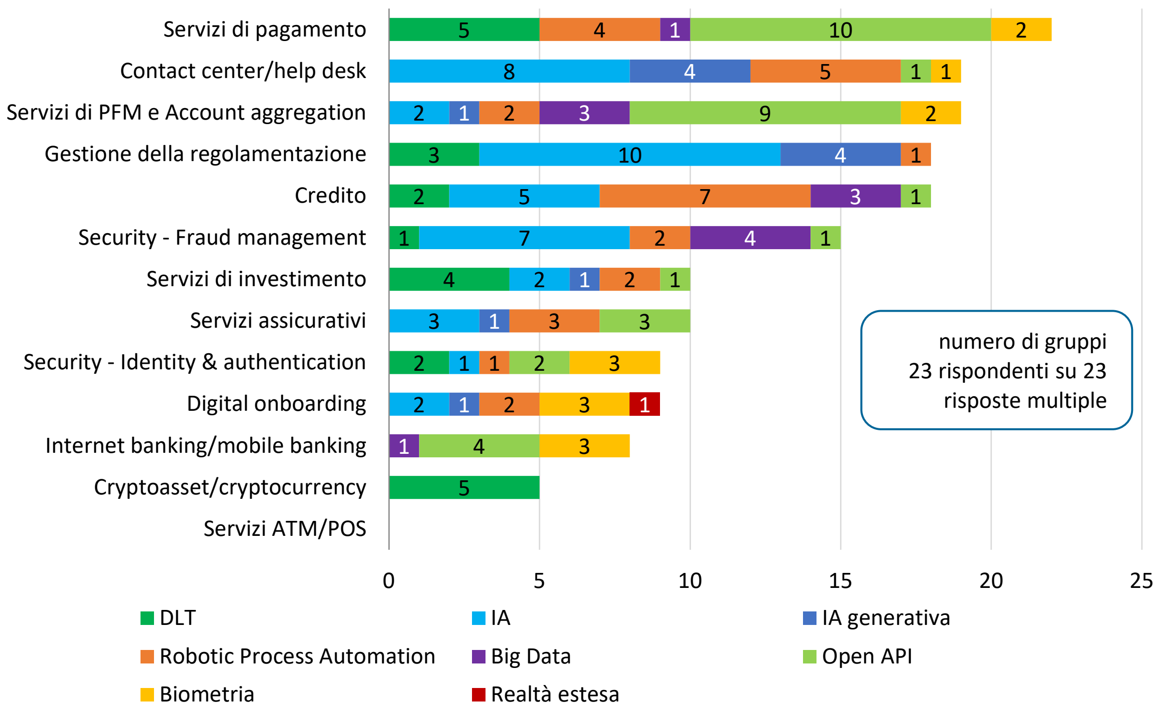
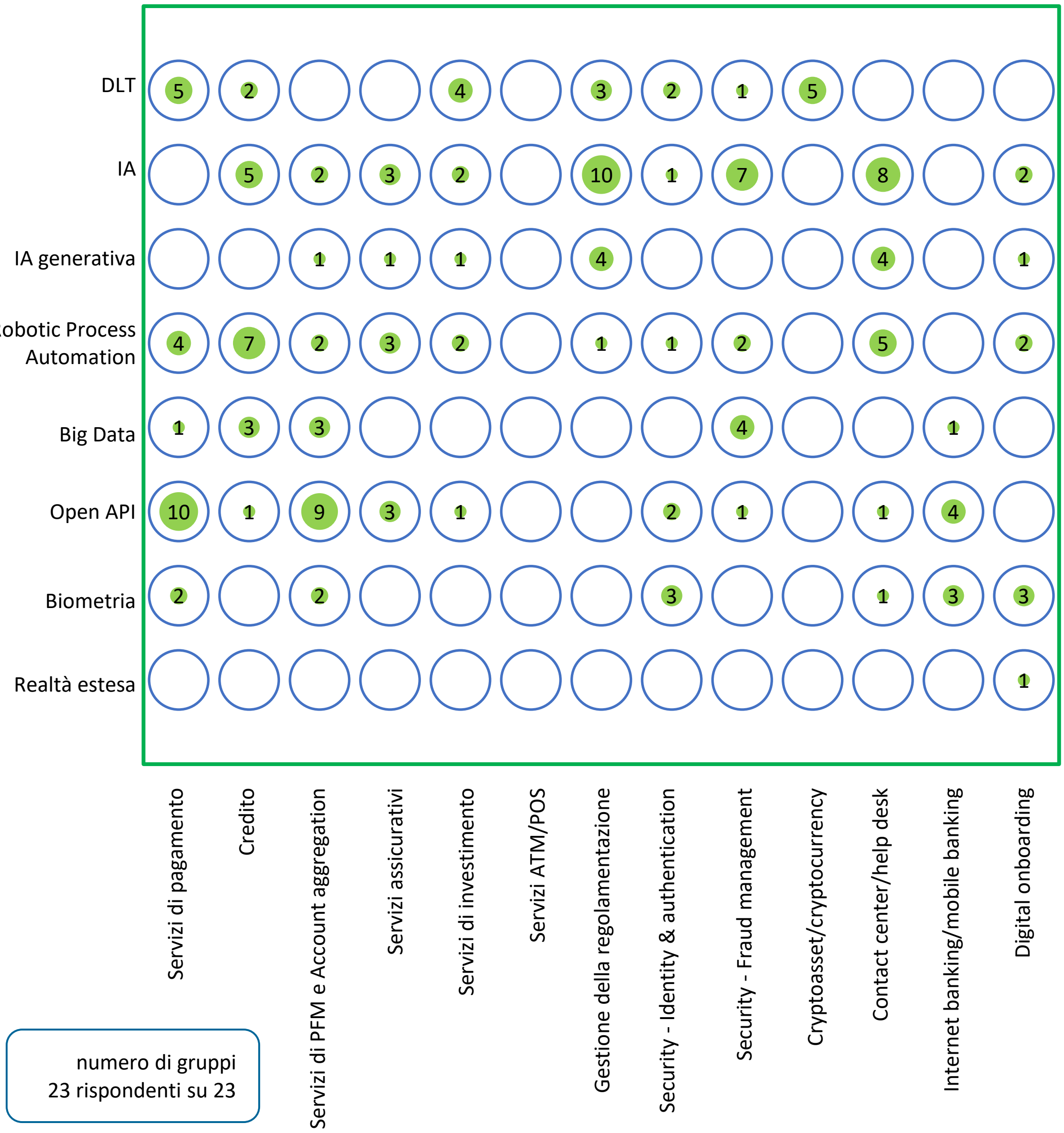
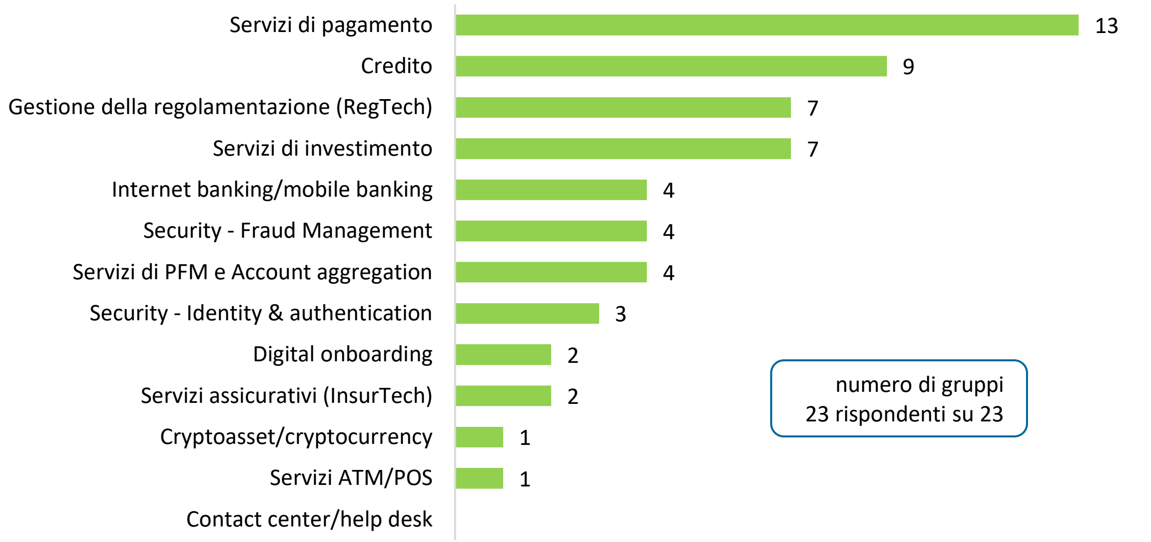


Figura 65 - Collaborazione con FinTech e tecnologie (vista 2)



A completamento dell'indagine, la Figura 66 riporta gli ambiti (ciascun gruppo poteva segnalarne fino a tre) che nell'esercizio 2024 hanno assorbito i maggiori investimenti IT nella collaborazione con aziende FinTech. I servizi di pagamento hanno attratto investimenti IT dal maggior numero di gruppi (13), seguiti dal credito, dalla gestione della regolamentazione (RegTech) e dai servizi di investimento.

Figura 66 - Collaborazione con FinTech e maggiori investimenti IT

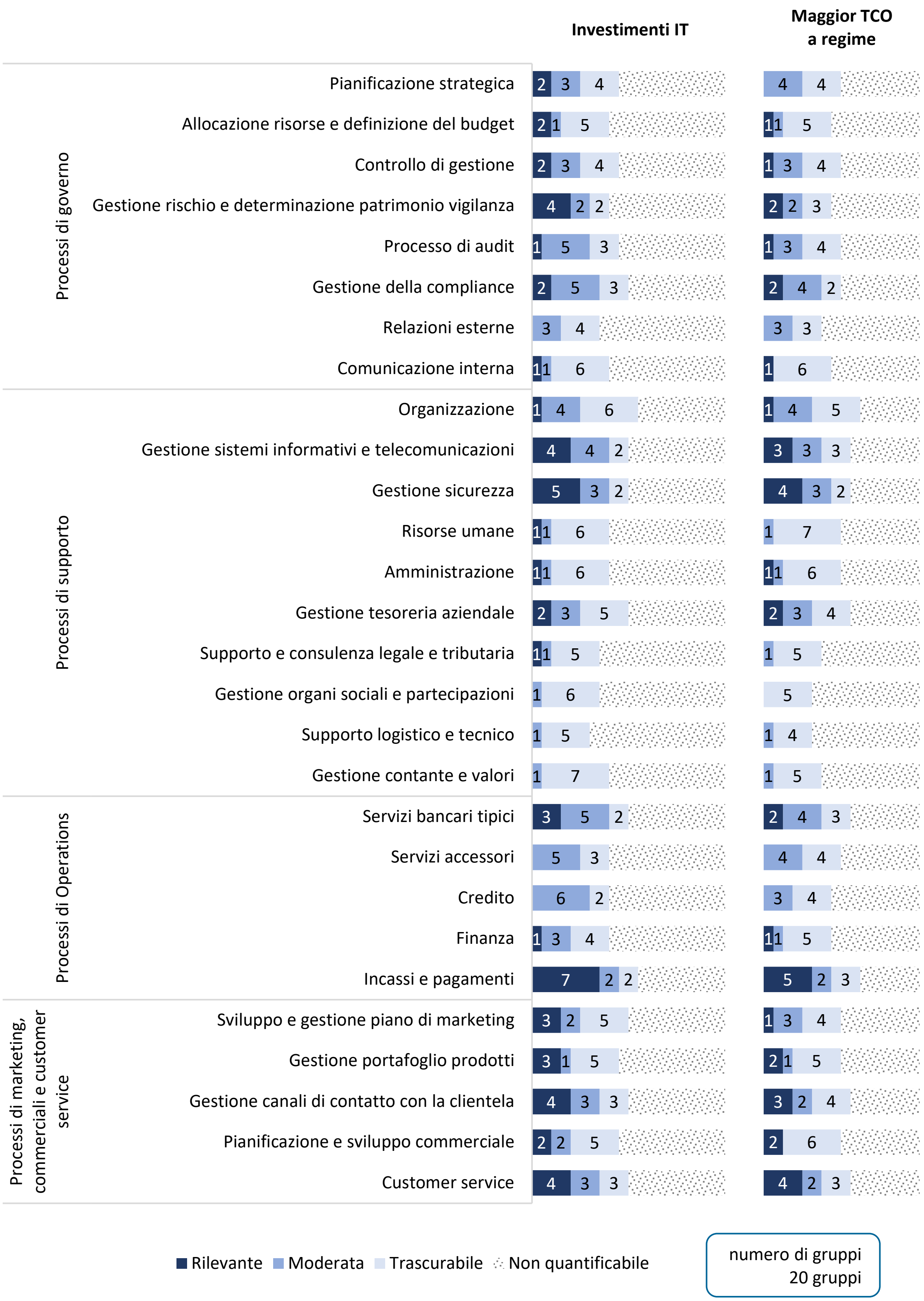


2.5 Euro digitale

Questa edizione torna ad affrontare il tema dell'euro digitale andando a rilevare una previsione dell'impegno economico che dovrebbe essere sostenuto dai gruppi bancari per predisporre i propri processi aziendali all'introduzione dell'euro digitale. Si focalizza, inoltre, sulle opportunità che i gruppi intenderebbero cogliere, intraprendendo iniziative che porterebbero ad ampliare l'offerta di nuovi servizi o alla revisione/ottimizzazione dei propri sistemi e delle proprie infrastrutture IT.

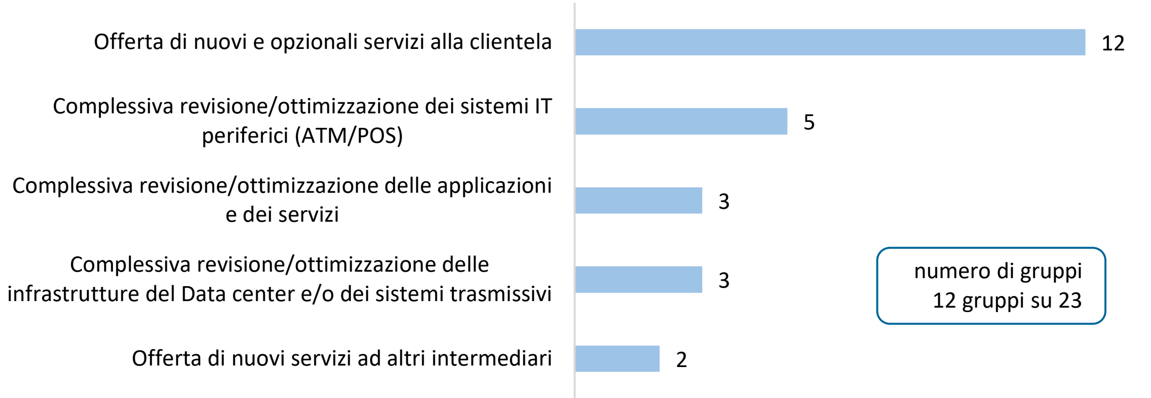
Basandosi sulla tassonomia dei processi bancari di ABI Lab, il grafico di Figura 67 mostra, per ciascuno di essi, le previsioni sull'entità degli investimenti IT necessari ad affrontare l'iniziale adeguamento della realtà IT del gruppo e i maggiori costi IT (TCO) previsti a regime per il mantenimento dell'operatività bancaria. L'analisi si concentra esclusivamente sugli adeguamenti minimi che si prevede debbano essere messi in atto a scopo di compliance, escludendo eventuali iniziative finalizzate all'introduzione di nuovi opzionali servizi connessi all'euro digitale. Su 20 gruppi rispondenti, 12 hanno contribuito all'analisi quantificando previsioni. Gli impatti economici riguardano trasversalmente tutte le aree mappate, in particolare quella dei processi di Operations. Dal punto di vista degli investimenti IT iniziali, i processi su cui il maggior numero di rispondenti quantifica impatti non trascurabili sono Incassi e pagamenti (9 gruppi), Servizi bancari tipici, Gestione sistemi informativi e telecomunicazioni e Gestione sicurezza (8 gruppi). Per quanto riguarda il maggior TCO previsto a regime, al termine degli adeguamenti finalizzati all'introduzione dell'euro digitale, i processi su cui sono stati più di frequente segnalati impatti quantificabili non trascurabili sono Incassi e pagamenti e Gestione sicurezza (7 gruppi), Servizi bancari tipici, Customer service, Gestione sistemi informativi e telecomunicazioni, Gestione della compliance (6 gruppi).

Figura 67 - Euro digitale: previsioni di investimenti IT e maggior TCO a regime



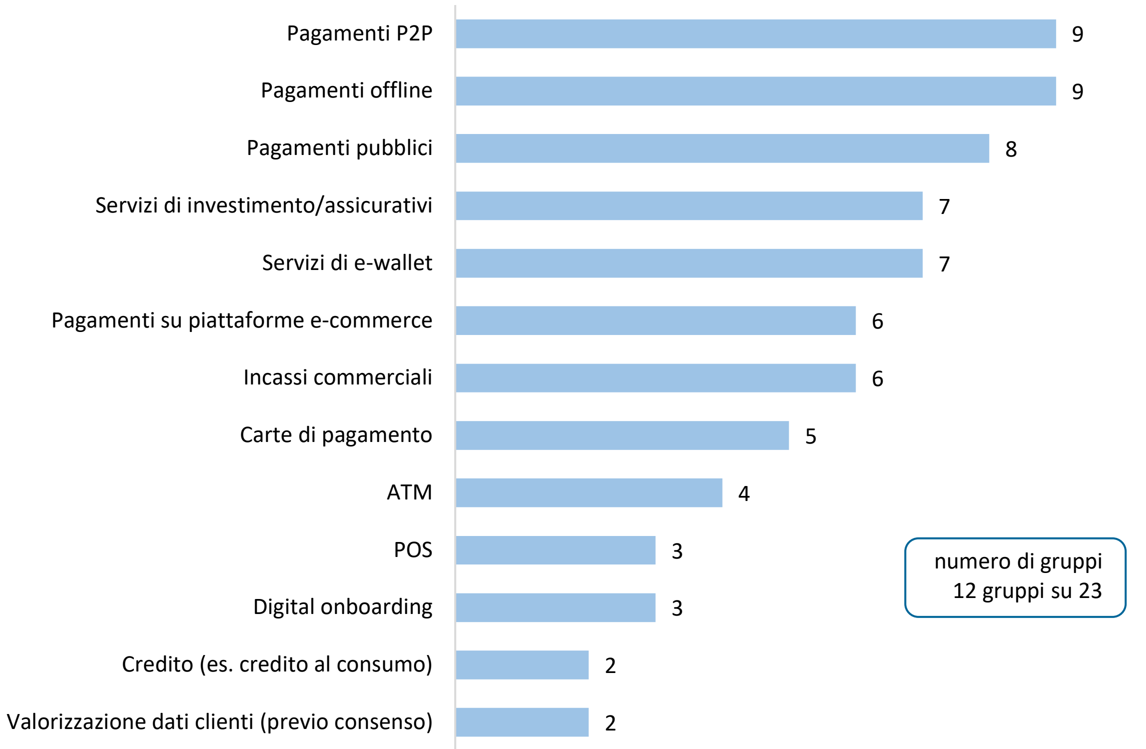
Dal punto di vista strategico, la possibile introduzione dell'euro digitale comporterebbe per le banche anche l'apertura di nuovi orizzonti di opportunità, alcune delle quali sono prese in esame dalla Figura 68. Dei 12 gruppi rispondenti, tutti segnalano di intravedere l'opportunità di offrire nuovi e opzionali servizi alla clientela e, una minoranza di essi, di svolgere attività di revisione e ottimizzazione della propria realtà IT. Due gruppi indicano, infine, anche l'opportunità di offrire ad altri intermediari nuovi servizi connessi con l'euro digitale.

Figura 68 - Euro digitale: possibili opportunità



La Figura 69 indaga in dettaglio alcuni dei possibili ambiti di offerta dei nuovi e opzionali servizi alla clientela connessi all'euro digitale indicati nella figura precedente. Per almeno la metà dei gruppi rispondenti l'offerta ruota attorno alle molteplici forme di servizi di pagamento - in primis P2P, offline e pagamenti pubblici - ai servizi di e-wallet, di investimento/assicurativi e agli incassi commerciali. In generale, tutti i servizi presi in esame sono interessati dal fenomeno.

Figura 69 - Euro digitale: possibili ambiti di offerta di nuovi servizi alla clientela

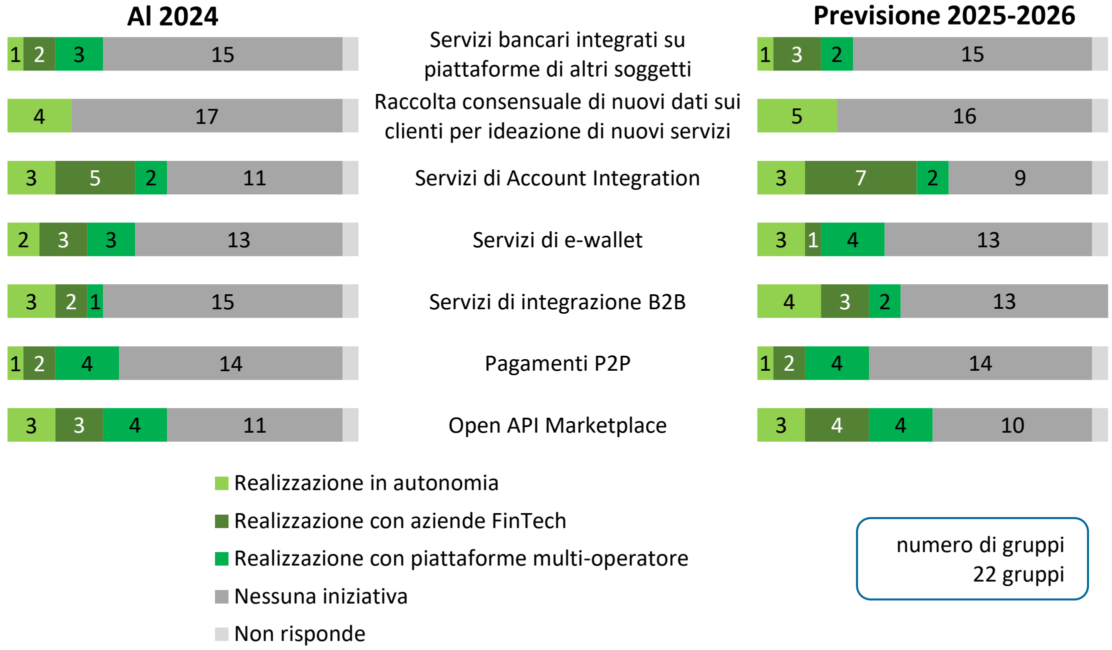


2.6 Open banking

Questa sezione si focalizza sulle iniziative in ambito open banking, in corso al 2024 e in previsione nel biennio 2025-2026, legate all'implementazione di servizi di business a valore aggiunto (VAS) e le relative modalità di attuazione.

Dalla Figura 70 si evince un ricorso all'open banking piuttosto contenuto, che avviene principalmente per realizzare account integration e servizi su open API marketplace, tendenza confermata anche in previsione, nel biennio 2025-2026.

Figura 70 - Open banking: ambiti[29] e modalità realizzative di servizi a valore aggiunto



2.7 Innovazione tecnologica

L'innovazione è un processo che si sviluppa nel continuo in tutti i domini tecnologici ed è particolarmente sentita nell'IT, dove interessa pressoché qualunque ambito.

La Figura 71 indaga le iniziative di innovazione IT di maggior rilievo intraprese o previste dai gruppi bancari, distinte per area tematica e per orizzonte temporale di attuazione. Al 2024 tutte le aree tematiche risultano interessate da rilevanti iniziative di innovazione, in corso o concluse durante l'anno. In particolar modo, oltre la metà dei rispondenti segnala, nell'esercizio, iniziative sulla Server farm e nell'ambito dello Sviluppo e manutenzione evolutiva.

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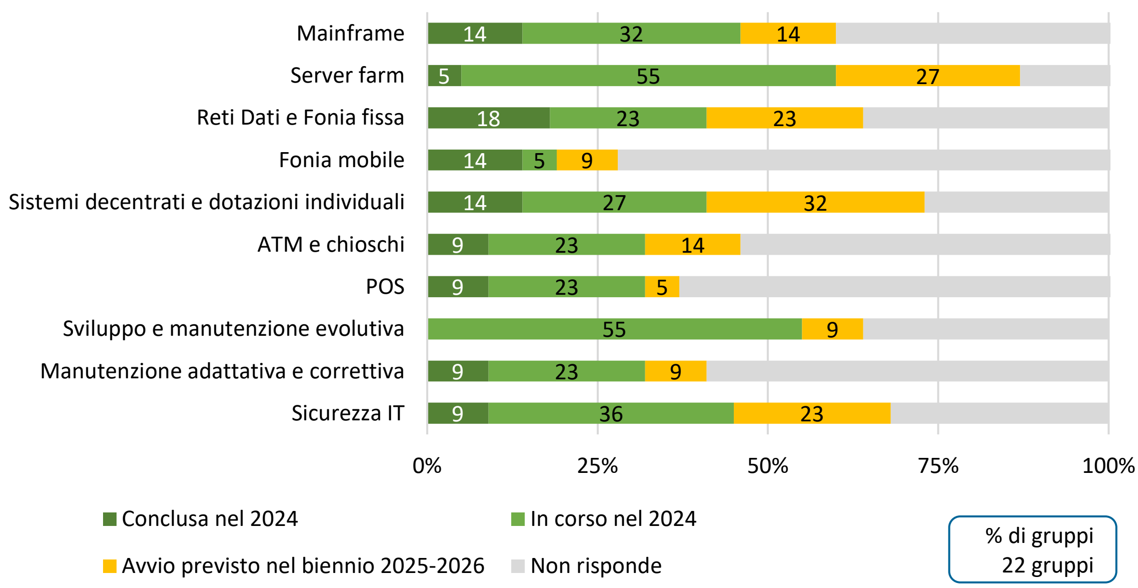
[29] Di seguito alcune definizioni esplicative per le voci elencate nel grafico:
- Account integration: integrazione operativa tra conti bancari, anche di istituti diversi, che consente al cliente l'esecuzione di operazioni in modo centralizzato;
- e-wallet: consente di memorizzare i dati di uno o più strumenti di pagamento su un dispositivo mobile del cliente e/o su un server remoto (del gestore del wallet) per eseguire operazioni di pagamento;
- Servizi di integrazione B2B: es. servizi di processing delle transazioni integrati sui sistemi ERP dei clienti corporate attraverso un canale sicuro;
- Pagamenti P2P: trasferimento in tempo reale di denaro tra privati;
- Open API marketplace: piattaforme di erogazione di API (application programming interface) per lo sviluppo di servizi a valore aggiunto.

Per il biennio 2025-2026 un discreto numero di gruppi segnala iniziative che impatteranno i Sistemi decentrati e dotazioni individuali, la Server Farm, le Reti dati e fonia fissa e la Sicurezza IT.

Segue un estratto delle principali attività segnalate in previsione per l'orizzonte temporale 2025-2026, suddivise per area tematica:

- ✓ **Mainframe**: migrazione in cloud di specifici workload, consolidamento tecnologico e ottimizzazione, creazione partizione logica di collaudo mainframe e revisione processi di rilascio software;
- ✓ **Server farm**: acquisizione di nuovo hardware, data center relocation program, migrazione al cloud, rinnovo infrastruttura sito primario, adozione architetture IaaS;
- ✓ **Reti dati e fonia fissa**: ricorso a SD-WAN, ibridazione della fonia fissa con MS Teams;
- ✓ **Fonia mobile**: adozione di Microsoft Intune, abilitazione dei dipendenti al BYOD (bring your own device), introduzione di Samsung Knox e Apple Business Manager;
- ✓ **Sistemi decentrati e dotazioni individuali**: rinnovo tecnologico delle postazioni di lavoro, introduzione di strumenti AI per la produttività, migrazione postazioni di lavoro a Windows 11 e Office 365;
- ✓ **ATM e chioschi**: sostituzione di ATM tradizionali con dispositivi evoluti (inclusi cash-in/cash out), migrazione a Windows 10;
- ✓ **POS**: collegamento tra registratori di cassa e POS/SoftPOS per conformità alla legge di bilancio 2025;
- ✓ **Sviluppo e manutenzione evolutiva**: sviluppo di microservizi, completamento dello sviluppo di un AI based Customer Personal Assistant;
- ✓ **Manutenzione adattativa e correttiva**: test automatici, introduzione strumenti di intelligenza artificiale;
- ✓ **Sicurezza IT**: aumento presidi di primo livello, potenziamento motore antifrode, nuovo modello di Transaction monitoring.

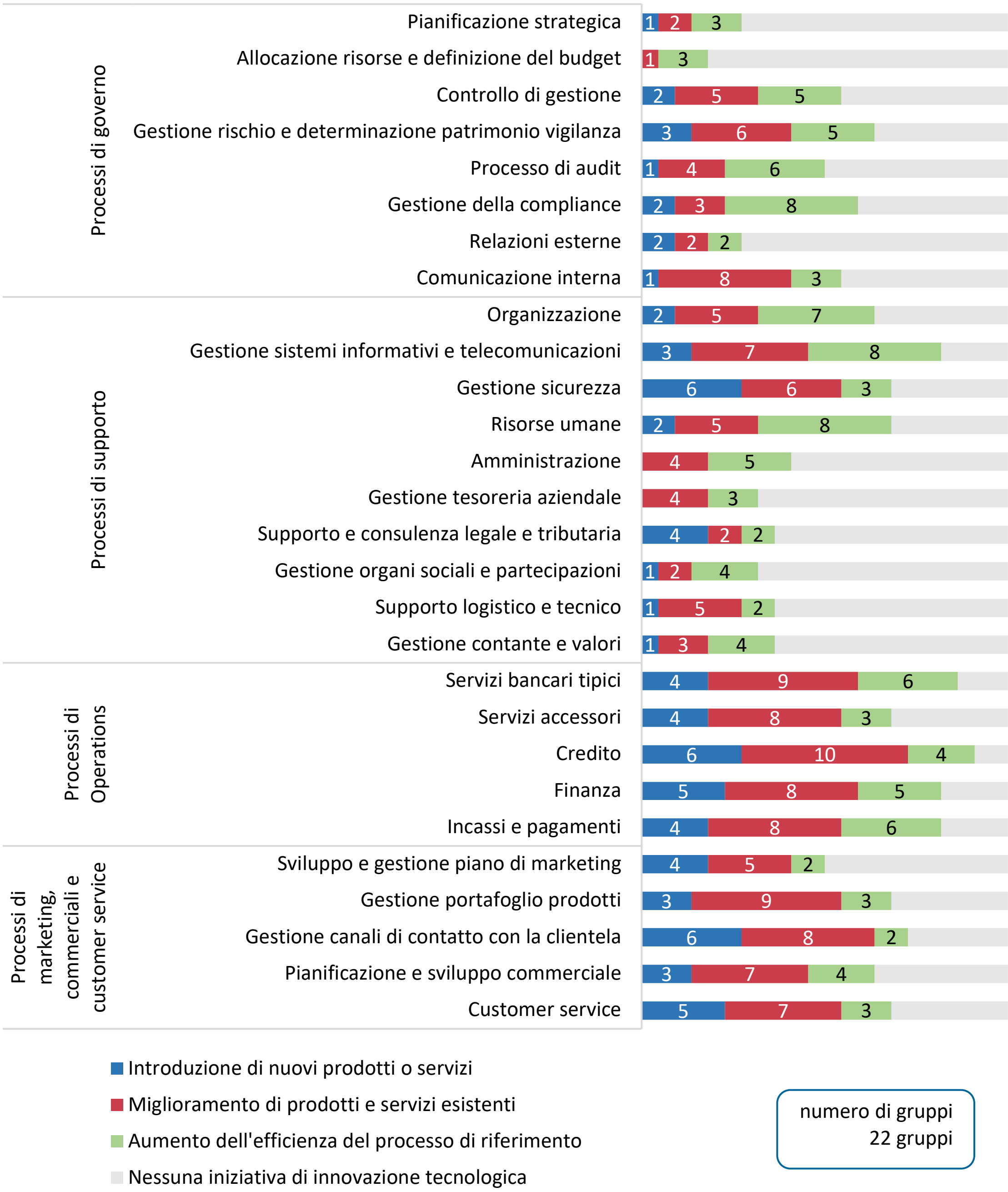
Figura 71 - Iniziative di innovazione tecnologica per aree tematiche



L'indagine si concentra infine sui processi bancari interessati da iniziative di innovazione tecnologica avviate o in corso nel 2024 e la finalità prevalente delle stesse (la tassonomia utilizzata per i processi è quella definita da ABI Lab).

Dalla Figura 72 risulta che l'area più soggetta a innovazione è quella dei processi di Operations. Prevalgono trasversalmente le iniziative finalizzate al miglioramento dei prodotti e servizi esistenti. L'introduzione di nuovi prodotti o servizi riguarda in particolar modo i processi di gestione della sicurezza, del credito e della gestione dei canali di contatto con la clientela. L'aumento dell'efficienza interessa soprattutto la gestione della compliance e dei sistemi informativi e delle telecomunicazioni. Nel complesso, oltre ai processi di Operations, quello più interessato da innovazione è il processo di gestione dei sistemi informativi e delle telecomunicazioni.

Figura 72 - Finalità delle iniziative di innovazione tecnologica avviate o in corso



In Appendice è riportata l'analisi sulle finalità dell'innovazione tecnologica condotta per classe dimensionale dei gruppi (da Figura 139 a Figura 141).

2.8 Personale IT

Questa sezione dedica ampio spazio alle analisi sul personale IT, che al 31 dicembre 2024 per i 23 gruppi partecipanti (perimetro CIPA) riguardava in totale 12.887 dipendenti, caratterizzando la compagine degli stessi e misurando l'allocazione delle risorse tra le aree tematiche, soffermandosi sulle competenze tecniche acquisite e quelle da potenziare, sulle modalità di reperimento e sulla qualificazione dell'offerta formativa.

2.8.1 Caratterizzazione della compagine

L'approfondimento sul personale IT prende avvio dall'analisi del rapporto tra il numero di dipendenti IT e il totale dei dipendenti del gruppo bancario, nel perimetro CIPA. La Figura 73 rappresenta tale rapporto, per l'intero campione e per le classi dimensionali, mediante diagrammi a scatole e baffi[27]. Sull'intero campione dei 23 gruppi, tale rapporto in media di percentuali è pari al 5,3%. Mediamente, i valori più alti sono attribuibili ai gruppi Medi (7,0%) mentre quelli più bassi ai gruppi Piccoli (4,1%), in virtù del maggior ricorso all'esternalizzazione delle attività informatiche. Tale fenomeno emerge anche dalla Figura 74, che riporta le medie di percentuali per modello di sourcing IT.

Figura 73 - Personale IT / totale dipendenti per classe dimensionale

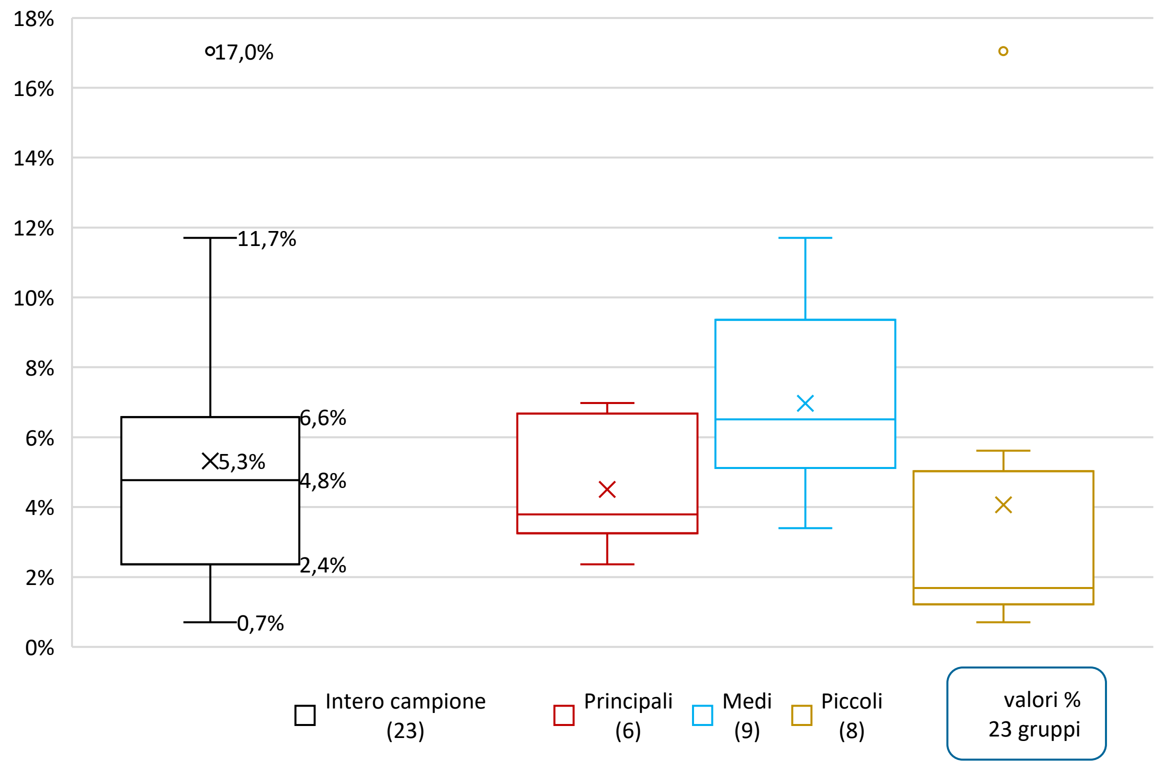
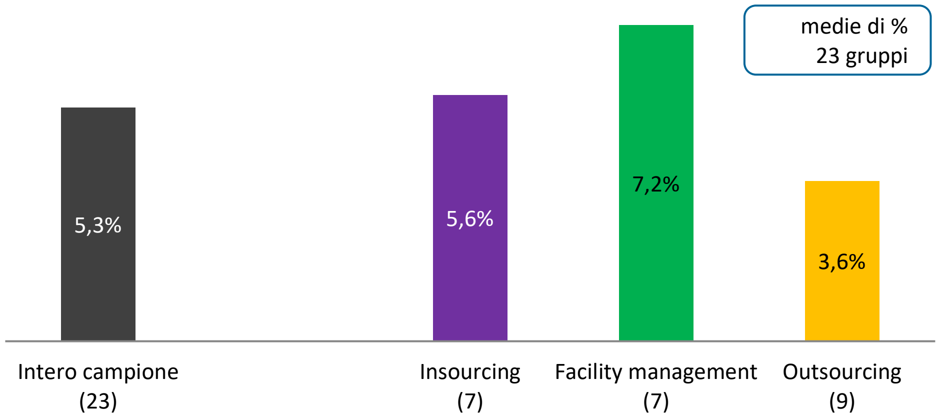
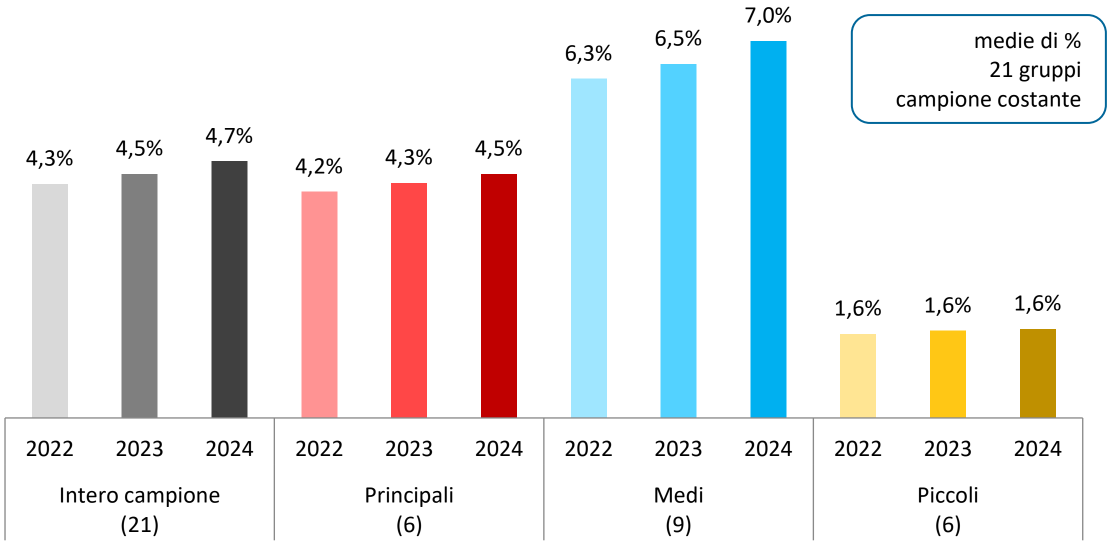


Figura 74 - Personale IT / totale dipendenti per modello di sourcing



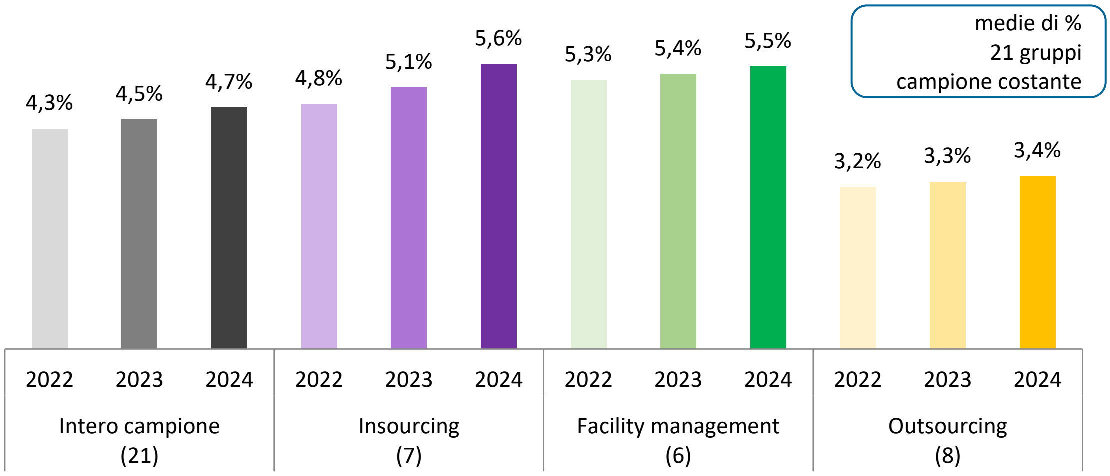
Nel triennio 2022-2024 l'andamento del rapporto tra personale IT e totale dipendenti, calcolato in media di percentuali su un campione costante di 21 gruppi, mostra un trend in crescita, registrando un incremento medio complessivo dello 0,4% (Figura 75). A livello di classi dimensionali si osserva un incremento costante per i gruppi Principali e Medi e un dato stabile per i gruppi Piccoli.

Figura 75 - Personale IT / totale dipendenti: andamento 2022-2024 per classe dimensionale



L'analoga analisi, svolta per classi di modello di sourcing (Figura 76), mostra nel triennio un incremento costante per ogni classe.

Figura 76 - Personale IT / totale dipendenti: andamento 2022-2024 per modello di sourcing

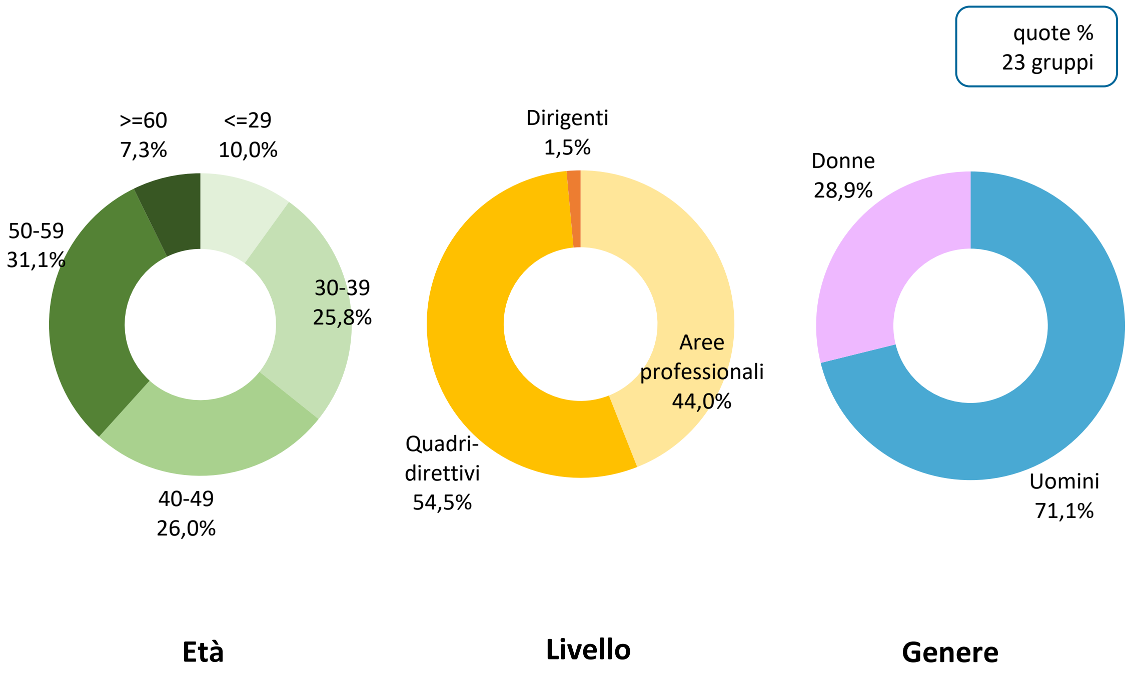


Le analisi che seguono forniscono una caratterizzazione della compagine IT per genere, età e livello contrattuale secondo la seguente classificazione:

- ✓ età, suddivisa in cinque fasce di ampiezza comparabile: sotto i 30 anni, tra 30 e 39 anni, tra 40 e 49 anni, tra 50 e 59 anni, 60 anni e oltre;
- ✓ livello contrattuale, suddiviso in tre fasce: aree professionali, quadri-direttivi e dirigenti.

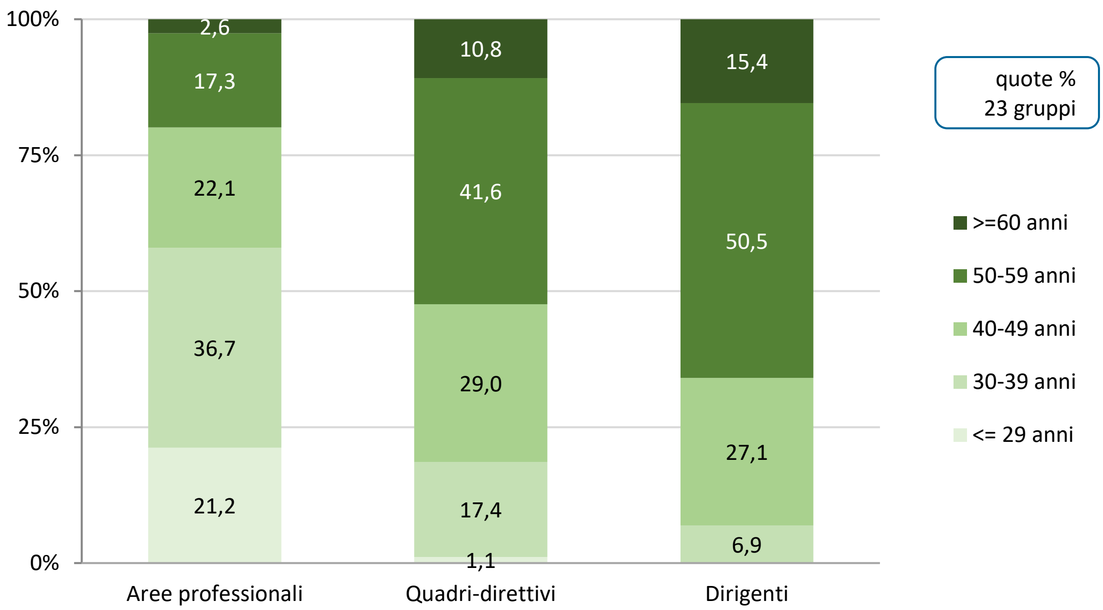
Nella Figura 77, riferita all'intero campione ed espressa in quote percentuali (rapporto tra la somma dei valori della grandezza in esame per tutti i rispondenti e il totale), si osserva che, tra il personale IT, la fascia d'età più numerosa è quella tra i 50 e i 59 anni (31,1%), i quadri-direttivi sono il 54,5% del totale e gli uomini sono in netta maggioranza rispetto alle donne che, nel campione esaminato, rappresentano il 28,9% dell'intera compagine IT.

Figura 77 - Personale IT per età, livello contrattuale e genere



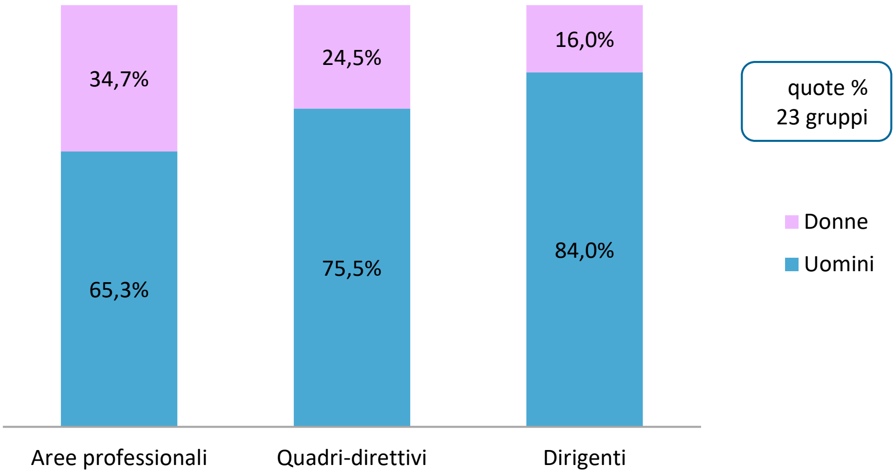
La Figura 78 mostra la ripartizione dei dipendenti IT per età e livello contrattuale. Si nota un generale aumento dell'età al crescere del livello. I dipendenti IT under 30 sono presenti quasi esclusivamente nelle aree professionali, in cui la fascia più ampia è quella tra i 30 e i 39 anni e oltre la metà del personale ha meno di 40 anni. Tra i quadri-direttivi e i dirigenti la fascia più numerosa è quella tra i 50 e i 59 anni e, nel complesso, oltre la metà dei dipendenti di questi livelli contrattuali ha un'età maggiore o uguale a 50 anni.

Figura 78 - Personale IT per età e livello contrattuale



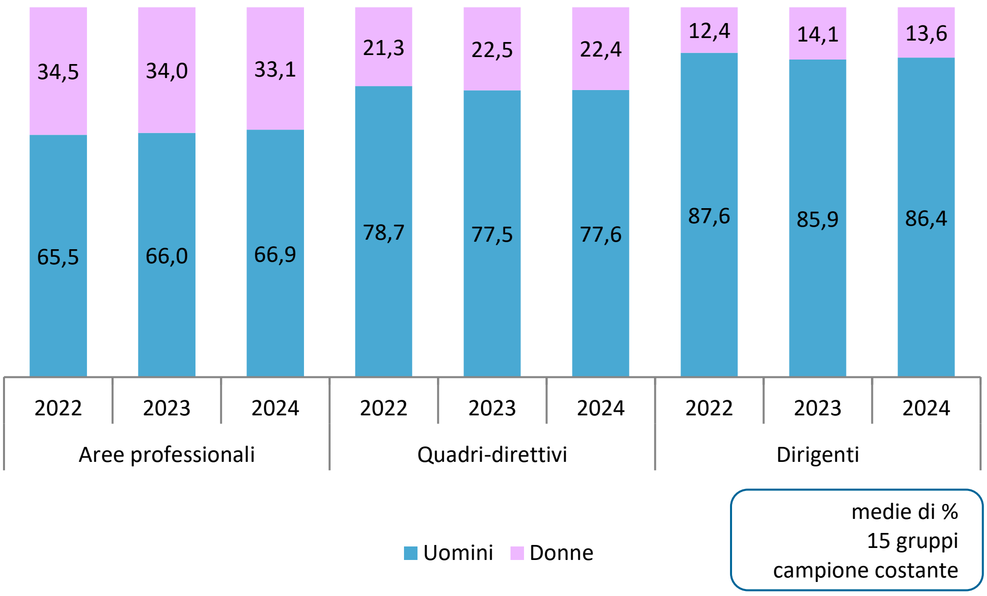
In relazione alla composizione per genere e livello contrattuale, la presenza femminile risulta più bassa rispetto a quella maschile in tutti i livelli contrattuali e diminuisce al salire con l'inquadramento, passando dal 34,7% all'interno delle aree professionali al 16,0% tra i dirigenti (Figura 79).

Figura 79 - Personale IT per genere e livello contrattuale



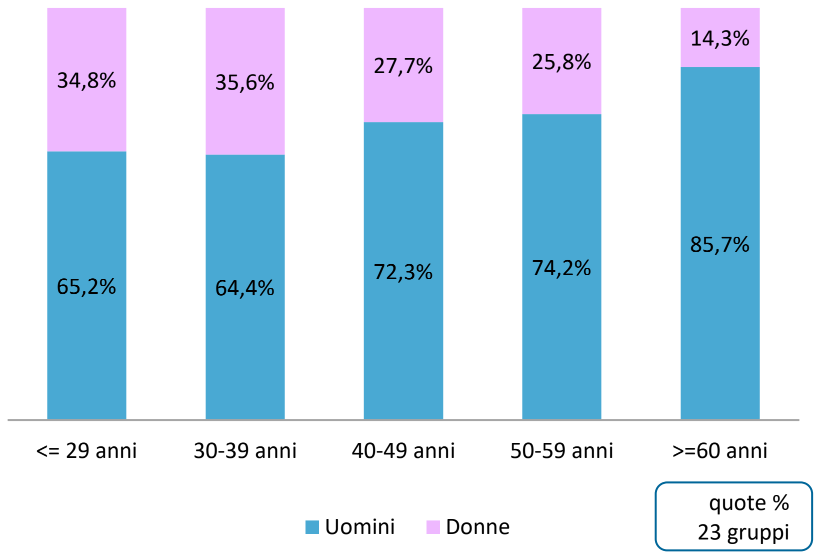
Per osservare l'andamento negli ultimi anni del rapporto di genere tra i diversi inquadramenti ci si può basare sulla Figura 80, che prende a riferimento un campione costante di 15 gruppi aventi almeno 50 dipendenti IT ed elabora il dato in medie di percentuali. Si evince negli anni una percentuale di donne in leggero calo nelle aree professionali e, nell'ultimo esercizio, anche tra i quadri-direttivi e i dirigenti.

Figura 80 - Personale IT per genere e livello contrattuale: andamento 2022-2024



In merito alla composizione per genere ed età, la quota femminile nell'IT è maggiore nelle fasce più giovani, passando gradualmente dal 14,3% delle over 60 a circa il 35% delle under 40 (Figura 81). Al fenomeno potrebbero aver contribuito un maggior tasso di neoassunzioni femminili in anni più recenti, una minore età di assunzione femminile e un maggior tasso di uscita femminile precoce.

Figura 81 - Personale IT per genere ed età



I grafici da Figura 82 a Figura 84 forniscono un raffronto tra classi dimensionali sulle medesime variabili fin qui trattate.

Figura 82 - Personale IT per livello contrattuale e classe dimensionale

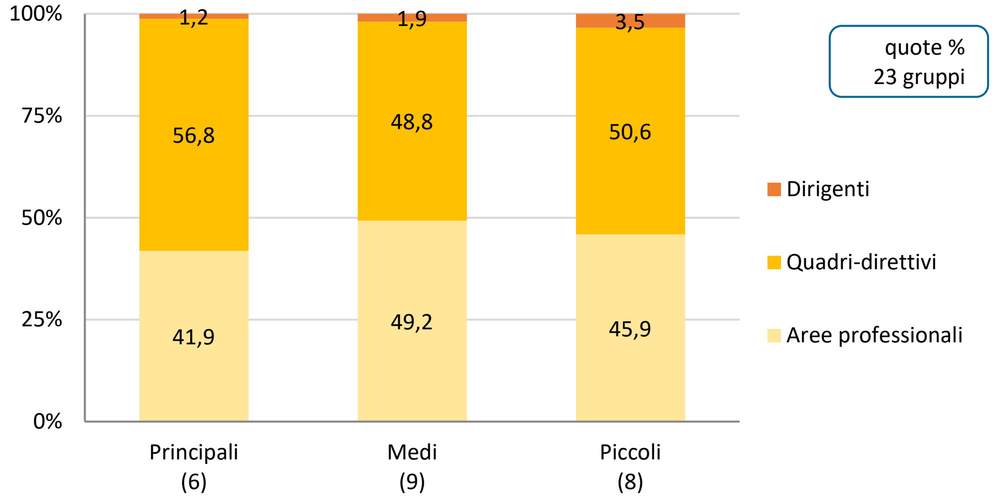


Figura 83 - Personale IT per età e classe dimensionale

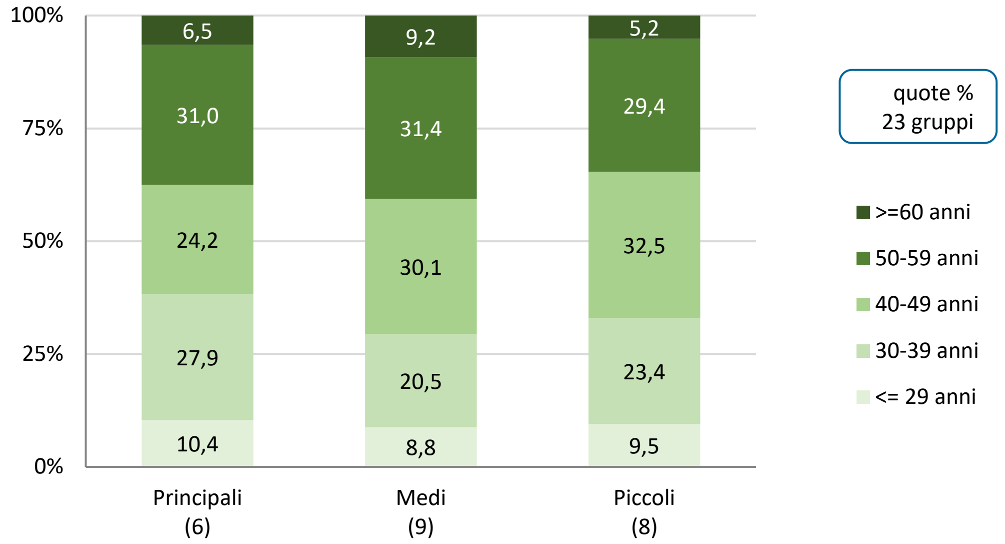
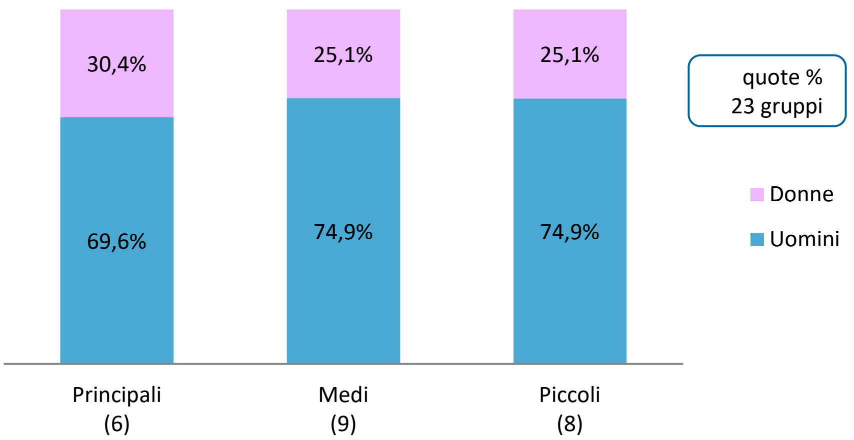


Figura 84 - Personale IT per genere e classe dimensionale



La Tabella 13 fornisce infine una visione di dettaglio, ripartendo in quote percentuali la popolazione IT dell'intero campione in 30 categorie, sulla base delle tre dimensioni di analisi fin qui viste: età, livello contrattuale e genere. Guardando alle categorie più numerose, per le donne si individua la fascia di età tra i 30 e i 39 anni, impiegate nelle aree professionali (6,3%), mentre per gli uomini si sale alla fascia 50-59 anni, impiegati come quadri-direttivi (17,1%).

Tabella 13 - Personale IT: ripartizione per genere, età e livello contrattuale

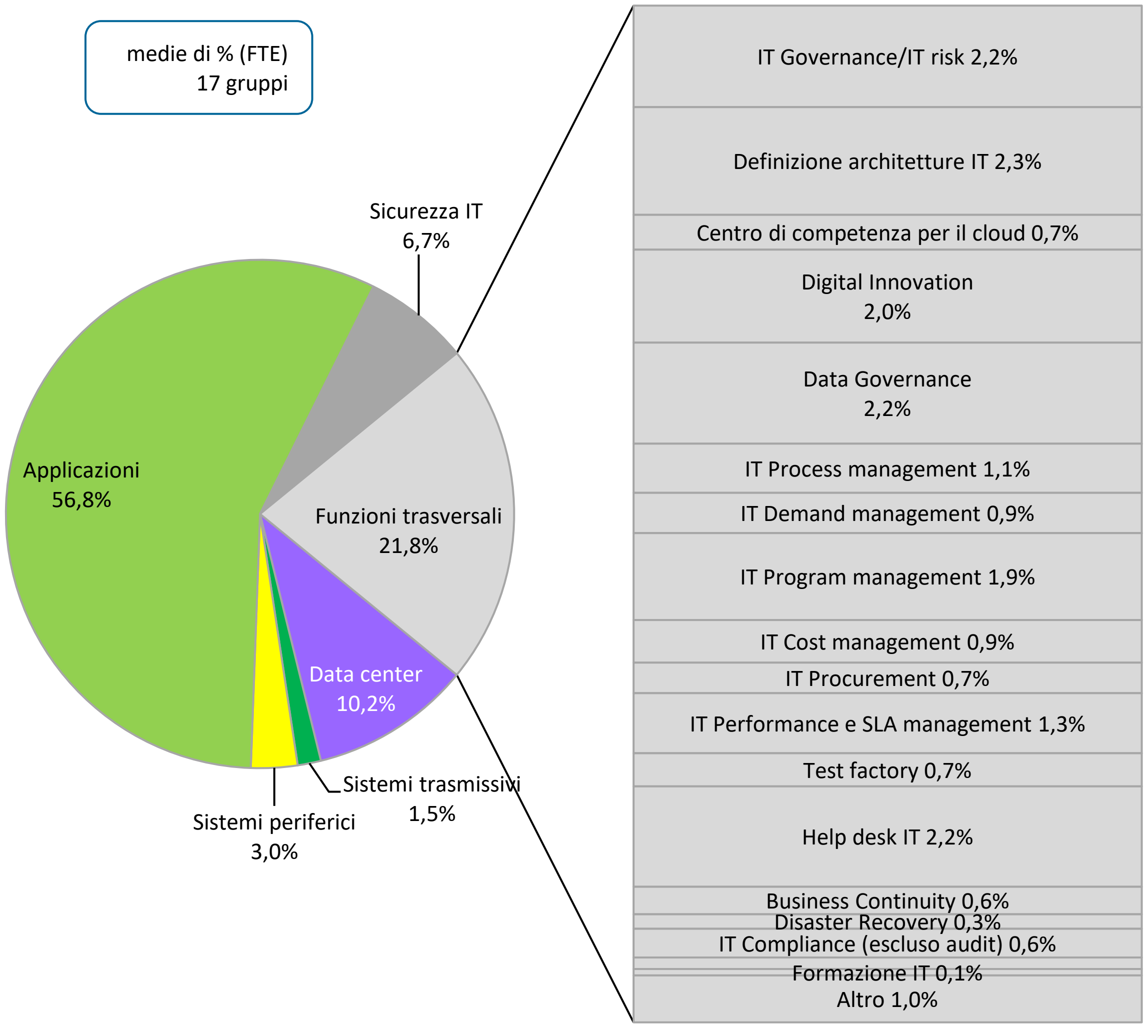
quote % 23 gruppi	<= 29 anni		30-39 anni		40-49 anni		50-59 anni		>= 60 anni	
	Uomini	Donne	Uomini	Donne	Uomini	Donne	Uomini	Donne	Uomini	Donne
Aree professionali	6,1	3,2	9,9	6,3	6,5	3,2	5,3	2,3	0,9	0,2
Quadri-direttivi	0,4	0,2	6,6	2,9	11,9	3,9	17,1	5,6	5,1	0,8
Dirigenti	0,0	0,0	0,1	0,0	0,3	0,1	0,6	0,1	0,2	0,0

La Tabella 15 riportata in Appendice mostra un'analoga ripartizione, espressa in medie di percentuali calcolate sui 16 gruppi aventi almeno 50 dipendenti IT.

2.8.2 Allocazione degli FTE

La Figura 85 esprime l'allocazione del personale IT all'interno delle aree tematiche, arricchite con un'ulteriore categoria che raccoglie il personale assegnato alle funzioni trasversali IT. In questa analisi, svolta in medie di percentuali per i gruppi con almeno 50 dipendenti IT, la quantificazione del personale è determinata in termini di FTE (full time equivalent) anziché di numero di dipendenti, per consentire la corretta differenziazione di ruoli anche al personale che svolge attività in più ambiti. Il 56,8% delle risorse IT è allocato nell'area delle Applicazioni, seguono il Data center (10,2%), la Sicurezza IT (6,7%) e quote residuali per i sistemi periferici e trasmissivi. Alle funzioni trasversali è dedicato più di un quinto degli FTE, dove prevalgono la definizione delle architetture informatiche, l'IT governance/IT risk, la data governance, l'help desk informatico e la digital innovation. La maggiore o minore presenza di personale IT nelle funzioni trasversali dipende dall'assetto deciso dal gruppo bancario riguardo la collocazione organizzativa di queste ultime, che possono trovarsi nel settore IT, fuori dal settore IT, oppure distribuite tra settore IT e non IT, o esternalizzate.

Figura 85 - FTE del personale IT nelle aree tematiche



In Appendice è rappresentata l'analoga ripartizione degli FTE per classe dimensionale (Figura 142), sulla base del modello di sourcing (Figura 143) e per i gruppi aventi meno di 50 dipendenti IT (Figura 144).

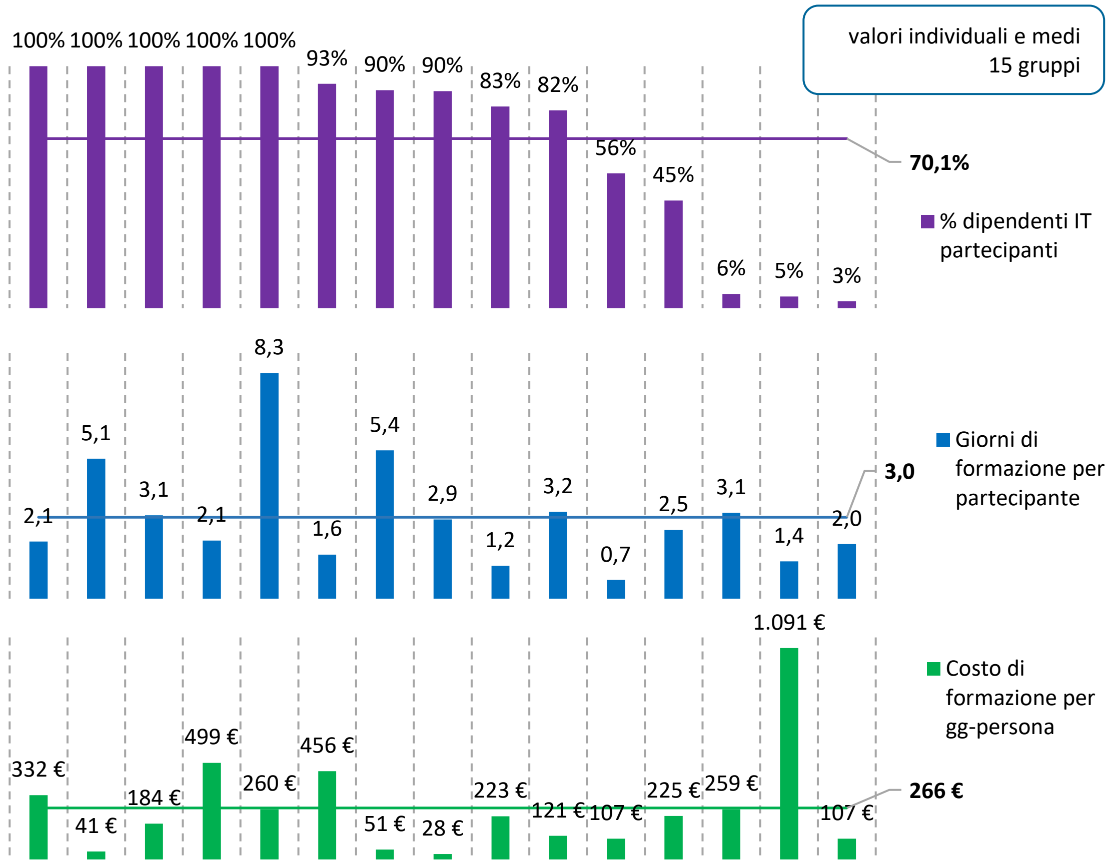
2.8.3 Competenze tecniche e formazione

Viene qui affrontato il tema della formazione tecnica del personale IT dal punto di vista dell'offerta formativa a pagamento (costi sostenuti dal gruppo bancario a beneficio del proprio personale) in termini di dipendenti partecipanti, durata e costi delle iniziative formative. L'analisi si sofferma infine sulla più generale questione delle competenze tecniche e del reperimento degli skill.

La Figura 86 mostra i dati forniti dai gruppi bancari con almeno 30 dipendenti IT nel 2024 e non tiene conto delle iniziative di formazione gratuite. Dalle voci di costo per la formazione sono esclusi i costi accessori, quali quelli di trasferta, del personale interno e della logistica. Nel grafico sono riportati i posizionamenti individuali e le medie di alcuni indicatori, sovrapposti verticalmente per agevolarne la lettura, in cui ciascuna linea verticale rappresenta un gruppo.

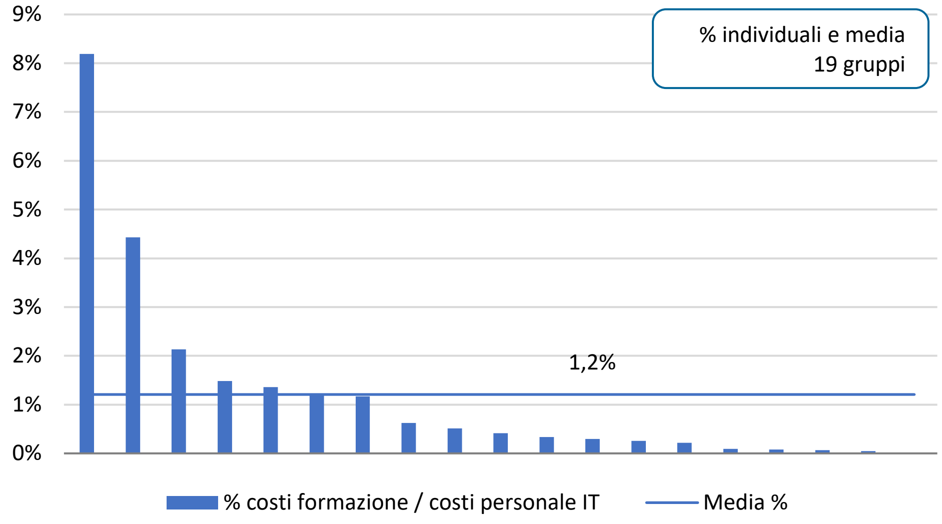
Mediando i valori dichiarati dai 15 gruppi che, tra quelli che soddisfano il criterio sopra descritto hanno fornito i relativi dati, si osserva che nel 2024 il 70,1% dei dipendenti IT ha partecipato a iniziative di formazione tecnica a pagamento, ogni partecipante ha seguito in media 3 giorni di formazione, aventi un costo medio di 266 euro per giorno-persona.

Figura 86 - Formazione IT: partecipanti, durata e costi



Il rapporto tra i costi di formazione e i costi totali del personale IT presenta, per i 19 gruppi che hanno fornito il dato, un'escursione fino all'8,2%, con un valor medio dell'1,2% (Figura 87).

Figura 87 - Formazione IT: costi di formazione / costi del personale IT



In Appendice sono riportate le percentuali medie per classe dimensionale e modello di sourcing (Figura 145).

La Figura 88 e la Figura 89 prendono in esame una serie di ambiti/profili IT, mostrando il livello di competenza associato, per il 2024 (as is) e per il biennio 2025-2026 (to be). Tale livello è la media di quelli determinati soggettivamente da ciascun gruppo bancario, su una scala che va da un minimo di zero (nullo) a un massimo di cinque[30]. Nelle barre, per ciascun livello è riportato il numero di gruppi che lo hanno indicato. Osservando i grafici per macro ambiti, si nota che nel 2024 ai profili informatici più tradizionali (governance, progettazione e sviluppo, gestione/erogazione servizi) sono associati livelli medio-alti, con valori compresi tra 2,9 (IT quality assurance) e 3,9 (IT governance). Di contro, tra i nuovi ambiti tecnologici si registrano livelli decisamente più bassi, eccetto che per la sostenibilità e green IT (2,9) e AI & data science (3,1). Per il biennio 2025-2026 sono presenti livelli medi più alti rispetto al 2024, a conferma dell'esigenza di rafforzare le competenze in tutti gli ambiti/profili IT. Il maggior gap emerge per AI & data science (Δ = 1,0), cloud management (Δ = 0,7), IT governance e security governance (Δ = 0,6).

[30] La media è calcolata solo sui livelli espressamente indicati dai gruppi.

Figura 88 - Competenze IT: livelli as is (2024) per ambiti e profili IT

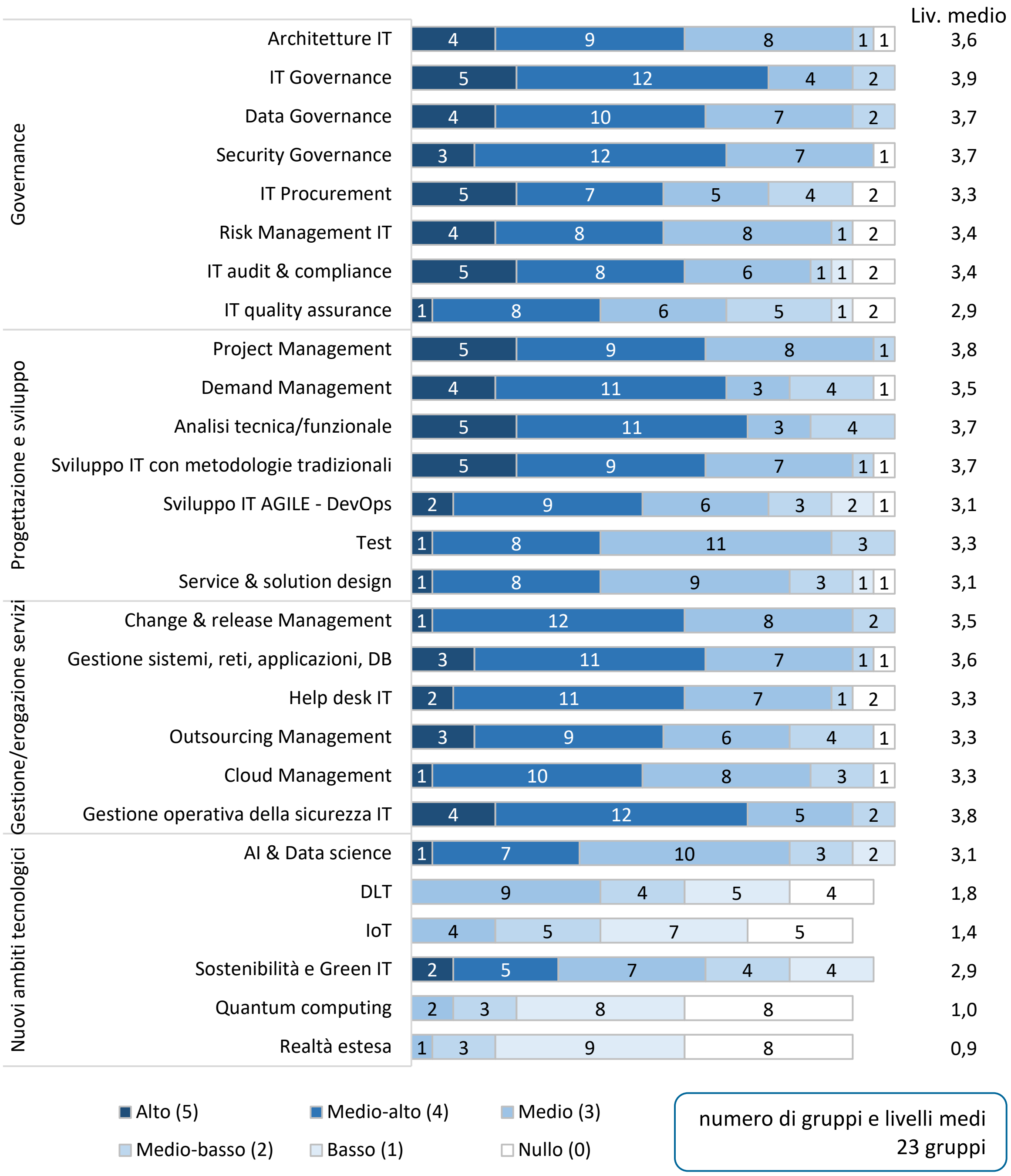
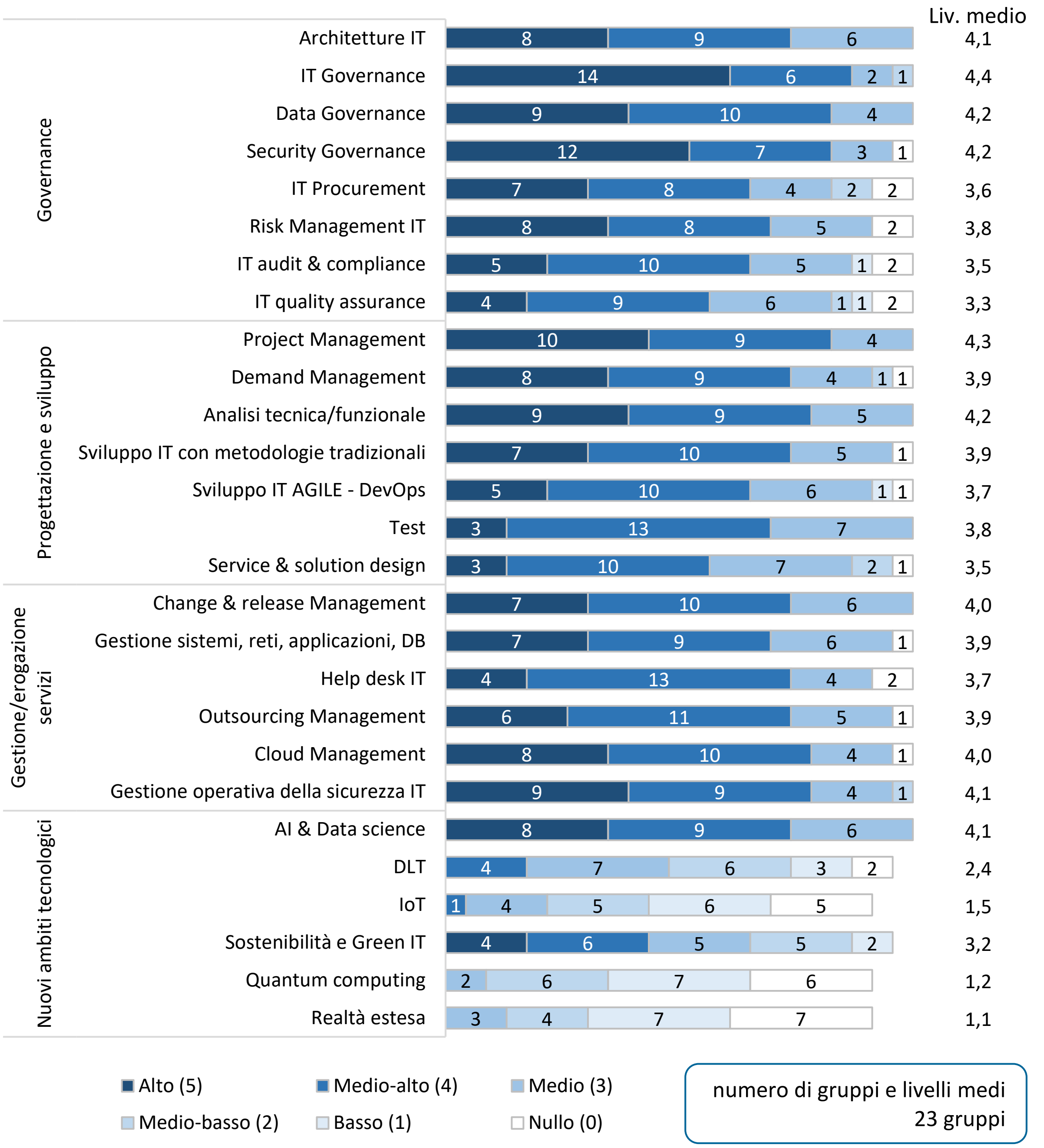


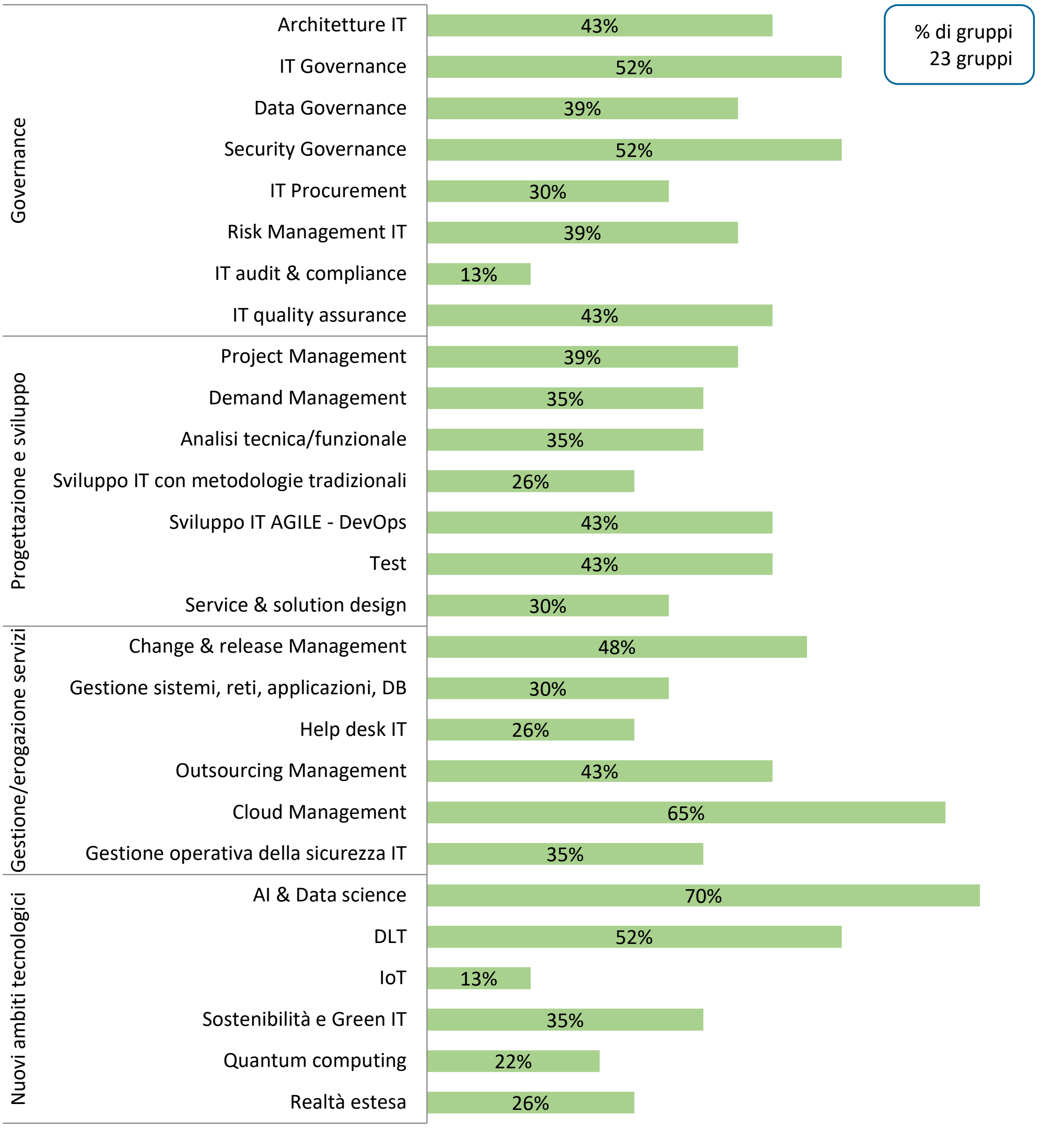
Figura 89 - Competenze IT: livelli to be (2025-2026) per ambiti e profili IT



La Figura 90 fornisce, per tutti gli ambiti, una gap analysis sulla percezione della necessità di competenze nel passaggio dalla situazione attuale a quella prospettica, indicando la percentuale di gruppi bancari che prevedono di incrementare, nel biennio 2025-2026, le proprie competenze rispetto all'esercizio in esame.

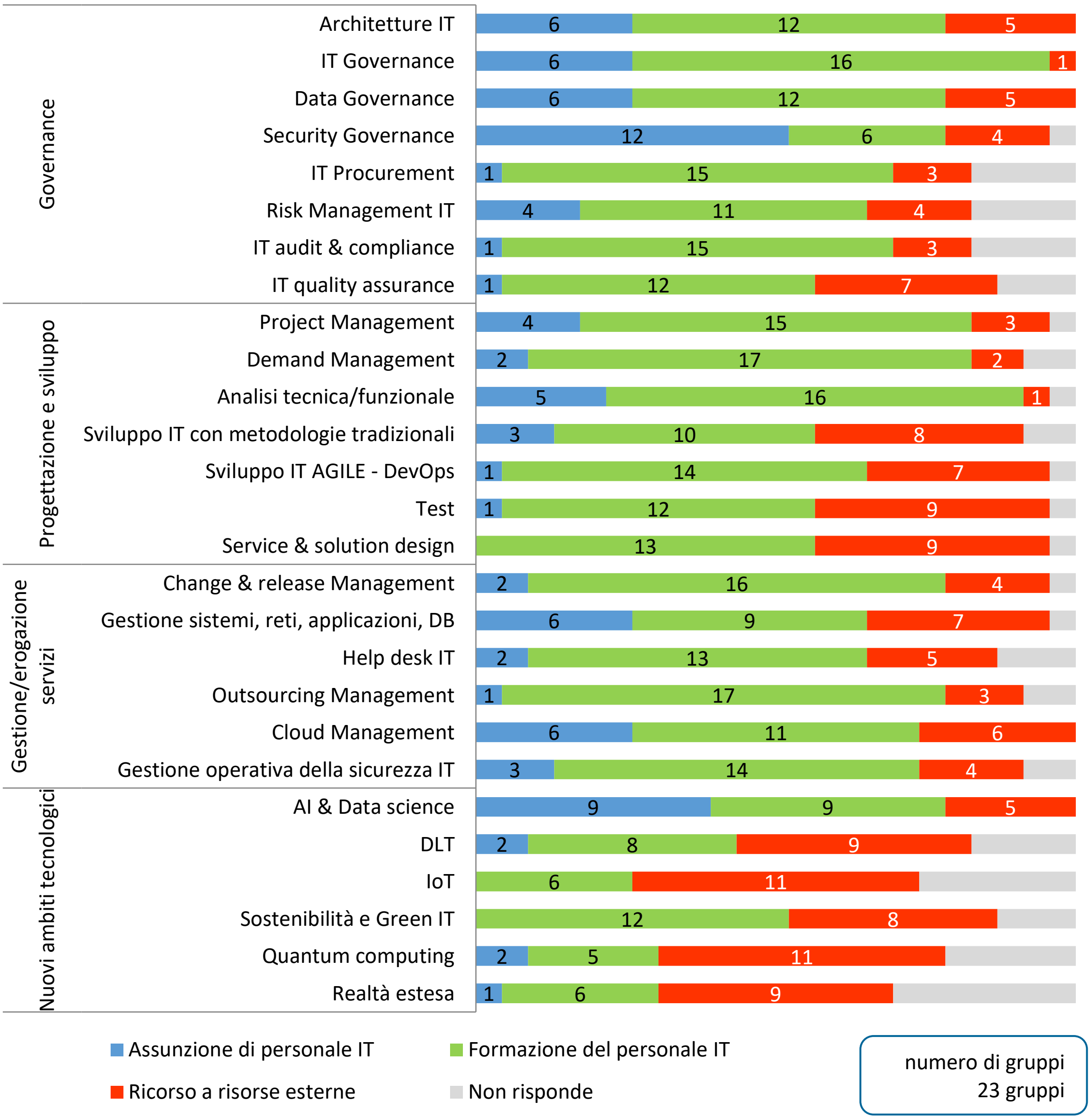
Almeno la metà del campione segnala la necessità di incrementare le competenze su AI & data science, cloud management, IT governance, security governance e DLT.

Figura 90 - Competenze IT: gap analysis as is - to be



In merito alle modalità di reperimento delle competenze nei diversi ambiti, si conferma anche nel 2024 una maggiore propensione dei gruppi a formare il proprio personale IT piuttosto che ad assumere o ricorrere a risorse esterne. L'assunzione di personale è più frequente negli ambiti della security governance e AI & data science, mentre il ricorso a risorse esterne si registra soprattutto nell'IoT e nel quantum computing (Figura 91).

Figura 91 - Competenze IT: modalità di reperimento



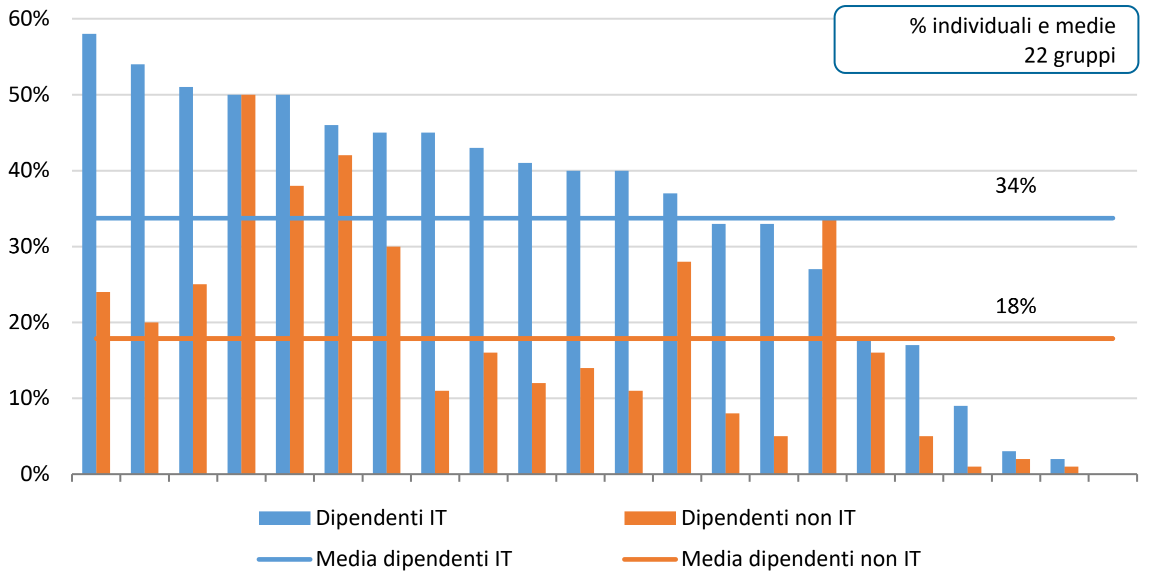
2.9 Lavoro da remoto

Il modello di lavoro prevede, anche nelle realtà bancarie, la possibilità, per tutti o per una parte dei dipendenti a seconda dell'attività di pertinenza, l'alternanza del lavoro da remoto rispetto alla consueta modalità in presenza, con formule e approcci anche molto differenti da gruppo a gruppo. La modalità di lavoro mista, da remoto e in presenza, risulta in vigore al 2024 per 21 gruppi bancari su 22 rispondenti.

La Figura 92 quantifica l'entità del ricorso alla modalità remota da parte dei dipendenti rappresentando, per ciascun gruppo, la percentuale delle giornate lavorate a distanza rispetto a quelle complessivamente lavorate nel 2024. L'analisi è condotta distintamente per i dipendenti che svolgono funzioni IT (barre blu) e per i restanti dipendenti del gruppo (barre arancioni), sempre con riferimento al perimetro CIPA. Come sopra anticipato, ad eccezione di un rispondente, 21 segnalano il ricorso al lavoro da remoto sia per i dipendenti IT che non IT, pur con percentuali molto variabili.

La percentuale delle giornate lavorate da remoto è in genere superiore per il personale informatico rispetto a quella degli altri dipendenti. Tra i 22 gruppi, in media il personale IT ha lavorato da remoto il 34% delle giornate, mentre per gli altri dipendenti il valor medio scende al 18%.

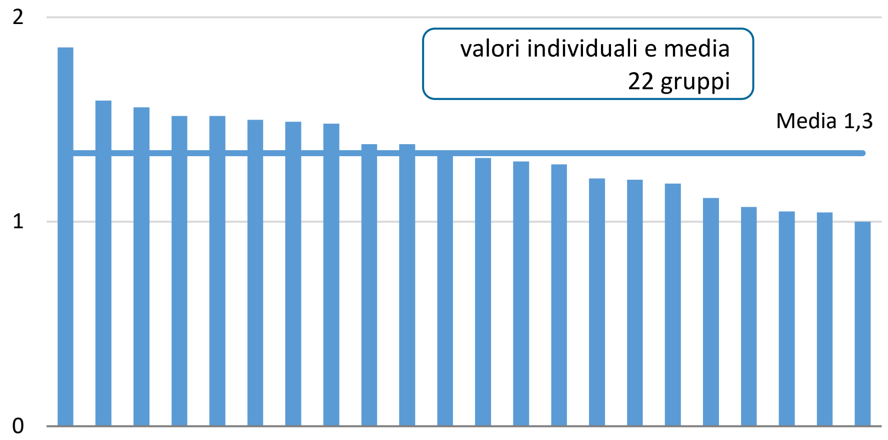
Figura 92 - Giornate lavorate da remoto nel 2024



2.10 Postazioni di lavoro (PDL)

Con riferimento alle postazioni di lavoro messe a disposizione del personale (IT e non IT) per le attività "standard"[31], la Figura 93 riporta, per ogni gruppo, il numero medio di PDL disponibili per singolo dipendente, ottenuto rapportando il totale delle postazioni (proprietà + locazione) al totale dei dipendenti del gruppo. Questo rapporto è sempre maggiore o uguale a uno e, in media, pari a 1,3 PDL ciascuno.

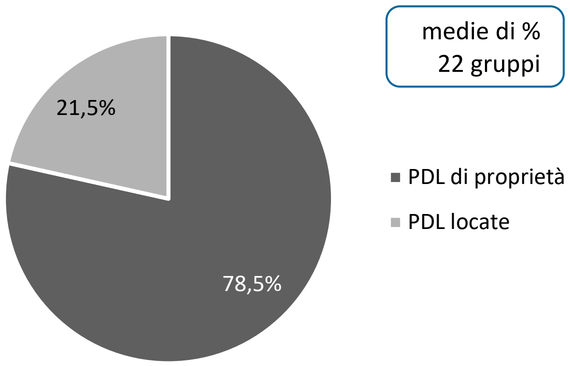
Figura 93 - Numero di postazioni di lavoro standard per dipendente



[31] In questa Rilevazione la postazione di lavoro (o posto di lavoro) ha un'accezione informatica, riferita all'insieme di dotazioni tecnologiche atte a svolgere l'attività lavorativa. Sono escluse da questa analisi quelle appositamente equipaggiate per lo svolgimento di particolari attività (es: finanza, trattamento del contante).

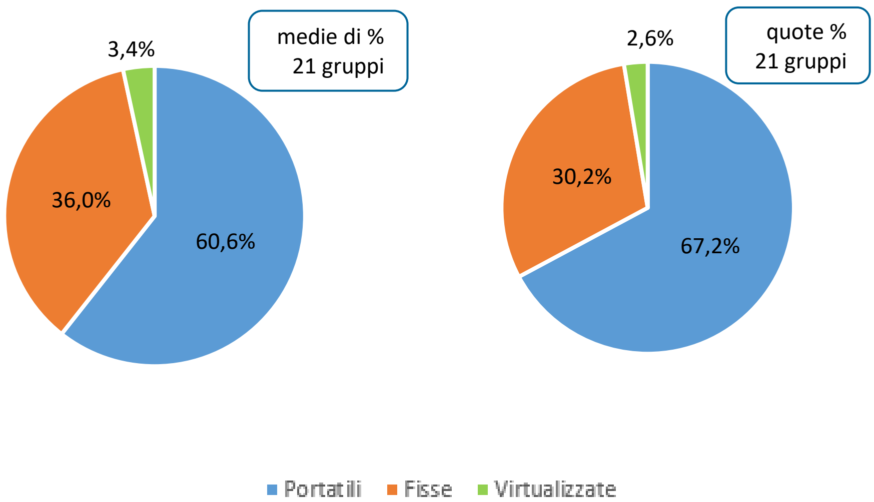
L'indagine distingue la quota delle postazioni di proprietà rispetto a quelle prese in locazione. Emerge che, in medie di percentuali, il 78,5% delle postazioni è di proprietà del gruppo bancario (Figura 94).

Figura 94 - Postazioni di lavoro standard: proprietà vs locazione



La Figura 95 fornisce una ripartizione delle PDL per tipologia (portatili, fisse e virtualizzate[32]) attraverso due grafici relativi allo stesso campione di 21 gruppi rispondenti, realizzati in medie di percentuali e in quote percentuali. Dal grafico di destra risulta che, posto a 100 il numero complessivo delle PDL dei 21 gruppi, 67,2 sono portatili, 30,2 fisse e 2,6 virtualizzate. Ragionando in medie di percentuali invece, in cui ogni gruppo è equiparato agli altri e concorre in egual misura al calcolo del valor medio a prescindere dal numero assoluto di PDL possedute, risulta che il 60,6% sono portatili, il 36% fisse e il 3,4% virtualizzate.

Figura 95 - Tipologie di postazioni di lavoro standard

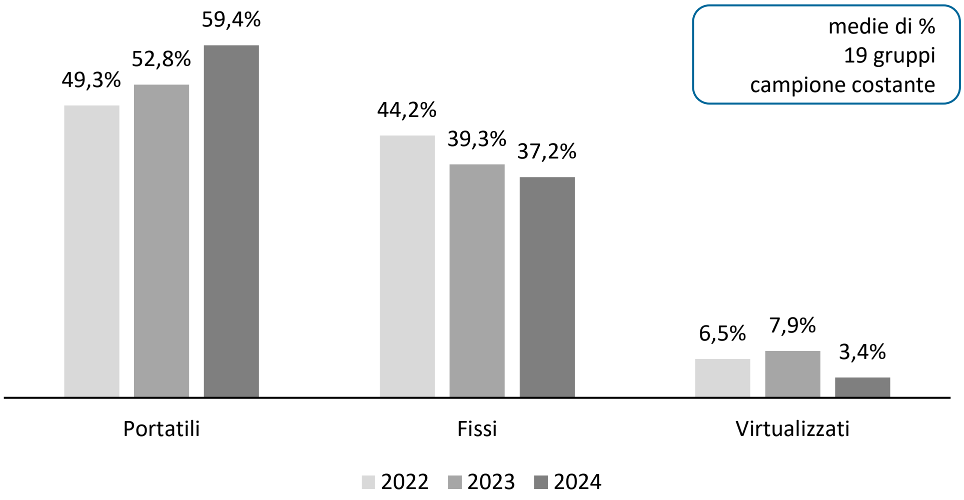


Analizzando in medie di percentuali la tipologia delle postazioni di lavoro standard su un campione costante di 19 gruppi nel periodo 2022-2024, appare chiara la prosecuzione del rapido e costante

[32] Desktop virtualization.

incremento delle postazioni portatili, che dal 2023 sono più della metà del totale. Nel 2024 si nota un'importante diminuzione delle postazioni virtualizzate (Figura 96).

Figura 96 - Tipologie di postazioni di lavoro standard: andamento 2022-2024



Capitolo 3. **Banche**

3.1 Profili economici

Il campione delle 32 banche partecipanti alla Rilevazione - di cui due non appartenenti a gruppi o appartenenti a gruppi diversi da quelli qui esaminati - rappresenta il 62,8% dell'intero settore bancario in termini di fondi intermediati.

Le grandezze economiche IT complessivamente segnalate per l'esercizio 2024 dalle 32 banche partecipanti alla Rilevazione sono[33]:

- ✓ **TCO** (spese correnti più ammortamenti): 5.606 milioni di euro;
- ✓ **Cash out** (spese correnti più investimenti): 5.766 milioni di euro;
- ✓ **Spese correnti**: 3.989 milioni di euro;
- ✓ **Investimenti**: 1.776 milioni di euro;
- ✓ **Ammortamenti**: 1.617 milioni di euro.

Come per i gruppi bancari, anche per le banche si utilizza il modello di analisi dei costi per aree tematiche e per fattori produttivi.

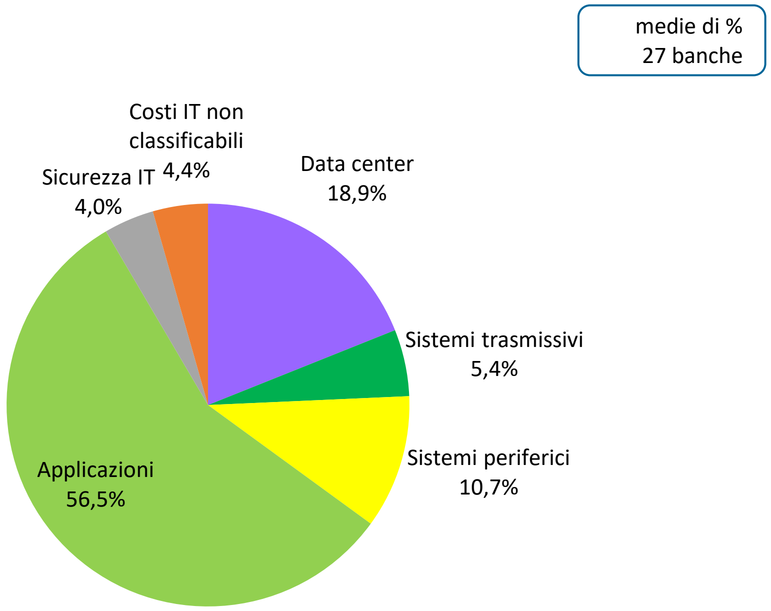
Delle 32 banche, 27 hanno effettuato una ripartizione del TCO per aree tematiche sufficientemente dettagliata da garantire una significativa rappresentazione dei fenomeni. Continua l'impegno da parte delle banche per giungere a una imputazione quanto più possibile granulare dei costi IT alle singole aree, resa talvolta difficoltosa a causa della presenza di forme di outsourcing che non garantiscono una visibilità di tali costi a questo livello di dettaglio.

In Appendice, da Tabella 24 a Tabella 30, è riportata la suddivisione di dettaglio dei costi IT tra aree tematiche e fattori produttivi in analogia con quanto prodotto per i gruppi bancari. Tutti i valori sono espressi in medie di percentuali con riferimento all'intero campione e alle varie classi di analisi, in relazione alla dimensione e alle caratteristiche operative. Per una significativa rappresentazione dei dati vengono presentate solo le tabelle relative a classi con campione sufficientemente ampio e dai conteggi sono escluse cinque banche che hanno attribuito alla voce "Costi IT non classificabili" più del 30% dei costi IT complessivi.

Mediamente il 56,5% del TCO viene assorbito dalle Applicazioni e il 18,9% dal Data center; seguono Sistemi periferici (10,7%) e Sistemi trasmissivi (5,4%). I costi per la Sicurezza IT si attestano al 4%, valore da ritenersi sottostimato a causa della difficoltà nell'isolare puntualmente tali costi (Figura 97).

[33] Nelle analisi dei gruppi i costi sono rilevati con il metodo del consolidamento integrale. L'ammontare dei costi IT di un gruppo è pertanto diverso da quello risultante dalla somma dei costi indicati singolarmente dalle diverse banche appartenenti al gruppo stesso.

Figura 97 - TCO delle banche per aree tematiche



La ripartizione del cash out IT per aree tematiche risulta ampiamente sovrapponibile a quella del TCO.

In Figura 98 e Figura 99 sono mostrate rispettivamente le ripartizioni di TCO e cash out per aree tematiche riferite alle banche, suddivise per classi dimensionali. Al crescere della dimensione, le banche indicano via via percentuali mediamente più alte sul Data center e sulla Sicurezza IT.

Figura 98 - TCO delle banche per aree tematiche e classi dimensionali

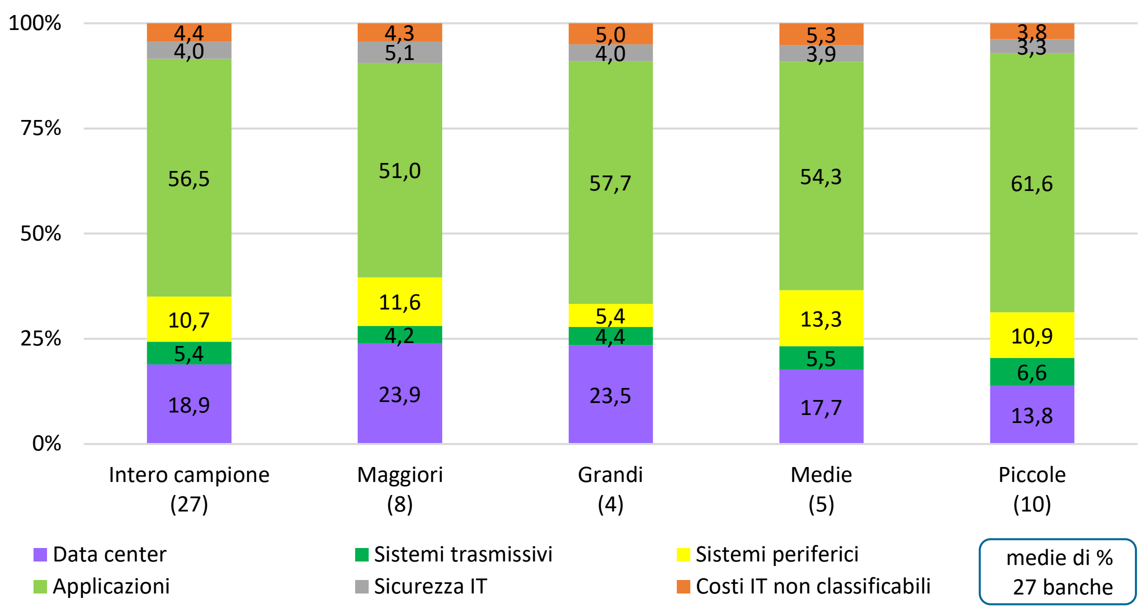
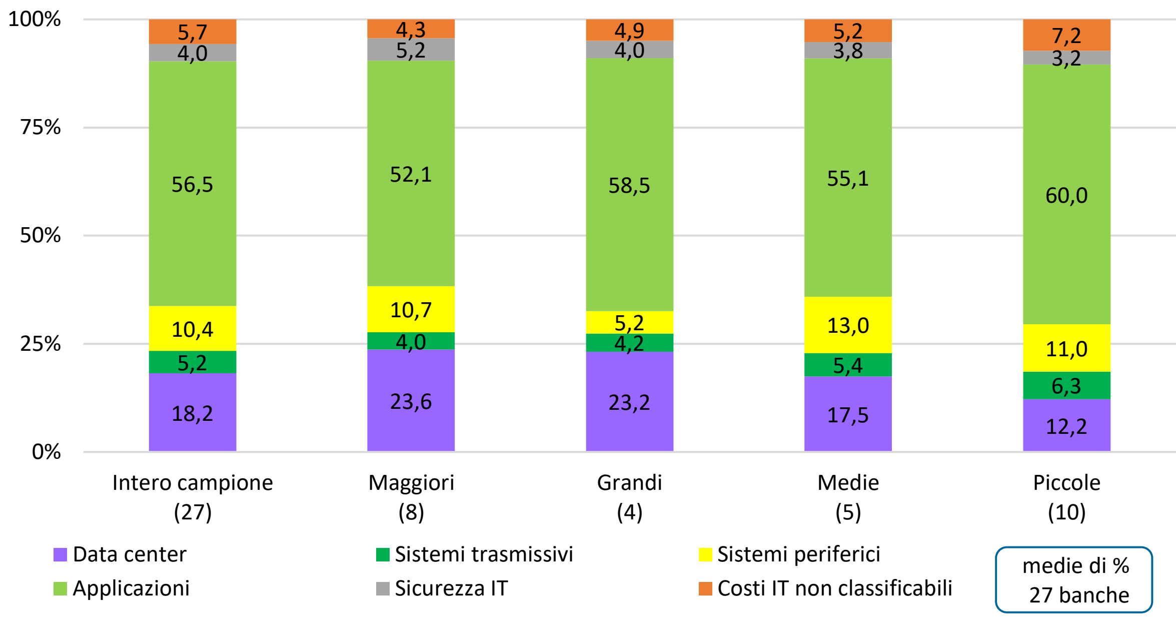
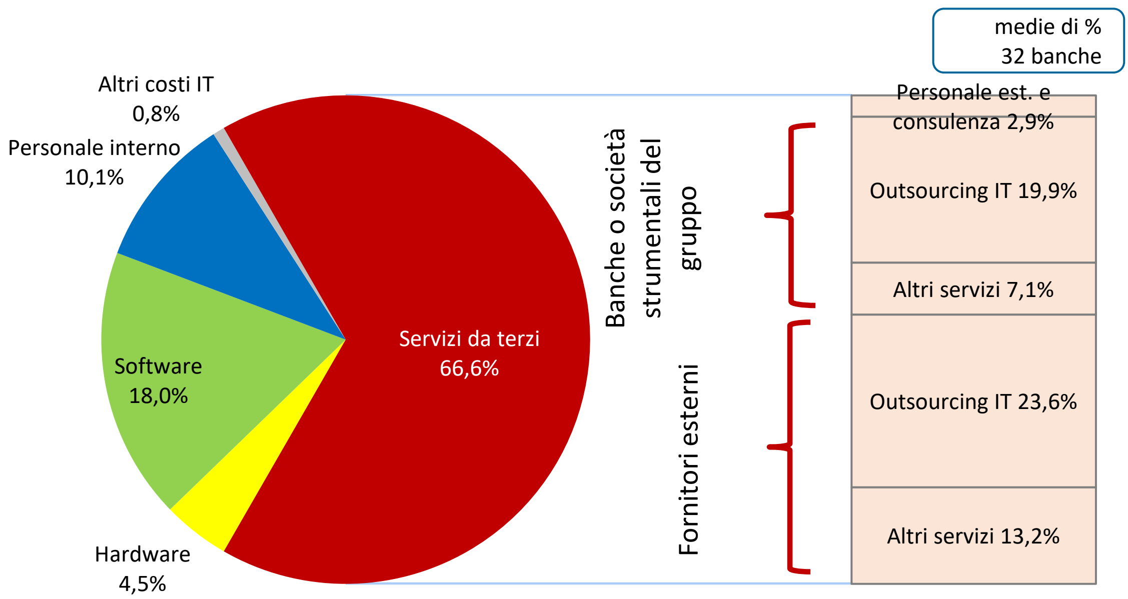


Figura 99 - Cash out IT delle banche per aree tematiche e classi dimensionali



Nella ripartizione del TCO per fattori produttivi la quota preponderante è destinata a Servizi da terzi (66,6%) erogati da: i) personale esterno alla banca o consulenze; ii) altre banche o società strumentali del gruppo bancario di appartenenza e interne al perimetro CIPA; iii) fornitori esterni[34]. Tra i costi sostenuti direttamente dalla banca, mediamente il 18% è attribuito al Software, il 10,1% al Personale interno e il 4,5% all'Hardware (Figura 100).

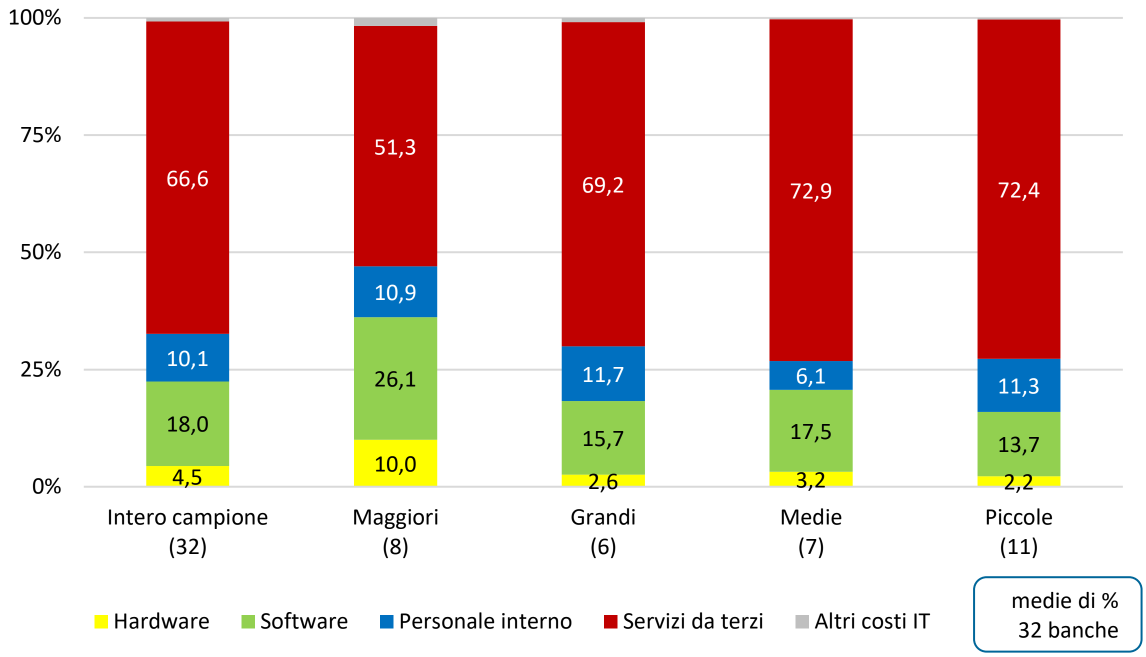
Figura 100 - TCO delle banche per fattori produttivi



[34] Per fornitore esterno (al perimetro CIPA) si intende: IT vendor, consorzio di banche, altra banca o componente del gruppo esterna al perimetro, altro gruppo bancario.

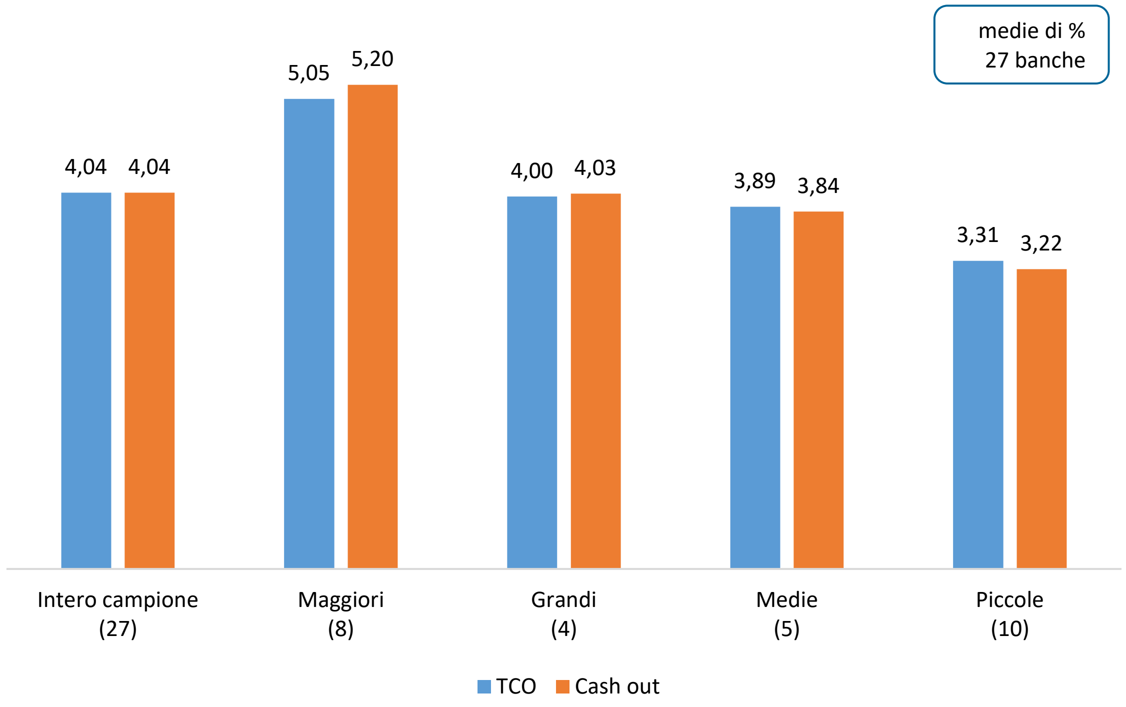
La Figura 101 rappresenta la ripartizione del TCO per fattori produttivi, differenziata per classe dimensionale.

Figura 101 - TCO delle banche per fattori produttivi e classi dimensionali



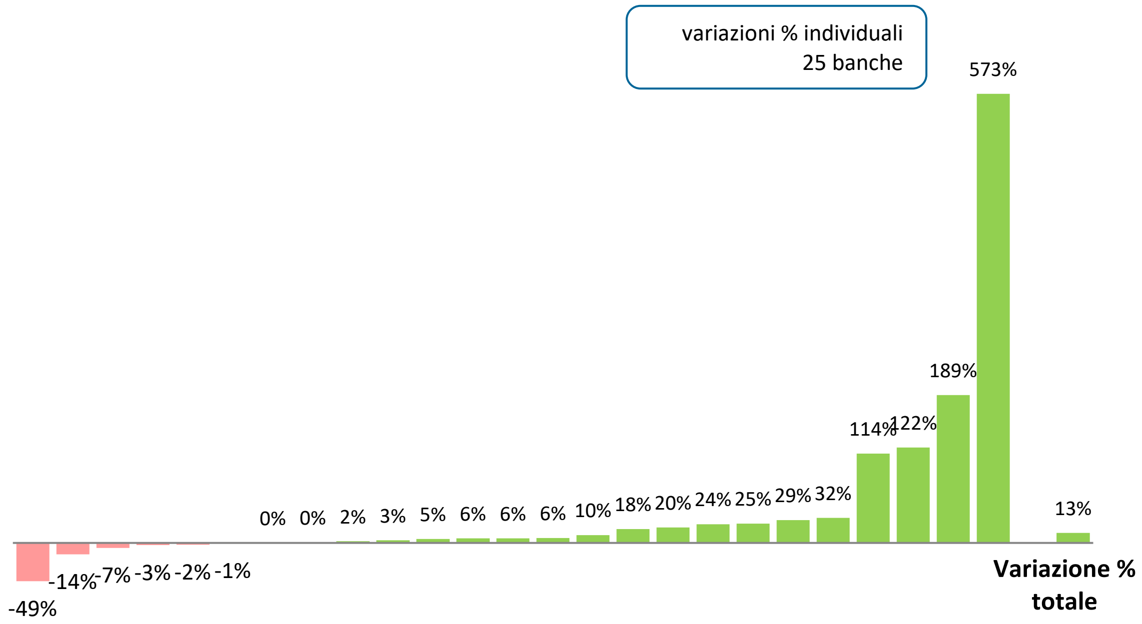
La Figura 102 mostra un focus sulla Sicurezza IT, rappresentando le medie di percentuali del TCO e del cash out per le classi che includono un significativo numero di banche. Dal punto di vista dimensionale si evince che, al crescere della dimensione, le banche indicano via via percentuali mediamente più alte.

Figura 102 - TCO e cash out delle banche per la Sicurezza IT



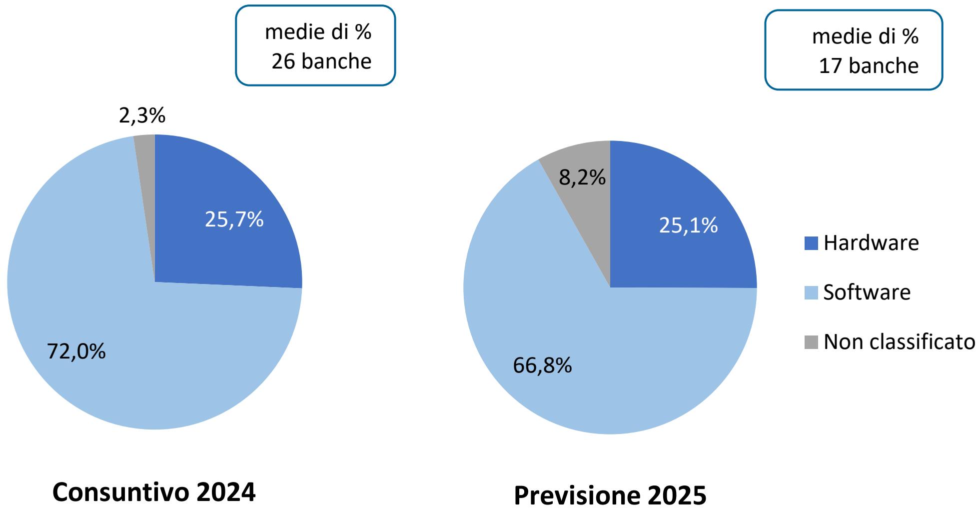
Il grafico di Figura 103 mostra la variazione percentuale individuale tra gli investimenti previsti per il 2025 rispetto a quelli attuati nel 2024, per le 25 banche che hanno fornito entrambi i dati. La maggioranza sono percentuali positive, che denotano incrementi, in alcuni casi anche molto consistenti. Nel complesso, l'importo nominale degli investimenti informatici previsti per il 2025 cresce del 13% rispetto all'esercizio 2024.

Figura 103 - Investimenti IT delle banche: variazione della previsione 2025 rispetto al consuntivo 2024



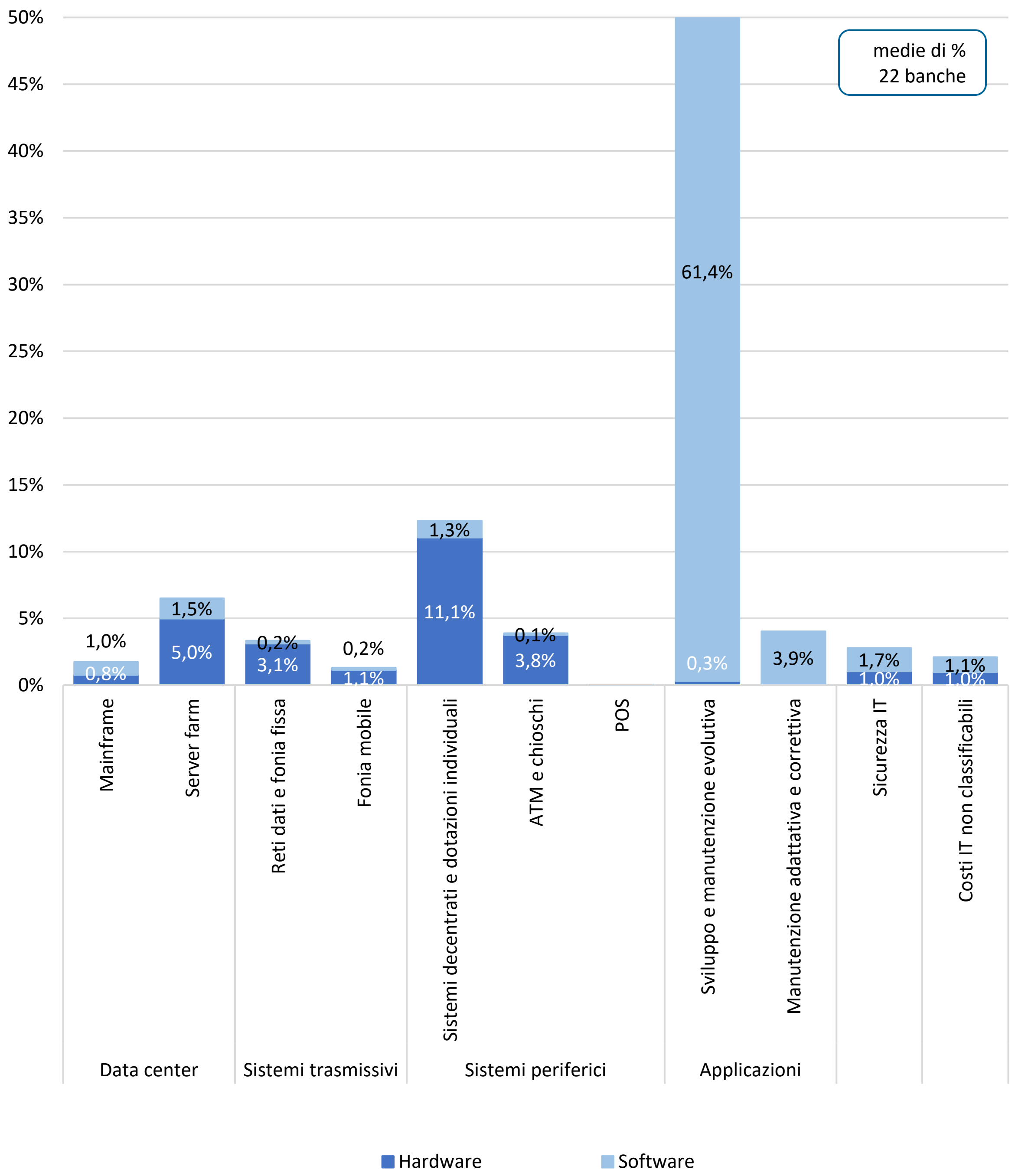
Analizzando la suddivisione tra Hardware e Software degli investimenti IT delle banche emerge che, sia a consuntivo che in previsione, più dei due terzi sono destinati al Software (Figura 104).

Figura 104 - Investimenti IT delle banche in HW e SW



Nella Figura 105 gli investimenti del 2024 in Hardware e Software sono a loro volta suddivisi per aree tematiche.

Figura 105 - Investimenti IT delle banche in HW e SW per aree tematiche



3.1.1 Indicatori economici

Sono di seguito riportati alcuni indicatori calcolati rapportando tra loro le principali grandezze di conto economico e operative delle 32 banche partecipanti alla Rilevazione, ripartite per classi in relazione alle dimensioni (Tabella 14).

Per le voci “costi IT”[35], “cash out IT”, “investimenti IT”[36], “ammortamenti IT”[37], “numero dipendenti totali” e “numero dipendenti al netto IT” (il numero di dipendenti è calcolato come media di valori mensili) sono utilizzati i valori segnalati dalle singole banche nel questionario. Le voci “fondi intermediati”[38], “numero di sportelli”[39], “numero dei rapporti di impieghi e depositi”[40], “prodotto bancario lordo”[41], “margine di gestione”[42], “costi di struttura”[42] e “risultato di gestione”[42] sono ricavate dalle segnalazioni di matrice dei conti individuale effettuate dalle banche.

Dagli indicatori calcolati a partire dal risultato di gestione vengono eliminati i valori delle banche con risultato di gestione negativo. In generale, dal calcolo degli indicatori vengono eliminati i valori outlier.

Rispetto alle edizioni precedenti, da quest’anno la classe “Particolare Operatività”, dove confluivano banche con strutture organizzative e operative molto diversificate, non è più presente e le relative banche sono state riclassificate sulla base del parametro dimensionale.

Gli indicatori di costo riportati nella tabella, necessariamente dipendenti dalla composizione del campione esaminato e dalla metodologia di calcolo utilizzata, hanno un valore statistico e non rappresentano una valutazione di merito sulle scelte e sui modelli organizzativi adottati dalle banche per la gestione dell’IT.

[35] TCO al netto dei ricavi IT posti a rettifica.

[36] Include investimenti in hardware e software.

[37] Quota degli ammortamenti a valere sul TCO.

[38] Media dei valori mensili di 13 mesi (esercizio di riferimento più il mese di dicembre dell’esercizio precedente).

[39] Media dei valori trimestrali dell’anno tratti dagli archivi della Banca d’Italia.

[40] Aggregato costituito dalla somma delle voci “impieghi: numero dei rapporti” e “depositi: numero dei rapporti”.

[41] Aggregato costituito dalla somma delle voci “raccolta diretta”, “raccolta indiretta” e “impieghi totali”.

[42] Fa riferimento alle nuove regole di segnalazione EBA (cfr. Circolare 272 della Banca d’Italia e Regolamento BCE n. 1534/2017).

Tabella 14 - Indicatori: 32 banche (intero campione)

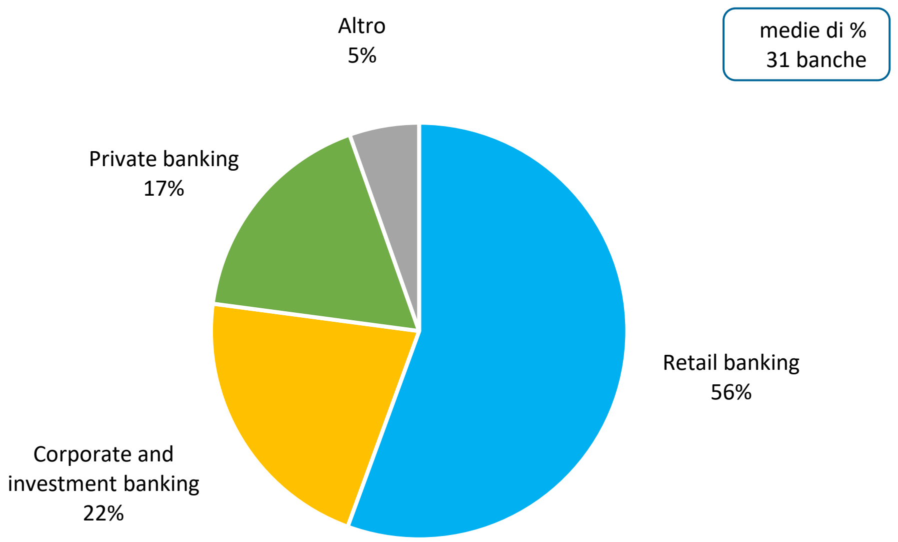
	Medie 2024					Coefficienti di variazione 2024					Mediane 2024				
Indicatori di costo IT*	Maggiori (8)	Grandi (6)	Medie (7)	Piccole A (5)	Piccole B (6)	Maggiori (8)	Grandi (6)	Medie (7)	Piccole A (5)	Piccole B (6)	Maggiori (8)	Grandi (6)	Medie (7)	Piccole A (5)	Piccole B (6)
Costi IT/Fondi intermediati (per mille)	2,35	3,11	3,29	2,68	5,80	0,39	0,39	0,44	0,33	0,79	2,04	2,72	2,90	2,35	4,57
Costi IT/Margine di gestione (%)	8,54	12,54	9,47	10,56	10,89	0,36	0,45	0,72	0,48	0,37	7,63	13,04	7,81	8,36	11,81
Costi IT/Risultato di gestione (%)	18,11	17,23	24,24	22,94	40,70	0,31	0,65	0,73	0,58	0,50	16,31	15,13	20,53	26,21	42,57
Costi IT/Costi di struttura (%)	19,23	23,28	16,14	19,98	22,68	0,43	0,16	0,41	0,51	0,60	15,93	24,31	16,33	15,74	19,54
Costi IT/Numero sportelli (migliaia di €)	381,93	557,80	199,47	264,38	-	0,44	0,52	0,33	0,59	-	328,41	527,08	180,43	193,36	-
Costi IT/Numero dipendenti al netto IT (migliaia di €)	33,82	50,56	41,42	43,52	56,11	0,66	0,33	0,76	0,89	0,77	25,22	50,97	25,94	26,39	26,83
Costi IT/Numero dipendenti totali (migliaia di €)	32,61	47,20	39,42	34,94	51,51	0,68	0,30	0,72	0,66	0,75	24,56	47,91	25,09	23,39	26,53
Costi IT/Numero rapporti di impieghi e depositi (decine di €)	9,79	8,36	9,70	8,64	20,56	0,64	0,36	0,43	0,43	1,19	7,79	7,50	8,79	7,73	6,24
Costi IT/Prodotto bancario lordo (per mille)	1,49	1,61	1,20	1,49	2,57	0,58	0,49	0,48	0,76	0,86	1,23	1,27	1,13	1,18	1,97
Investimenti IT/Ammortamenti IT	0,95	1,07	1,26	2,18	25,61	0,39	0,41	0,22	0,60	1,12	1,01	1,21	1,27	1,83	19,34
Investimenti IT/Fondi intermediati (per mille)	0,93	0,61	0,60	1,38	0,47	0,65	0,58	0,92	1,33	0,42	0,83	0,51	0,42	0,76	0,57
Investimenti IT/Costi di struttura (%)	5,31	4,01	2,58	13,01	3,33	0,66	0,81	0,74	1,31	0,63	5,23	4,15	2,17	7,63	3,94
Cashout IT/Margine di gestione (%)	8,78	12,95	9,69	13,54	11,13	0,35	0,42	0,71	0,68	0,32	8,20	13,52	7,86	8,36	11,39
Cashout IT/Numero dipendenti al netto IT (migliaia di €)	34,53	53,22	42,29	57,28	55,90	0,63	0,34	0,74	1,06	0,70	28,76	50,24	26,08	25,08	35,09
Cashout IT/Numero dipendenti (migliaia di €)	33,28	49,68	40,26	45,08	51,77	0,65	0,31	0,71	0,85	0,70	27,57	47,21	25,23	22,49	34,69
Altri indicatori	**Medie 2024**					**Coefficienti di variazione 2024**					**Mediane 2024**				
Margine di gestione/Fondi intermediati (%)	2,87	2,86	4,29	2,91	5,45	0,30	0,41	0,42	0,39	0,64	2,91	2,80	3,44	2,81	3,74
Risultato di gestione/Fondi intermediati (%)	1,14	1,60	1,78	1,40	1,61	0,36	0,84	0,85	0,64	0,71	1,13	1,16	1,46	0,90	1,00
Costi di struttura/Fondi intermediati (%)	1,36	1,32	2,06	1,47	3,21	0,38	0,31	0,20	0,35	0,82	1,42	1,25	1,95	1,49	1,94
Costi di struttura/Margine di gestione (%)	46,16	52,37	53,84	53,43	53,79	0,21	0,39	0,35	0,25	0,27	49,25	57,38	56,61	53,11	56,56
Costi di struttura/Numero di sportelli (centinaia di migliaia di €)	22,31	27,12	25,43	19,39	-	0,29	0,66	0,88	0,64	-	19,62	22,87	14,88	14,73	-
Fondi intermediati/Numero dipendenti al netto IT (milioni di €)	10,78	17,60	12,11	15,11	22,29	0,30	0,44	0,45	0,55	1,22	10,88	16,20	9,94	13,03	11,31
Fondi intermediati/Numero dipendenti totali (milioni di €)	10,27	16,55	11,63	12,71	21,30	0,29	0,45	0,42	0,41	1,28	10,44	15,13	9,61	11,54	11,22
Fondi intermediati/Numero sportelli (milioni di €)	156,18	209,90	116,07	116,59	-	0,43	0,82	0,79	0,76	-	139,77	133,46	69,03	66,47	-

*** gli indicatori sono calcolati eliminando i valori negativi e gli outlier.**

3.2 Profili organizzativi

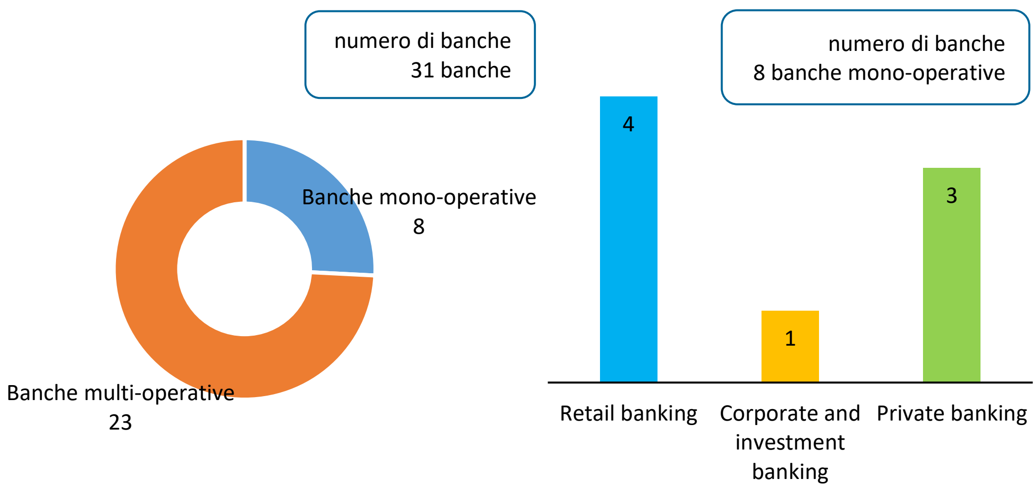
Con riferimento all'operatività bancaria del campione, sulla base del margine di intermediazione emerge che, in medie di percentuali, per 31 banche il retail banking rappresenta l'attività prevalente, pari al 56%; seguono il corporate and investment banking (22%) e il private banking (17%). Altre attività incidono mediamente del 5% sull'operatività complessiva (Figura 106).

Figura 106 - Attività delle banche



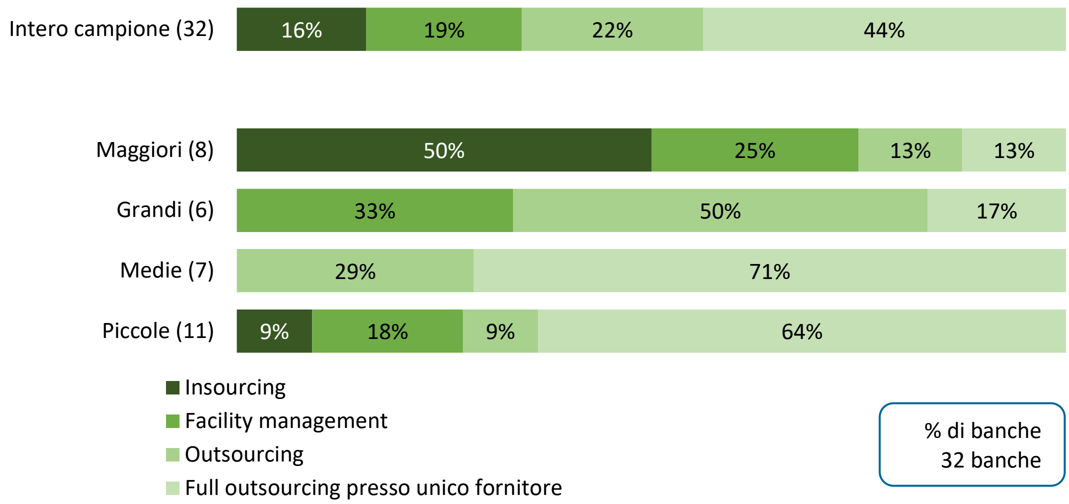
Rispetto alle 31 banche rispondenti, 23 dichiarano di svolgere più di una attività, mentre otto operano in un solo comparto: quattro nel retail banking, tre nel private banking e una nel corporate and investment banking (Figura 107).

Figura 107 - Banche multi e mono-operative



L'Outsourcing si conferma il modello prevalente per il sourcing dell'IT: il 66% delle banche affida a uno o più fornitori esterni la gestione del Data center e delle Applicazioni. Il 16% adotta il modello Insourcing, gestendo internamente le risorse IT e le Applicazioni, indipendentemente dalla presenza di forme di outsourcing selettivo per singole iniziative o singoli ambiti e il 19% di esse si basa su un modello "misto", affida cioè all'esterno le infrastrutture del Data center e mantiene internamente la gestione delle Applicazioni (Facility management). La Figura 108 analizza i modelli di sourcing per l'intero campione e per classe dimensionale.

Figura 108 - Modello di sourcing IT prevalente delle banche



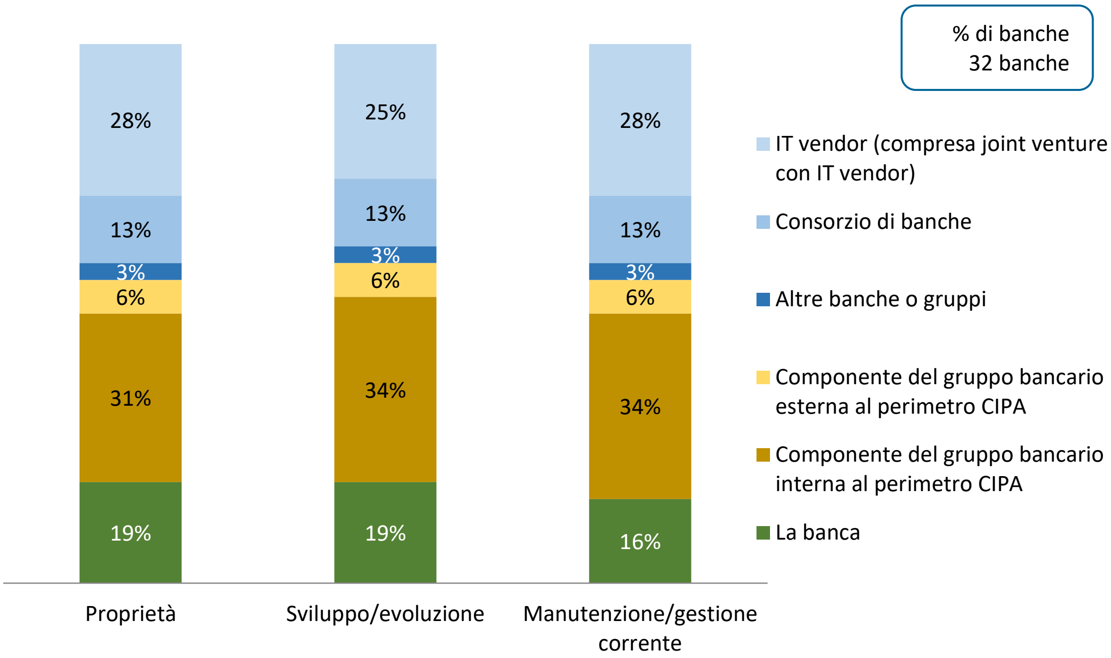
Di seguito vengono esaminate più in dettaglio le scelte di sourcing effettuate dalle banche distintamente per le infrastrutture del Data center (Hardware e Software di base) e per le Applicazioni.

Per le infrastrutture del Data center si analizza, seguendo un criterio di prevalenza e prescindendo dalla presenza di forme di outsourcing selettivo per singole iniziative/ambiti, di chi è la proprietà (incluse forme di noleggio e leasing), chi cura lo sviluppo/evoluzione e chi la manutenzione correttiva/gestione corrente, distinguendo tra:

- ✓ la banca stessa;
- ✓ componenti del gruppo bancario interne al perimetro CIPA (altre banche o società strumentali del gruppo);
- ✓ componenti del gruppo bancario esterne al perimetro CIPA (inclusa la casa madre estera);
- ✓ altre banche o gruppi bancari;
- ✓ consorzi di banche;
- ✓ IT vendor (compresa joint venture con vendor).

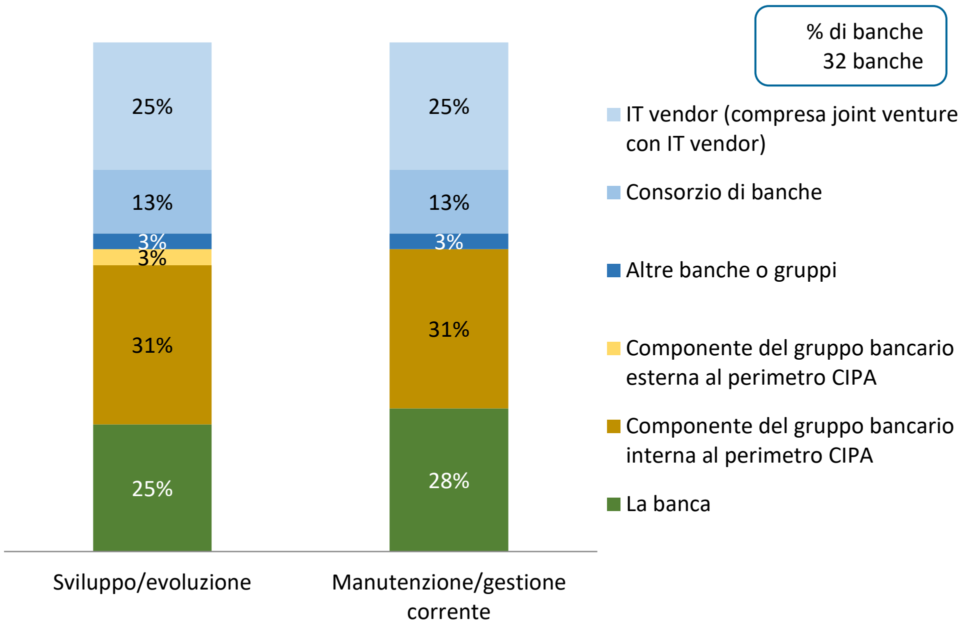
Emergono modelli di sourcing sostanzialmente allineati per proprietà, sviluppo e gestione del Data center. Una quota di banche che va dal 16% al 19% ne detiene la proprietà e cura direttamente sviluppo/evoluzione e manutenzione correttiva/gestione corrente. La quota preponderante (31-34%) si affida a componenti del gruppo interne al perimetro CIPA, un'altra fetta di rilievo (25-28%) ricorre ai vendor e il 13% a consorzi di banche (Figura 109).

Figura 109 - Proprietà, sviluppo e gestione del Data center delle banche



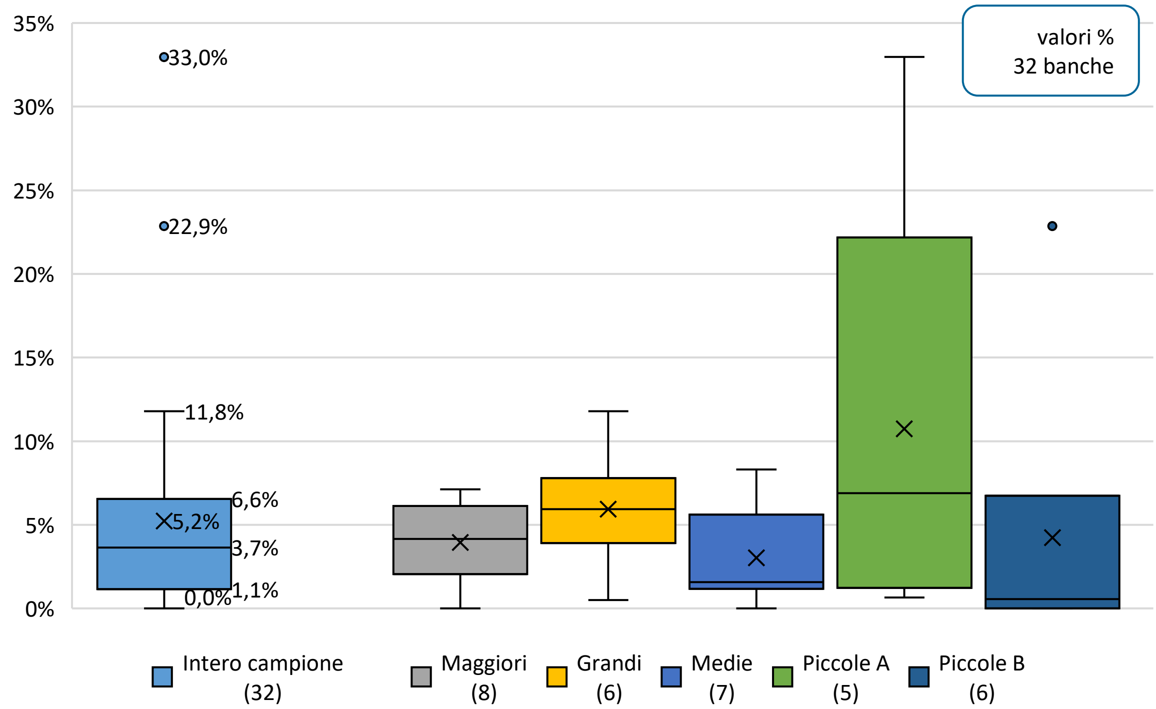
Con riferimento alle Applicazioni, l'approccio di sourcing è molto simile tra sviluppo/evoluzione e manutenzione/gestione corrente. Circa un quarto delle banche cura direttamente entrambe le attività, il 31% le affida all'interno del gruppo CIPA, mentre la restante quota le affida all'esterno, dove risulta preponderante la scelta del vendor IT (25%) seguita dal consorzio di banche (13%) (Figura 110).

Figura 110 - Sviluppo e gestione delle Applicazioni delle banche



La Figura 111 rappresenta, mediante diagrammi a scatole e baffi[27], il rapporto percentuale tra il numero di dipendenti IT e il totale dei dipendenti delle 32 banche partecipanti, anche per classe dimensionale. In media, i dipendenti IT costituiscono il 5,2% del personale delle 32 banche partecipanti.

Figura 111 - Personale IT / totale dipendenti delle banche



Appendice

Figura 112 - Rappresentatività delle banche partecipanti per sportelli e dipendenti

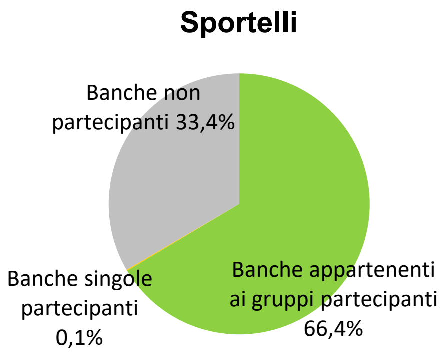


Figura 113 - TCO: confronto tra previsione 2024 e consuntivo 2024

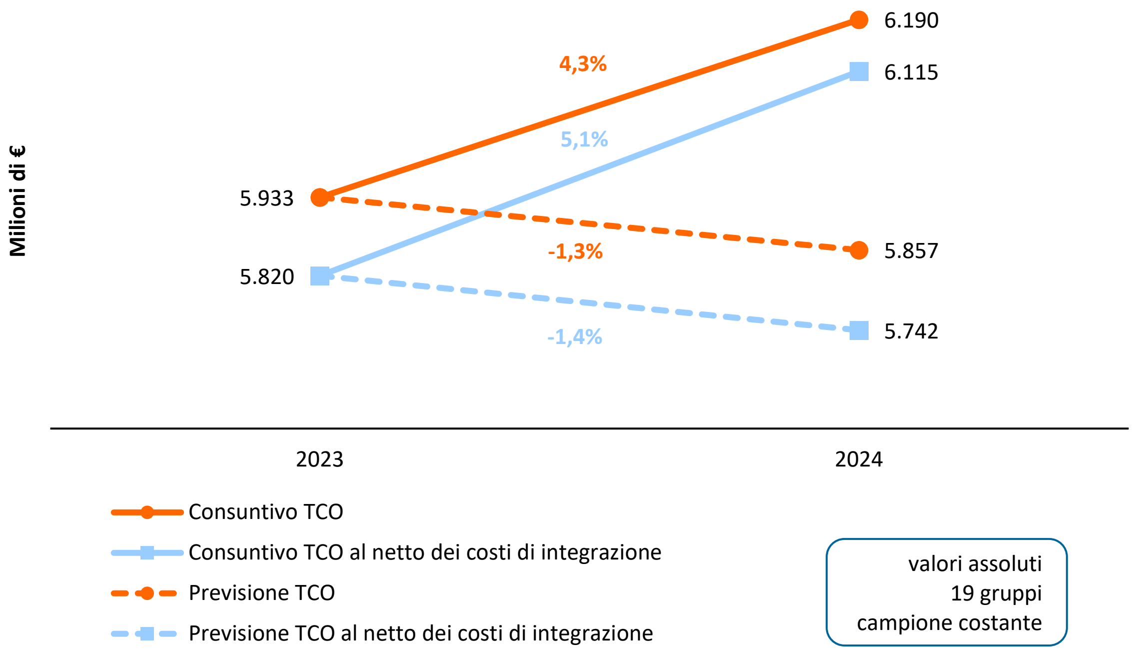


Figura 114 - TCO per aree tematiche e classe dimensionale

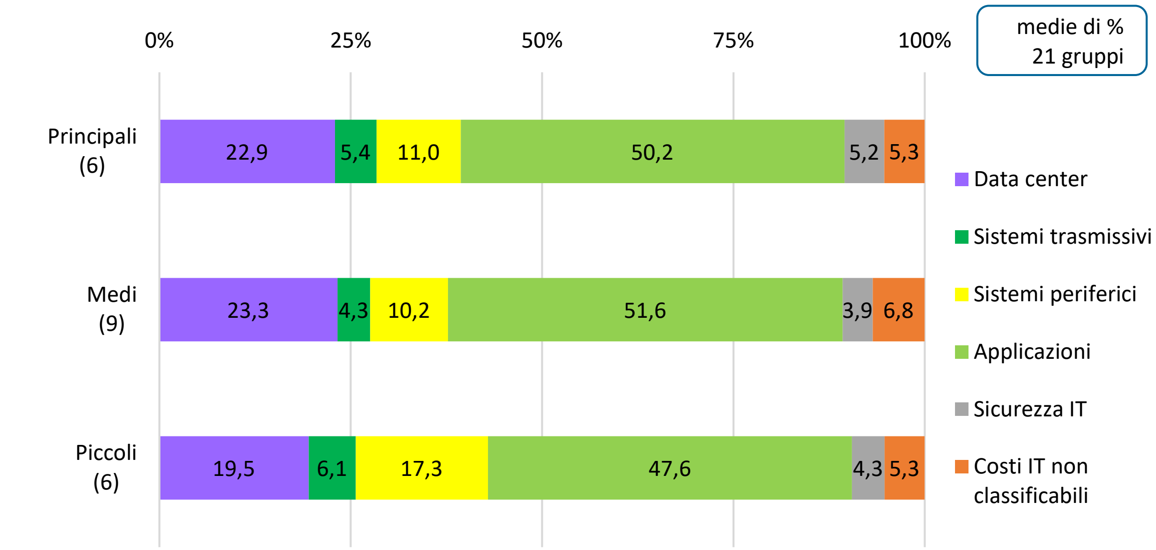


Figura 115 - TCO per aree tematiche e modello di sourcing

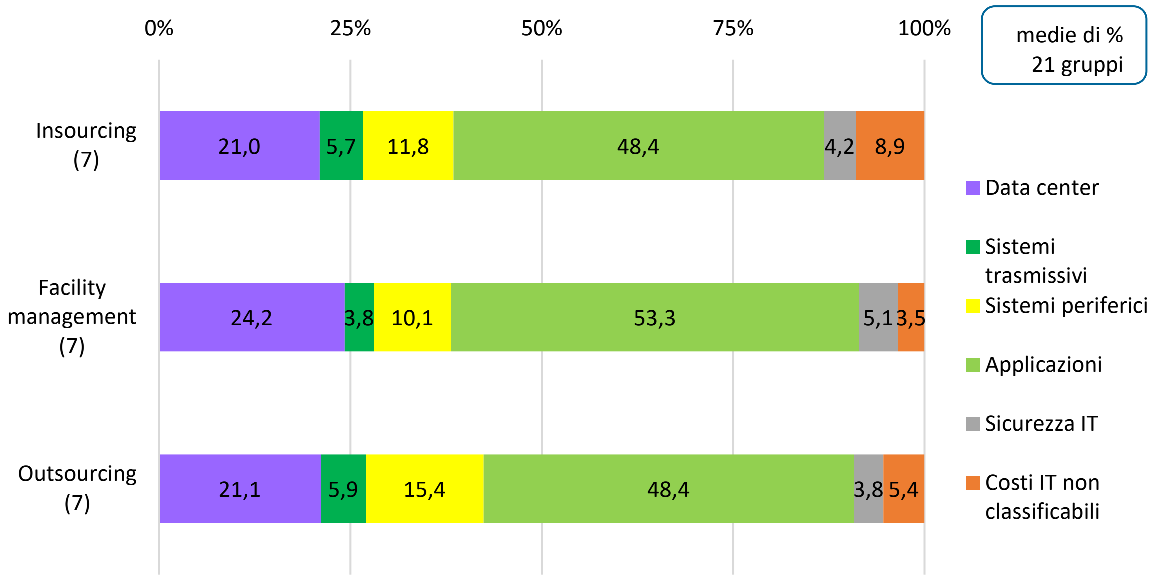


Figura 116 - Cash out IT per processi - gruppi Principali

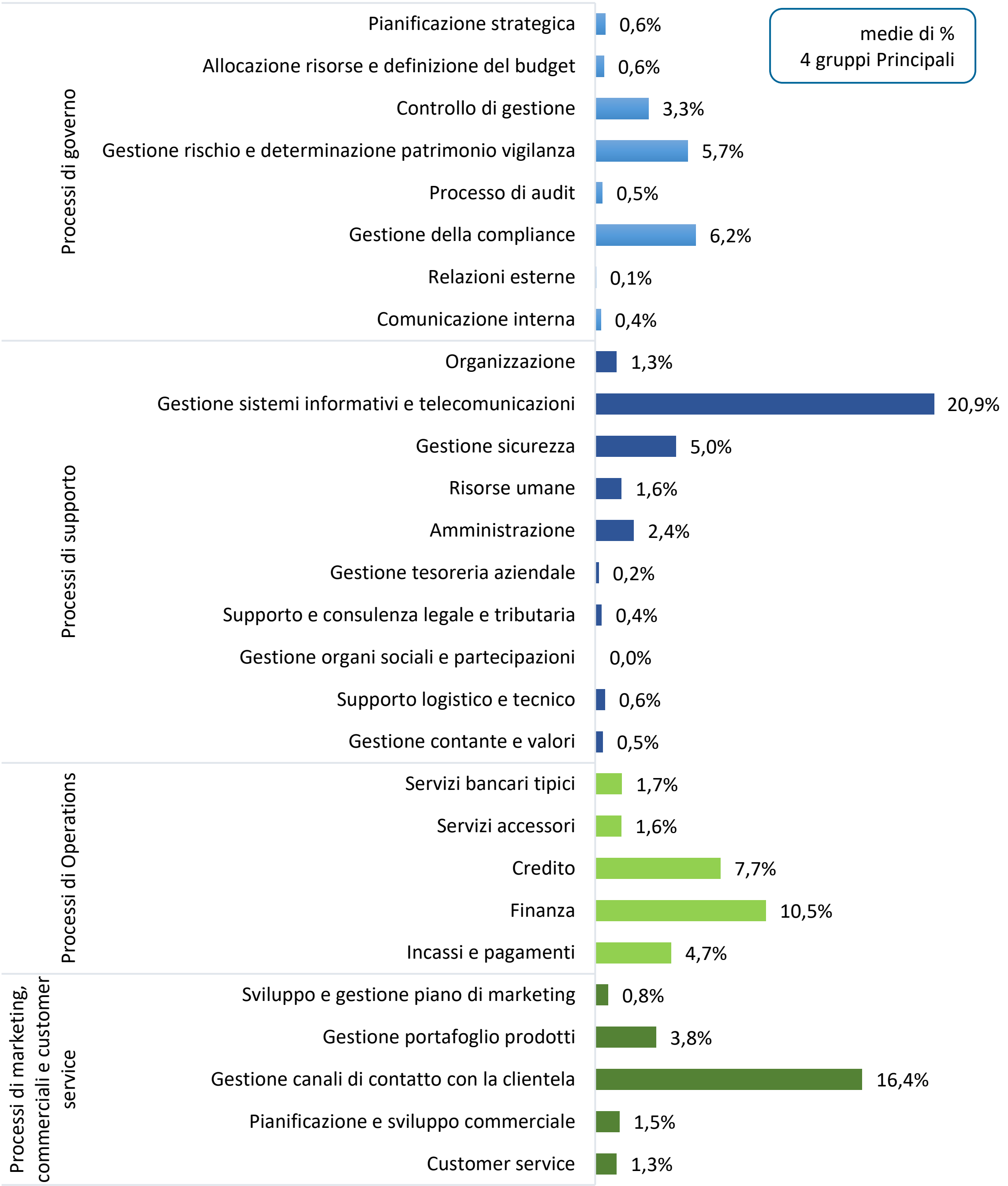


Figura 117 - Cash out IT per processi - gruppi Medi

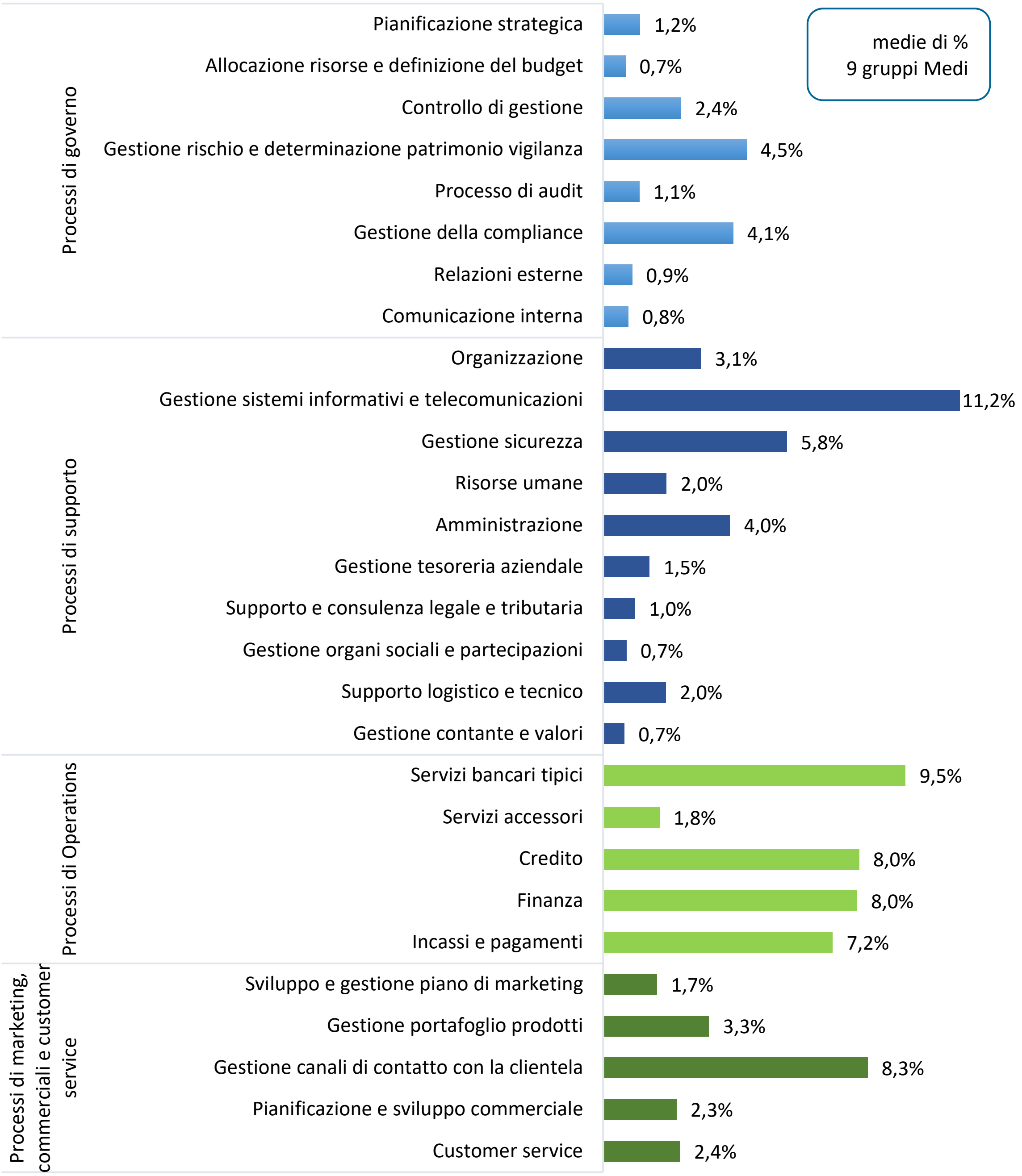


Figura 118 - Cash out IT per processi - gruppi Piccoli

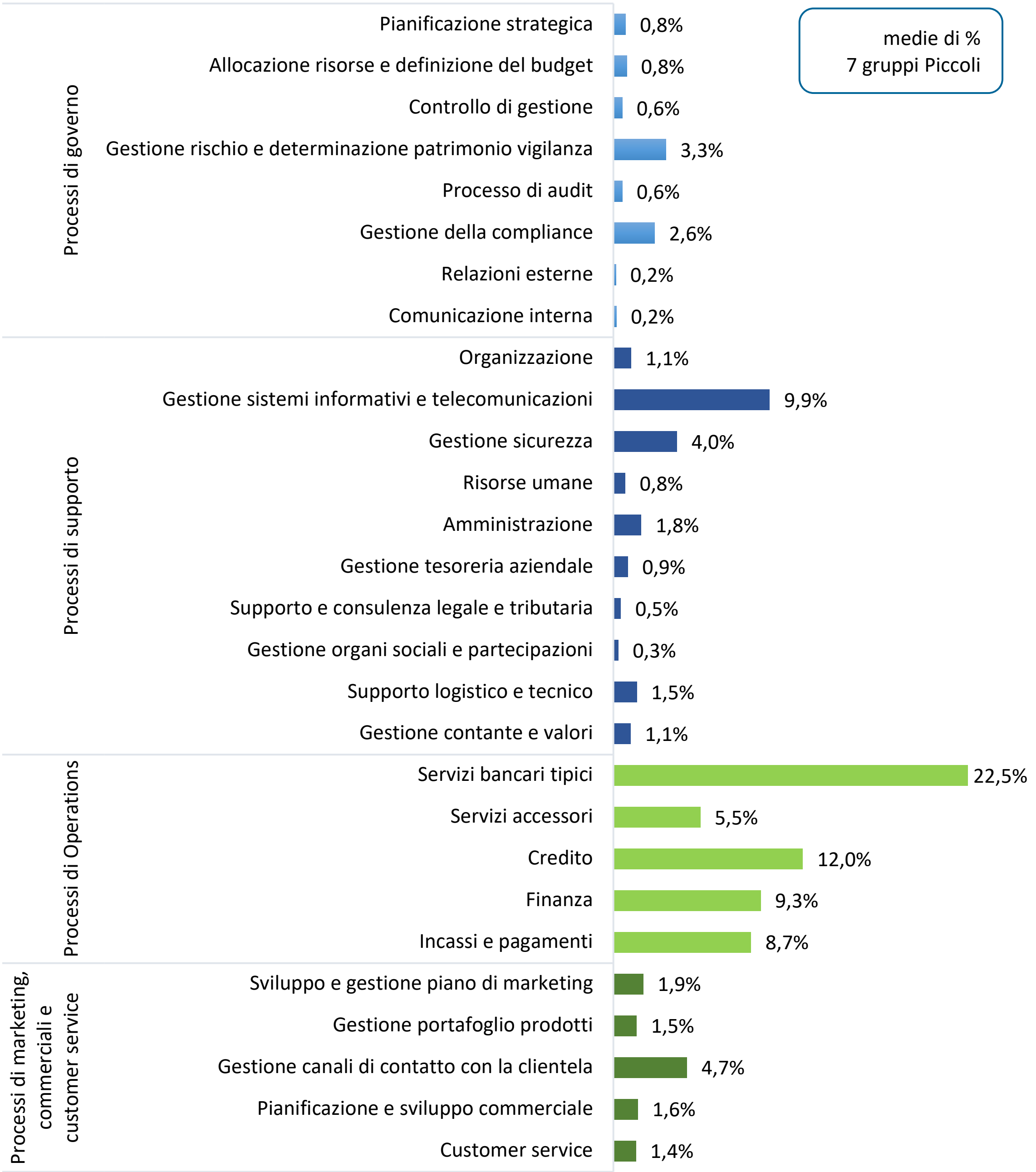


Figura 119 - Cash out IT per run/change e modello di sourcing

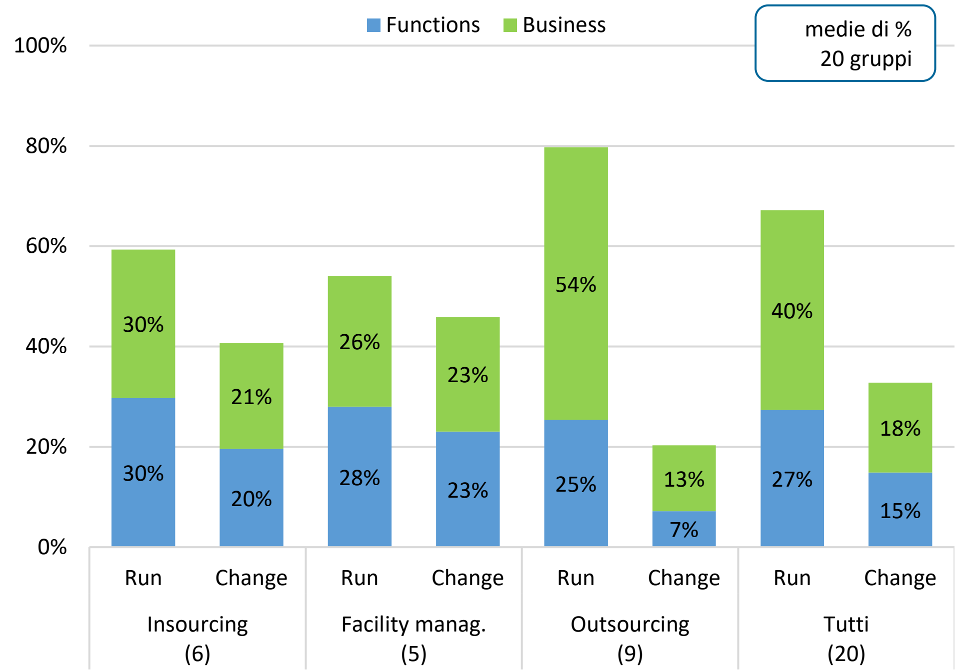


Figura 120 - Cash out IT per business/functions, run/change: valori individuali e per modello di sourcing

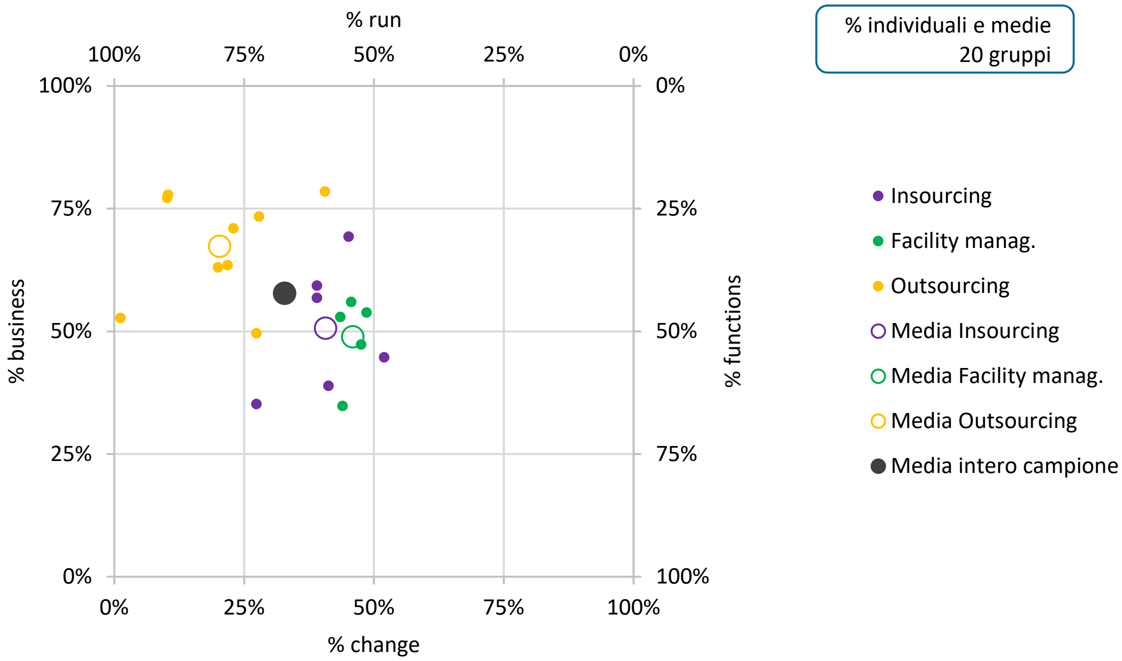


Figura 121 - Cash out IT per la compliance: distribuzione per ambito

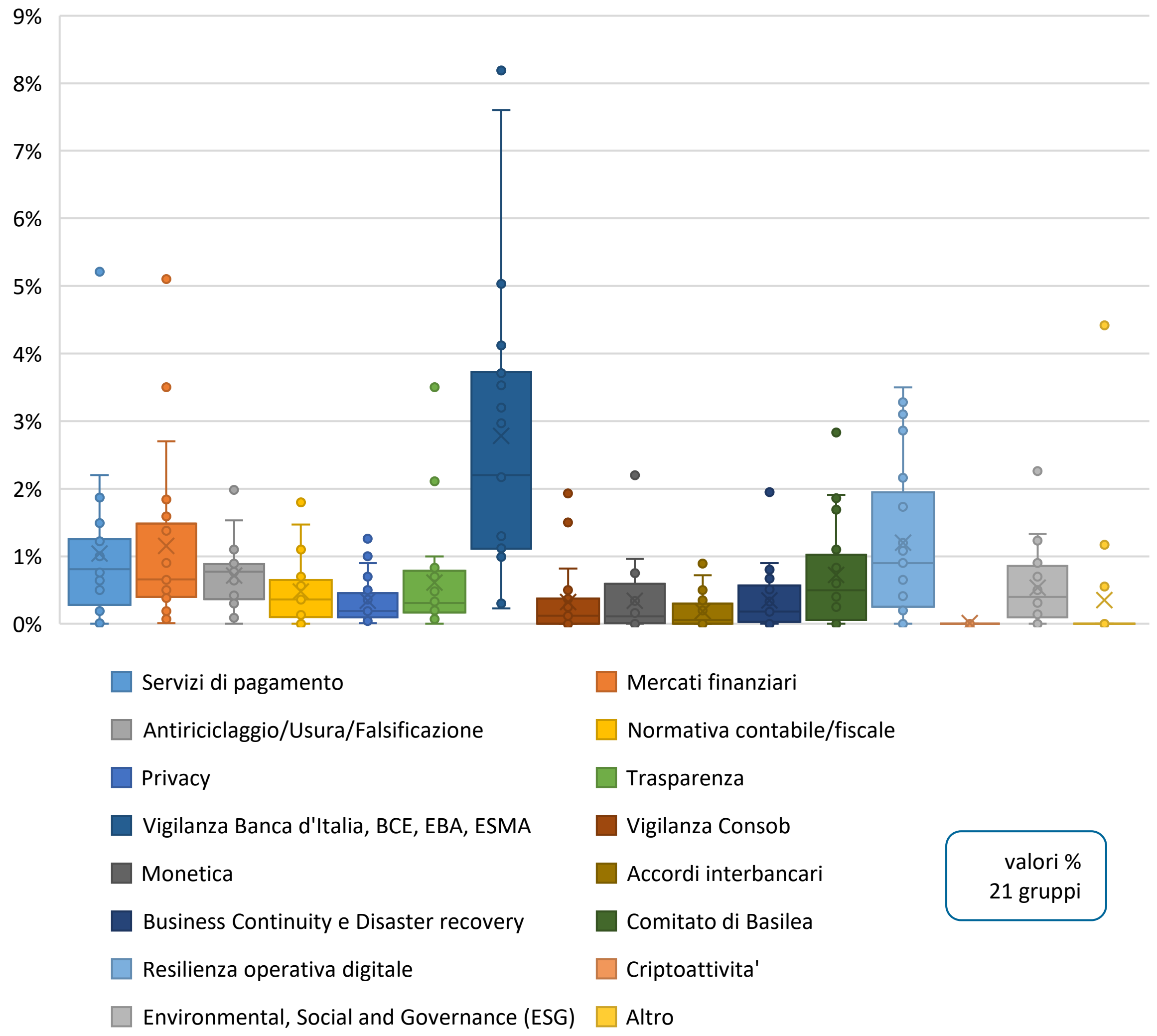


Figura 122 - Iniziative progettuali per la compliance - gruppi Principali

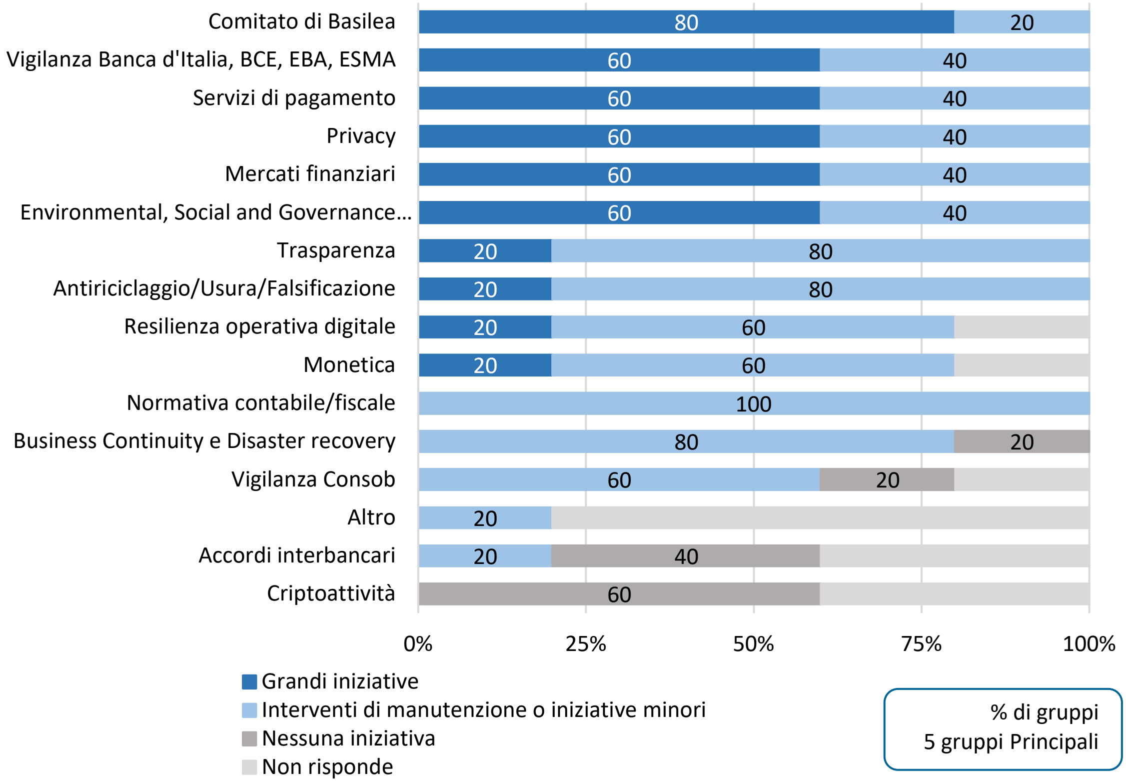


Figura 123 - Iniziative progettuali per la compliance - gruppi Medi

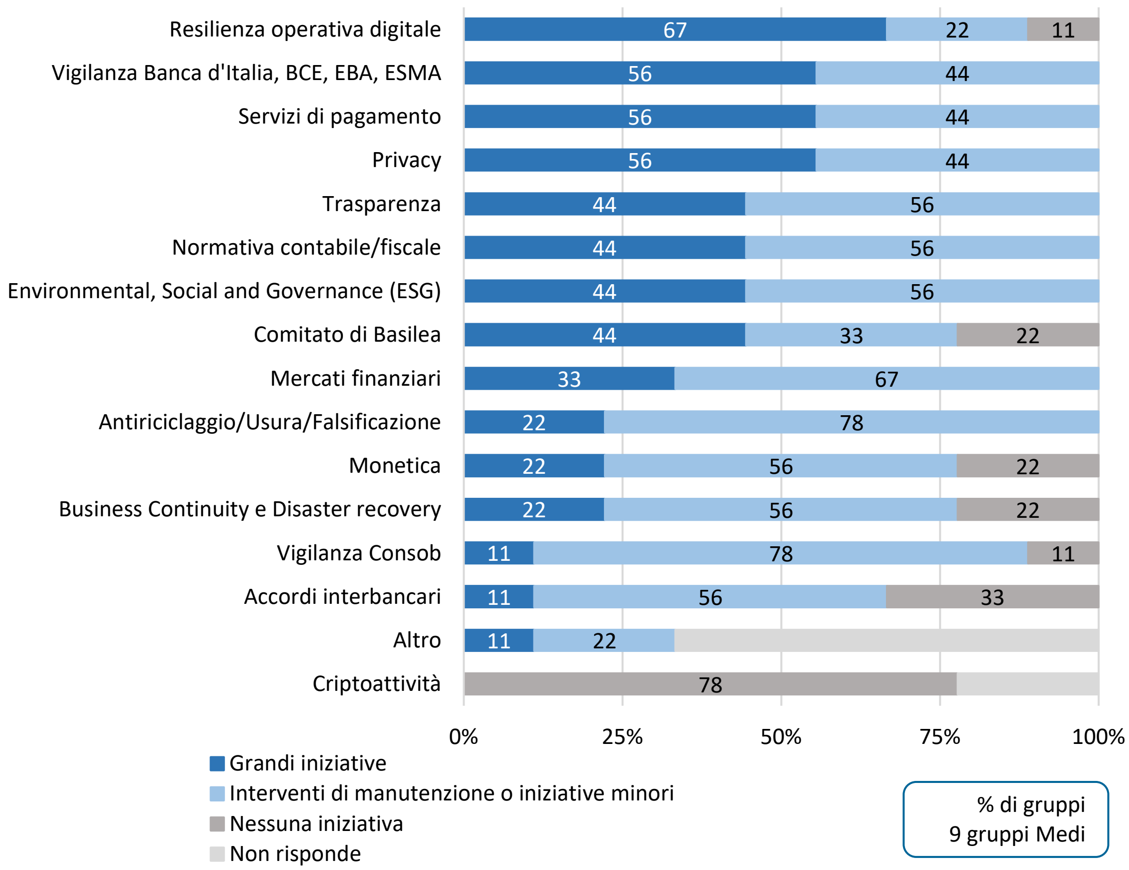


Figura 124 - Iniziative progettuali per la compliance - gruppi Piccoli

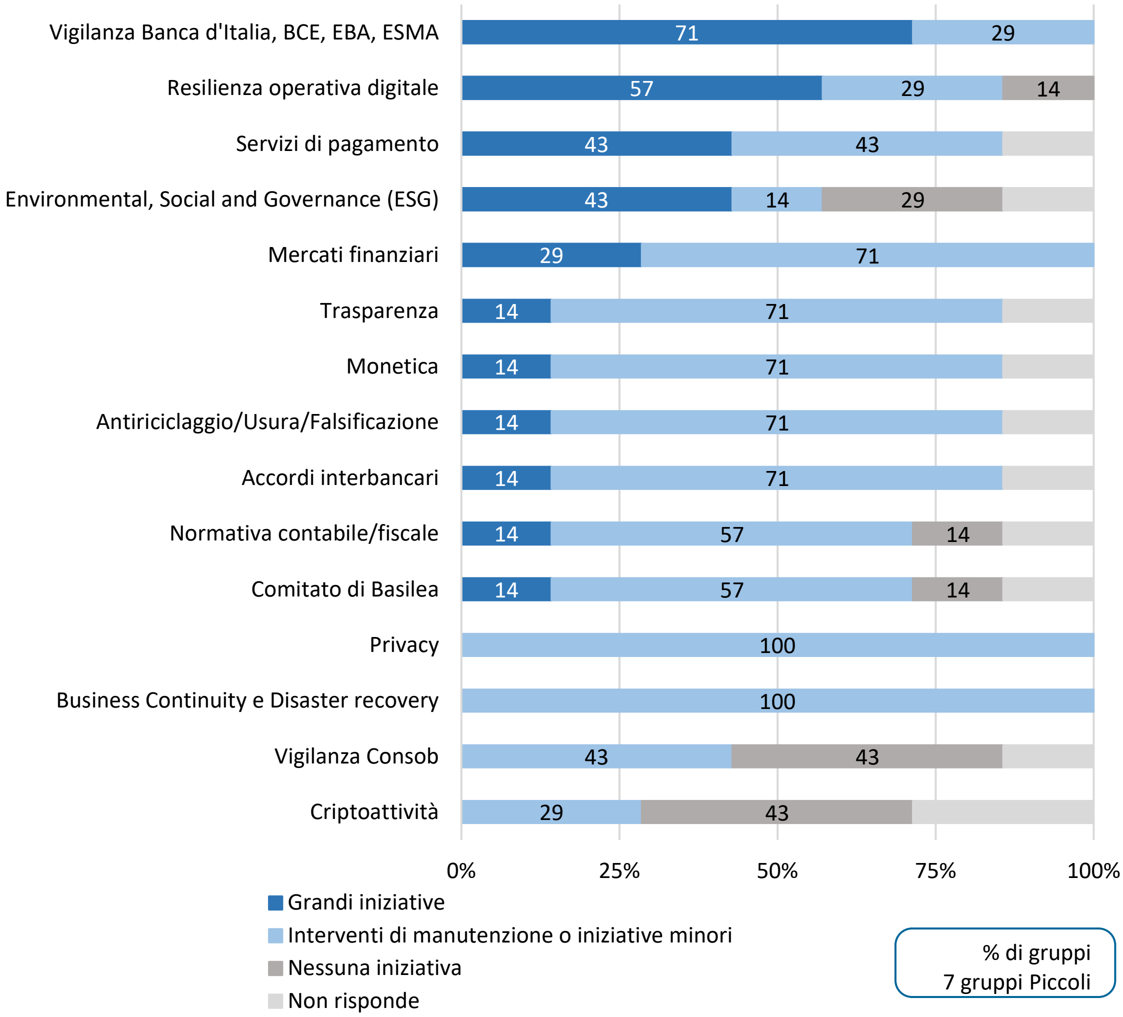


Figura 125 - Cash out IT per l'open banking: ripartizione per classe dimensionale e modello di sourcing

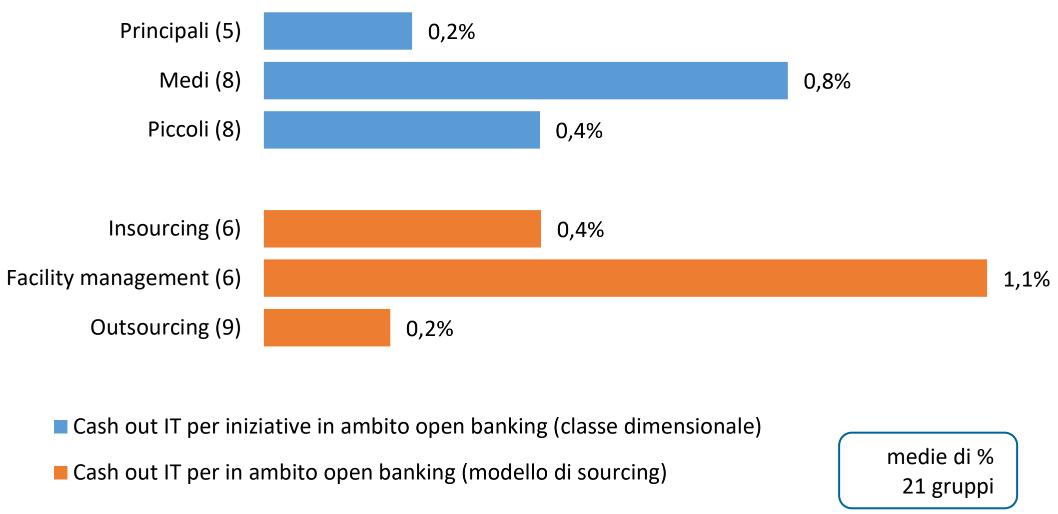


Figura 126 - Investimenti IT in HW e SW - gruppi Principali

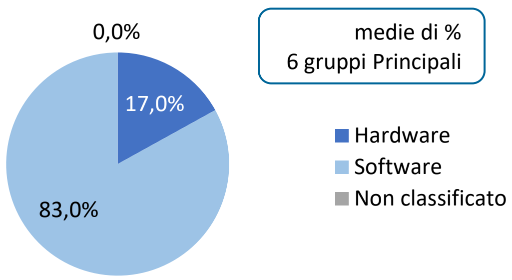


Figura 127 - Investimenti IT in HW e SW per aree tematiche - gruppi Principali

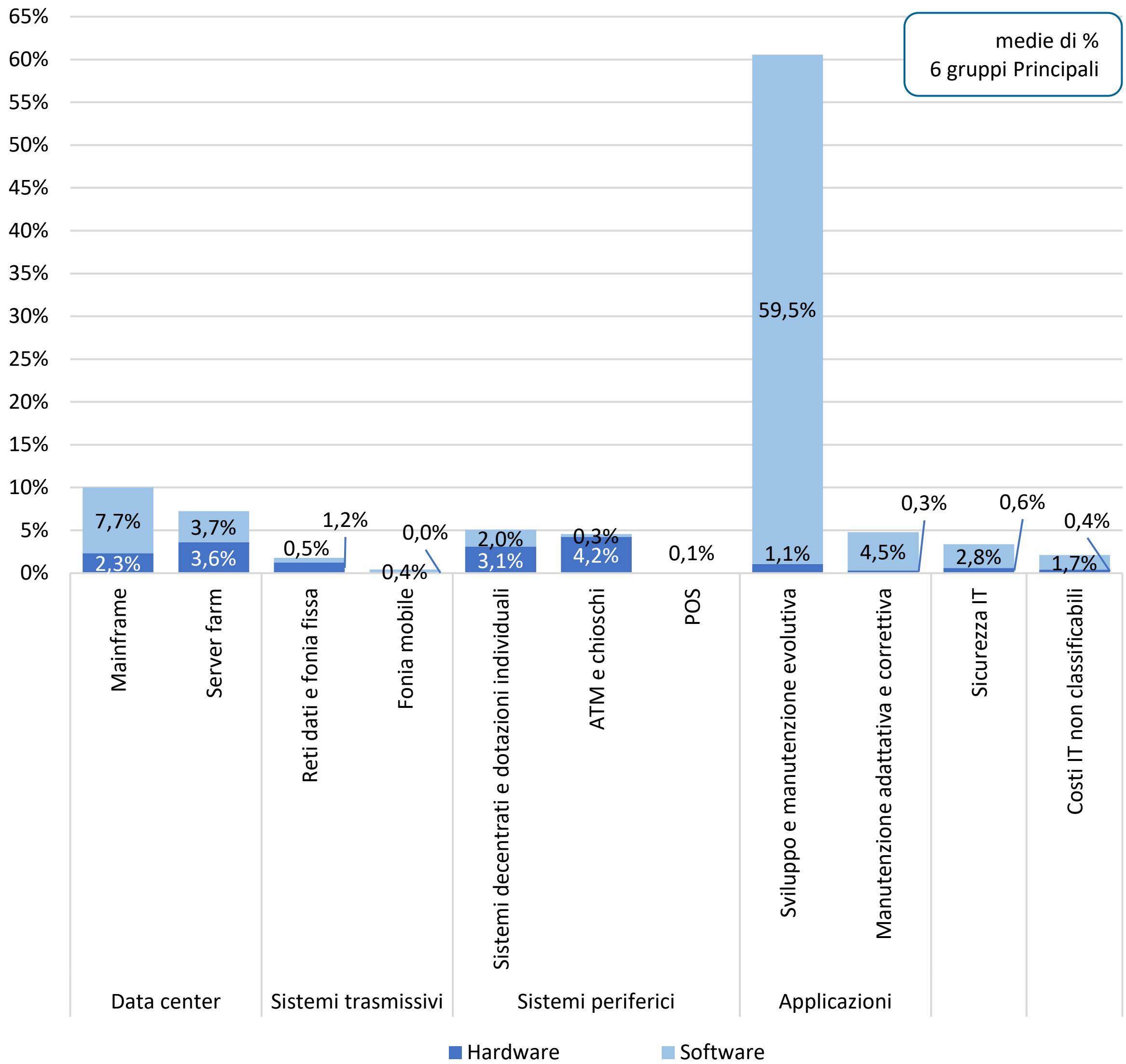


Figura 128 - Investimenti IT in HW e SW - gruppi Medi

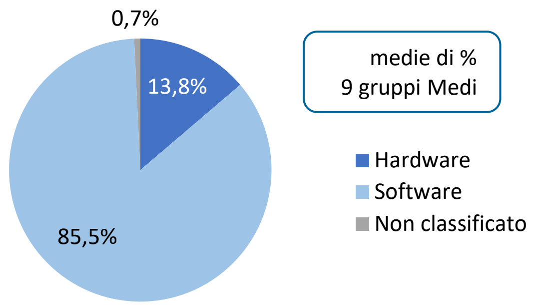


Figura 129 - Investimenti IT in HW e SW per aree tematiche - gruppi Medi

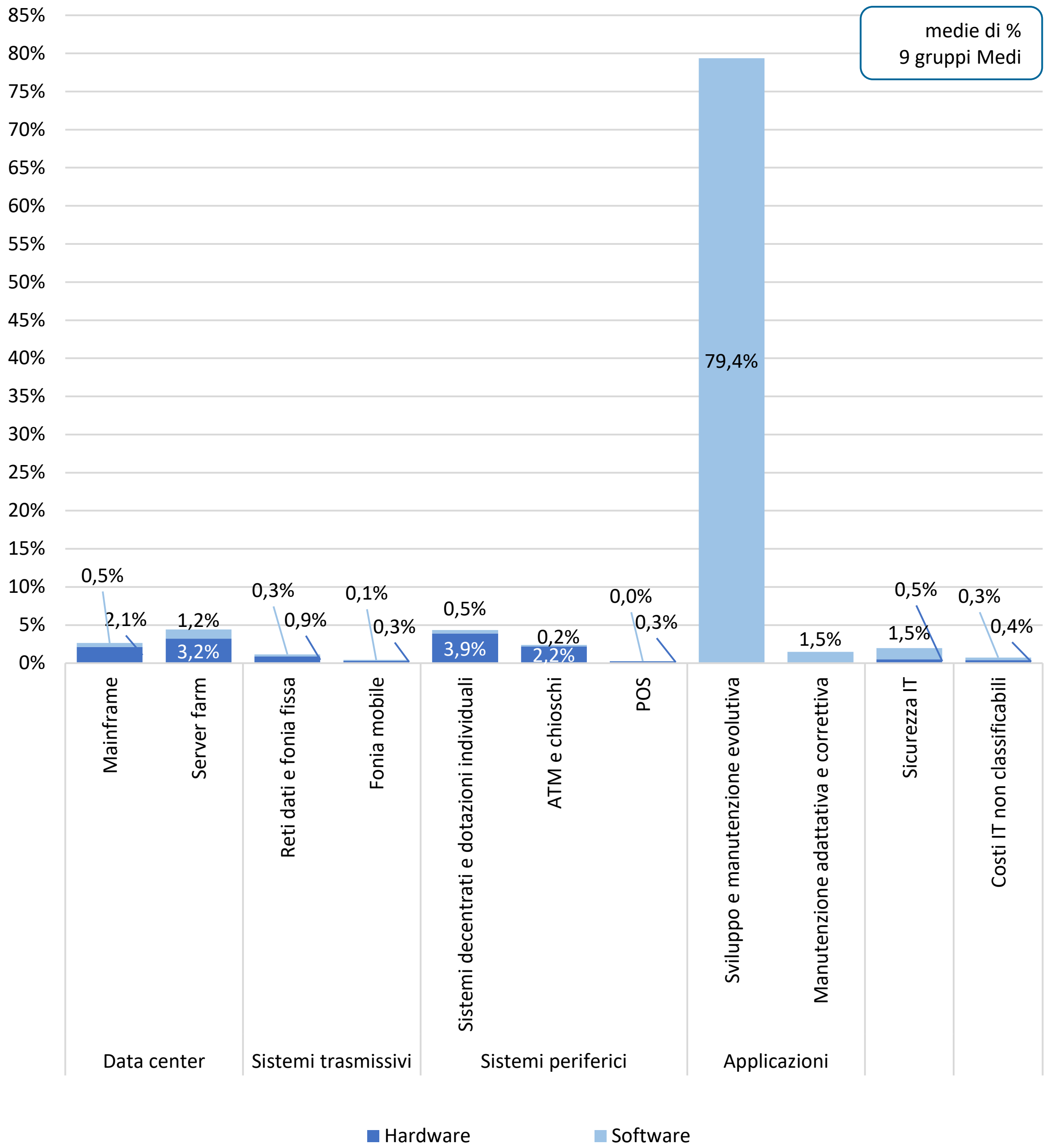


Figura 130 - Investimenti IT in HW e SW - gruppi Piccoli

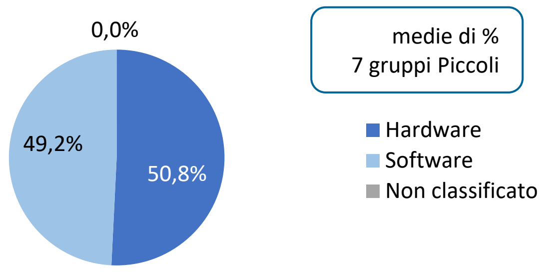


Figura 131 - Investimenti IT in HW e SW per aree tematiche - gruppi Piccoli

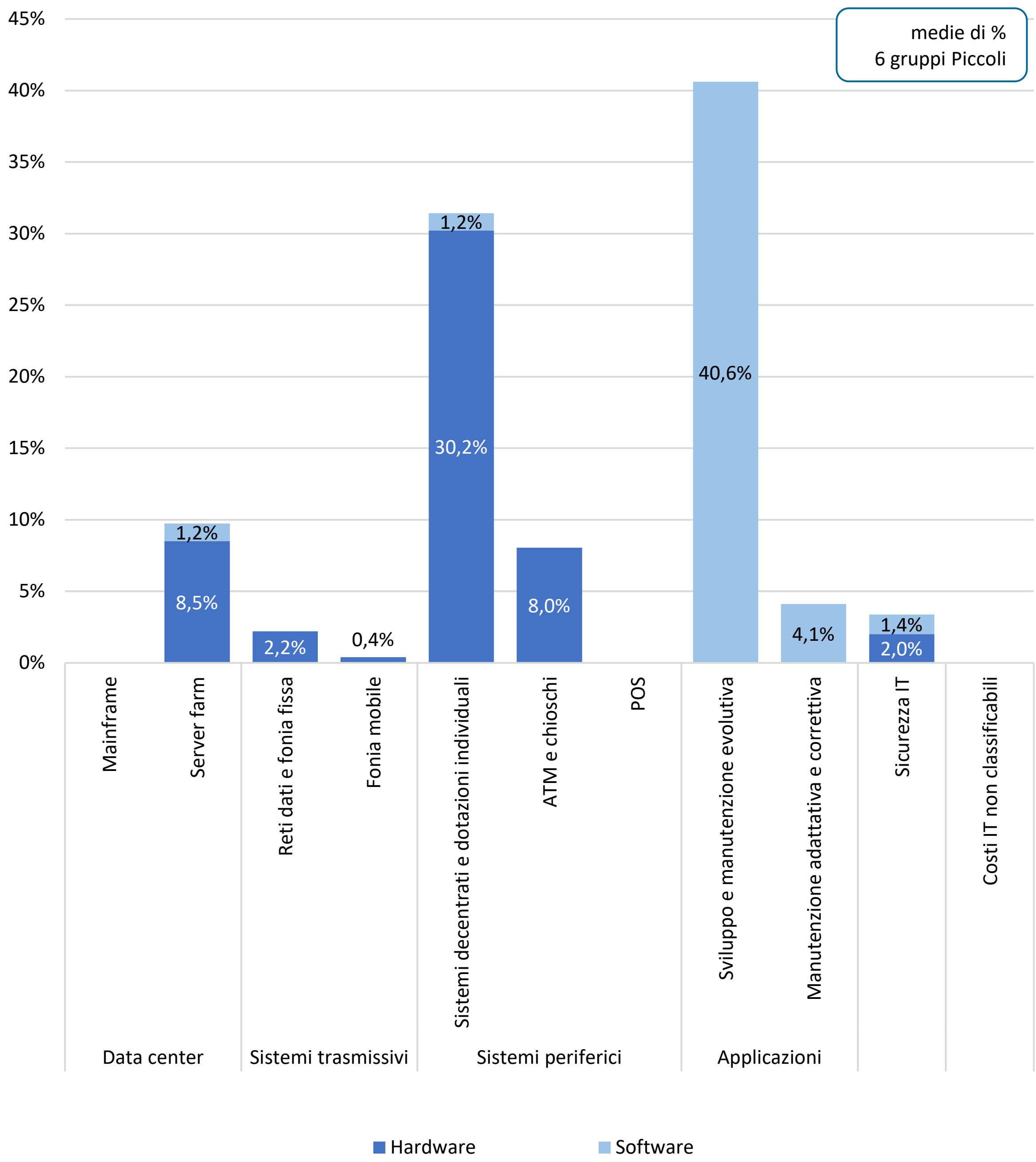


Figura 132 - Investimenti IT in HW e SW - gruppi Insourcing

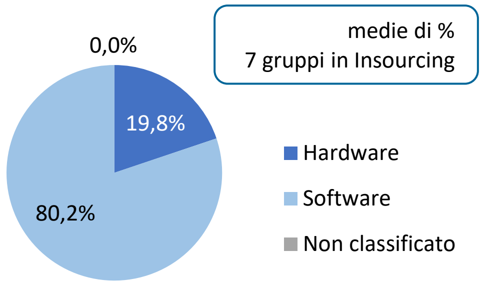


Figura 133 - Investimenti IT in HW e SW per aree tematiche - gruppi Insourcing

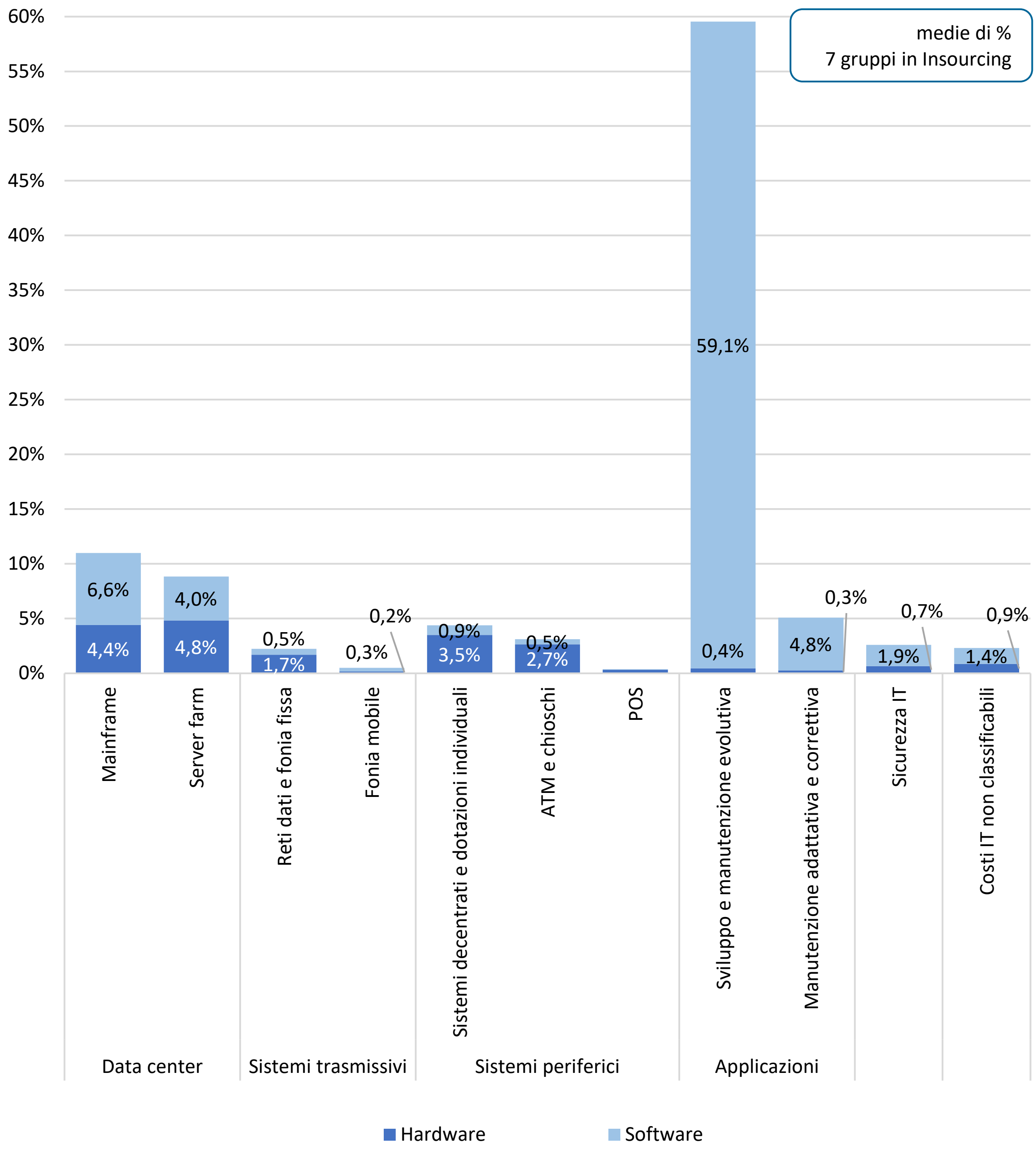


Figura 134 - Investimenti IT in HW e SW - gruppi Facility management

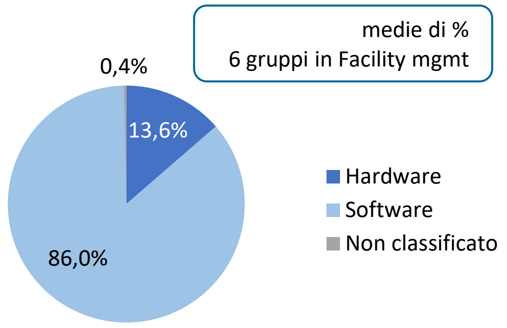


Figura 135 - Investimenti IT in HW e SW per aree tematiche - gruppi Facility management

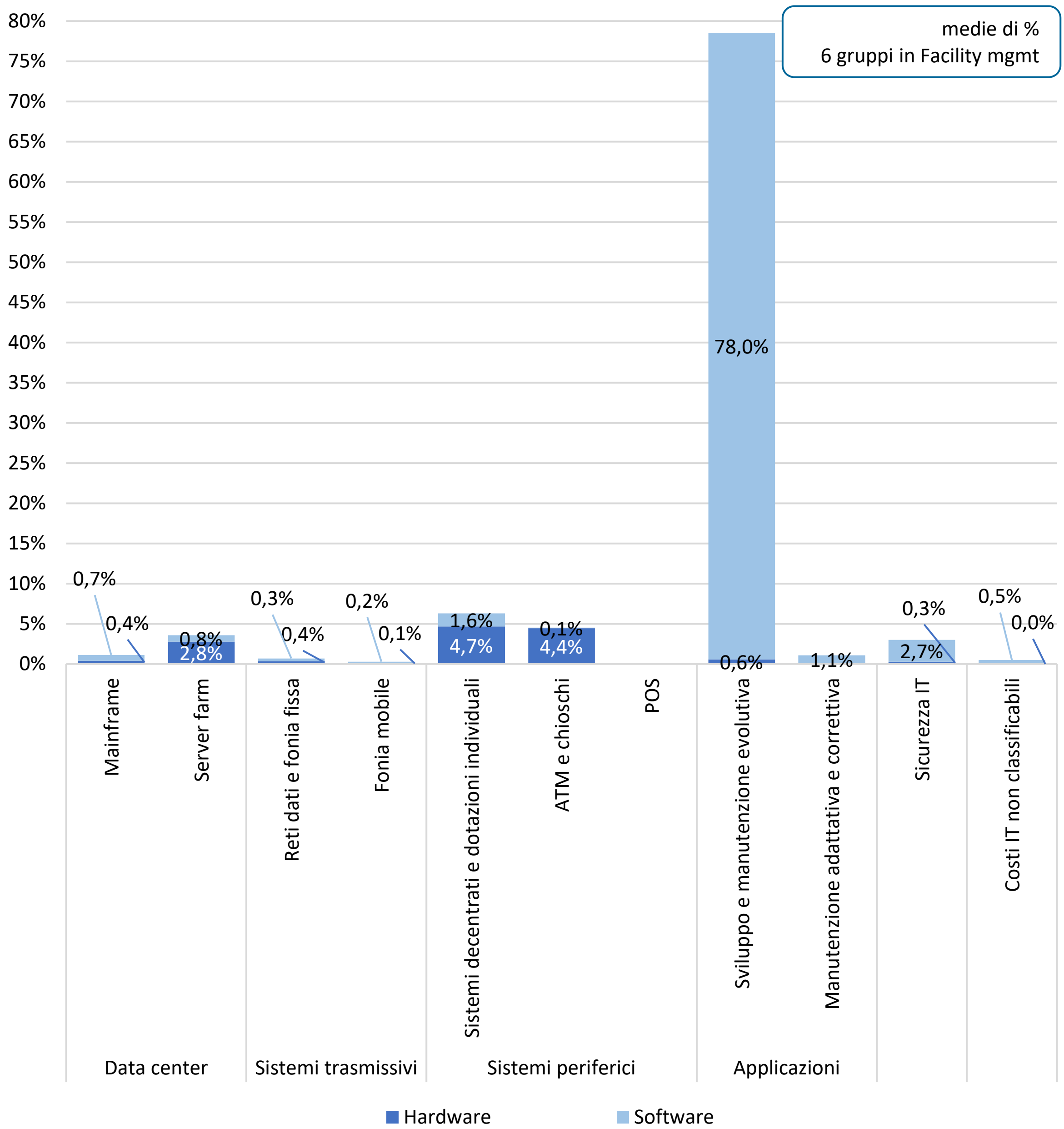


Figura 136 - Investimenti IT in HW e SW - gruppi Oustourcing

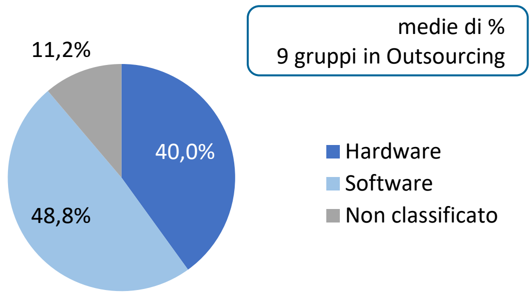


Figura 137 - Investimenti IT in HW e SW per aree tematiche - gruppi Outsourcing

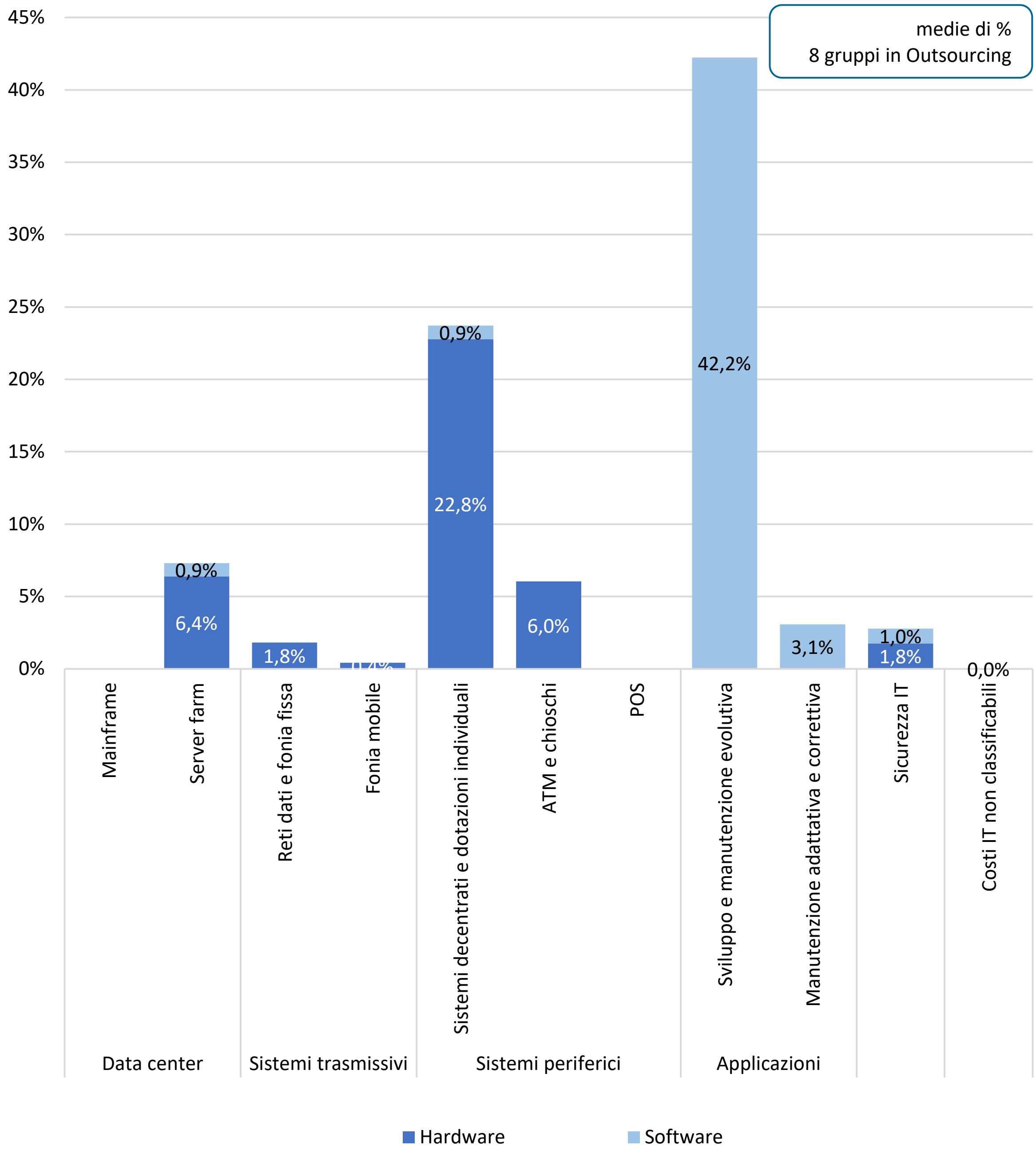


Figura 138 - Attività bancaria dei gruppi per classe dimensionale

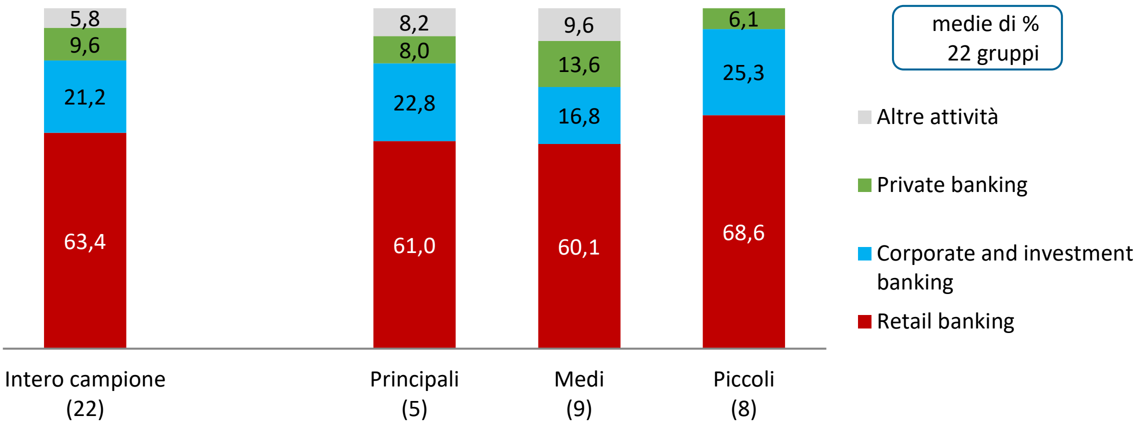


Figura 139 - Finalità delle iniziative di innovazione tecnologica avviate o in corso: gruppi Principali

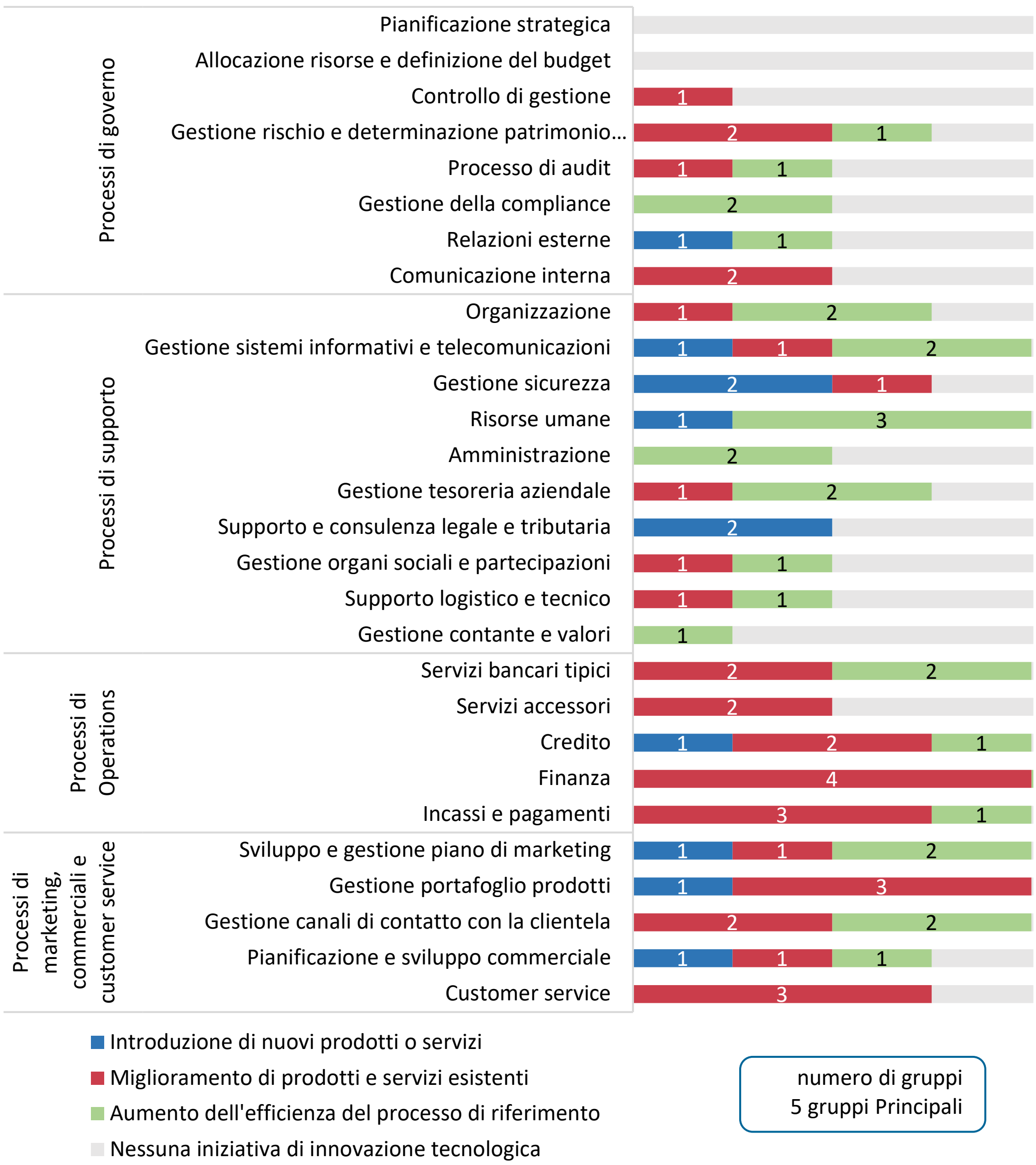


Figura 140 - Finalità delle iniziative di innovazione tecnologica avviate o in corso: gruppi Medi

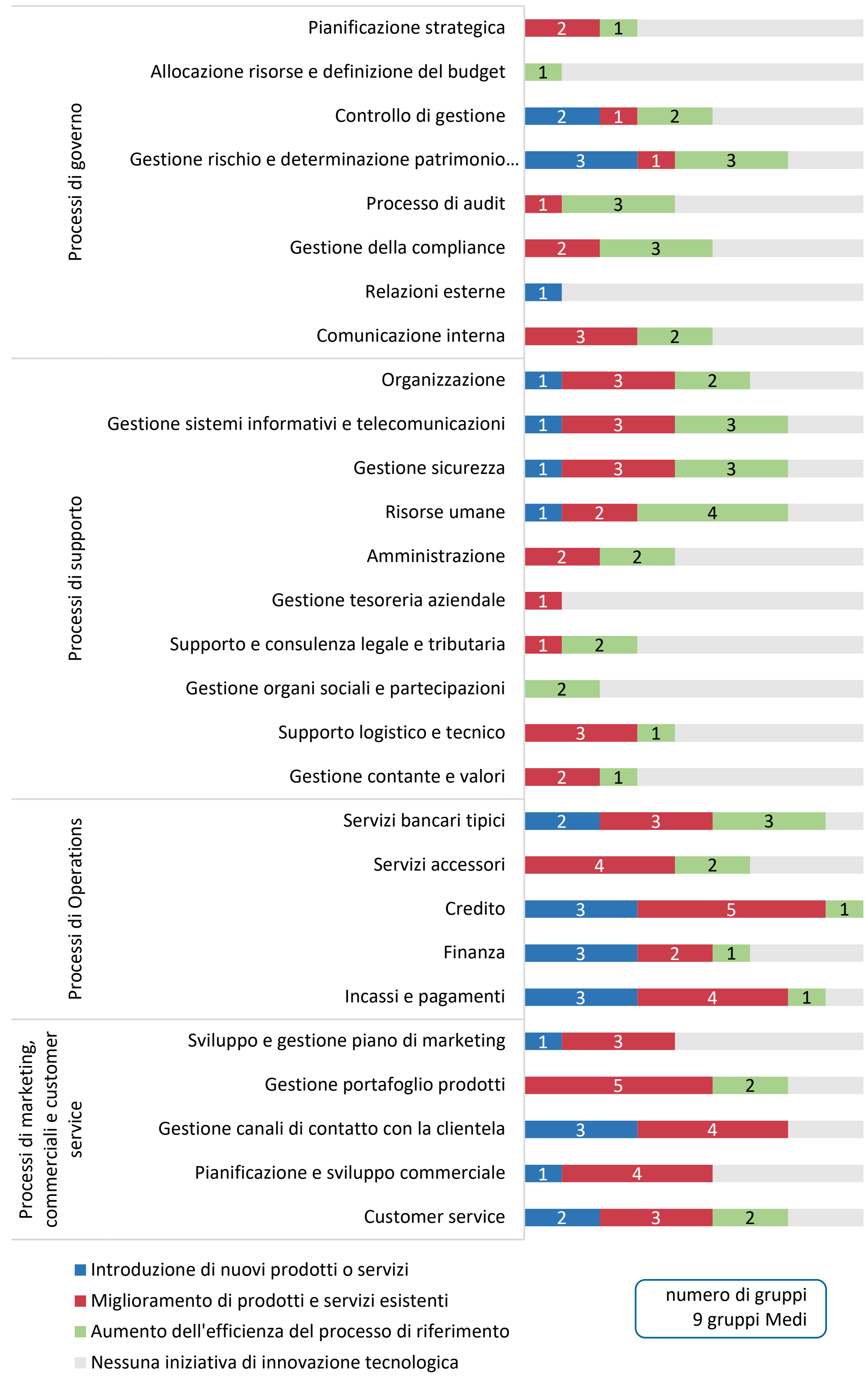


Figura 141 - Finalità delle iniziative di innovazione tecnologica avviate o in corso: gruppi Piccoli

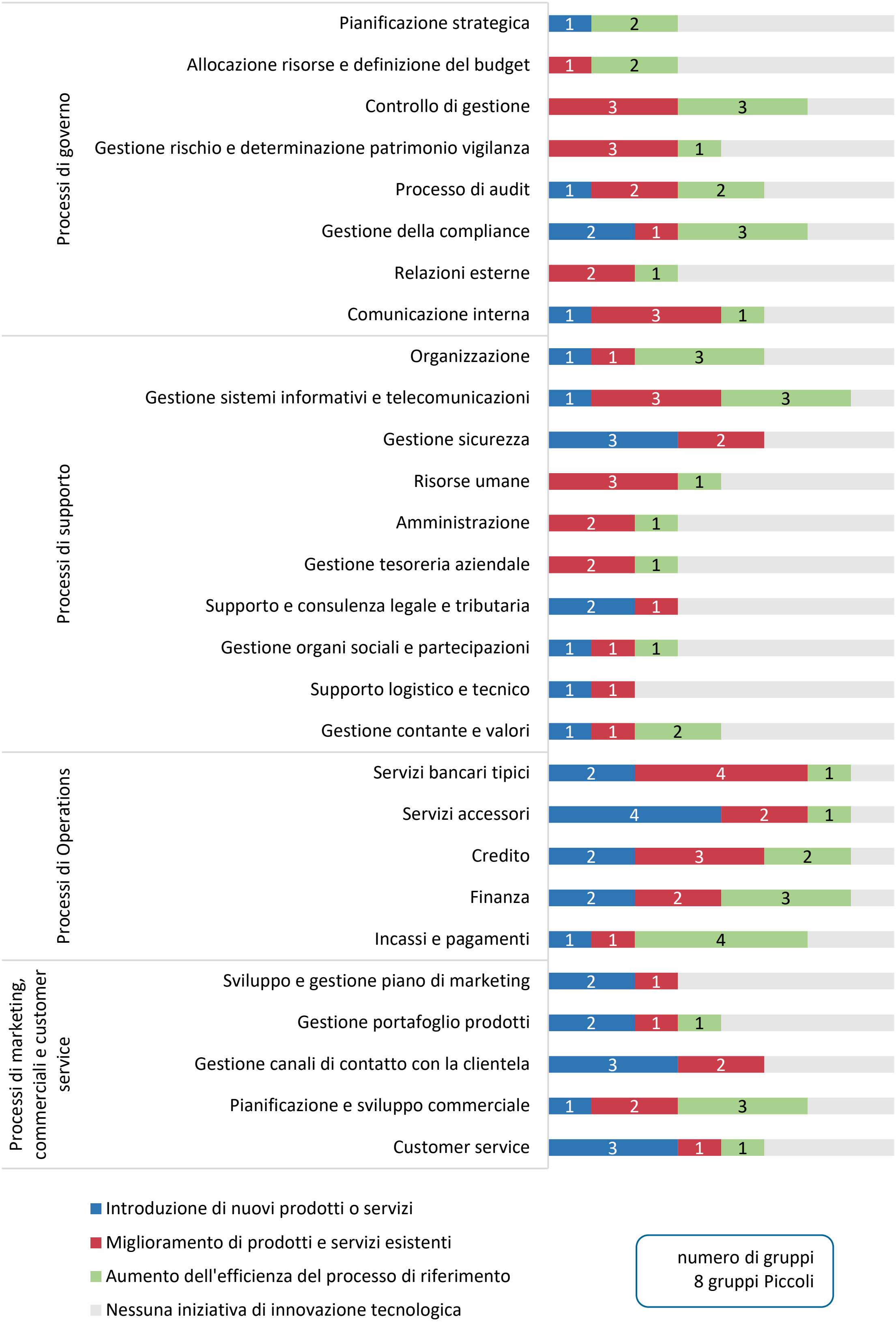


Figura 142 - FTE del personale IT nelle aree tematiche per classe dimensionale

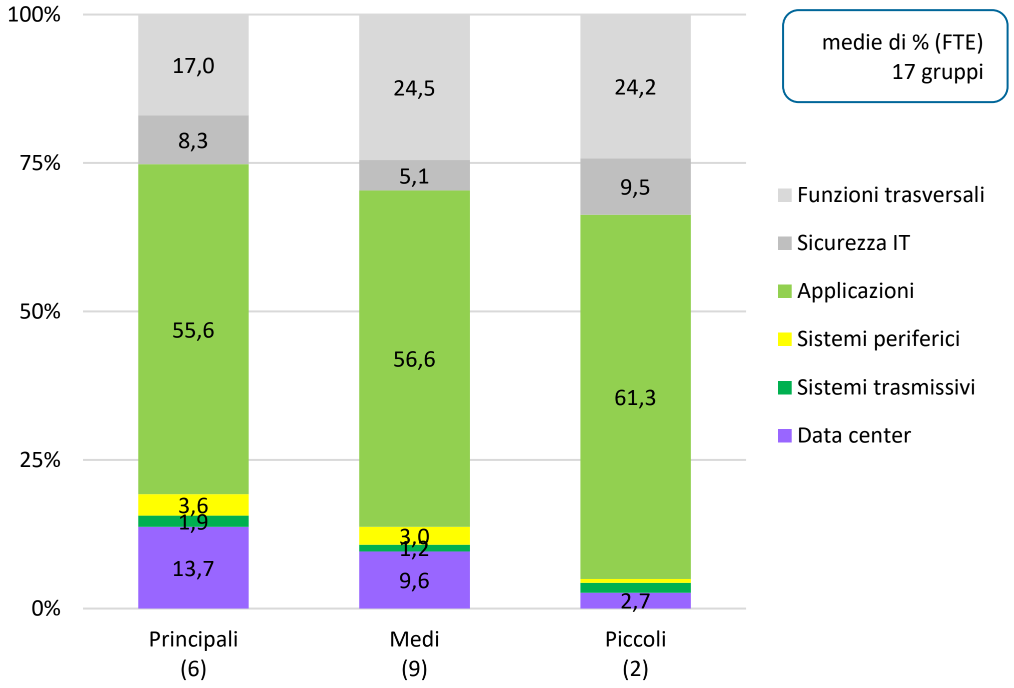


Figura 143 - FTE del personale IT nelle aree tematiche per modello di sourcing

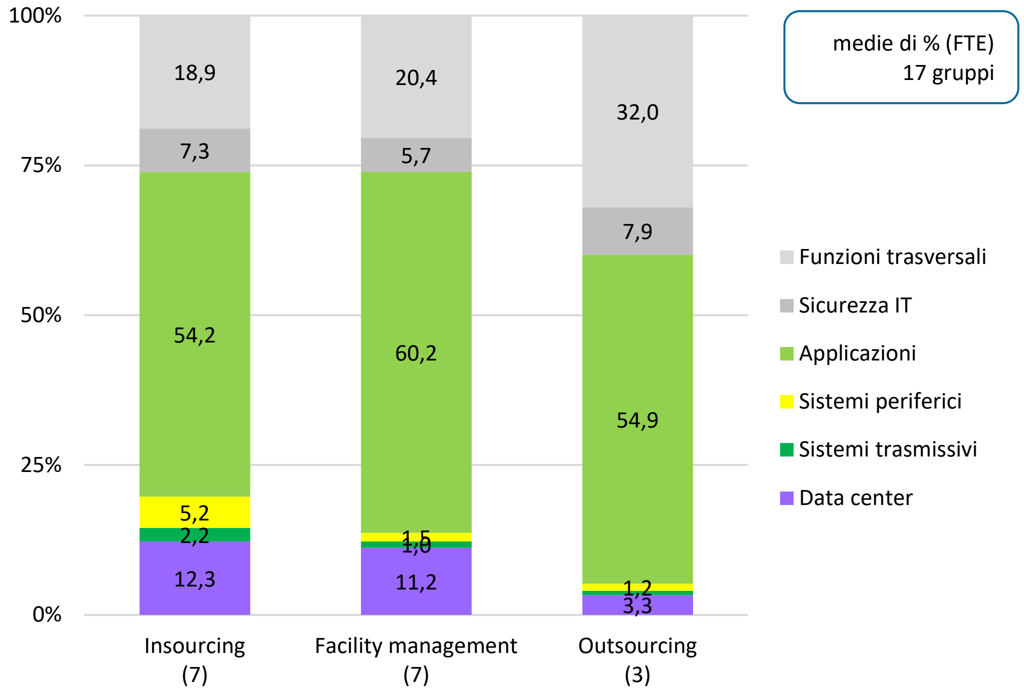


Figura 144 - FTE del personale IT nelle aree tematiche - gruppi con meno di 50 dipendenti IT

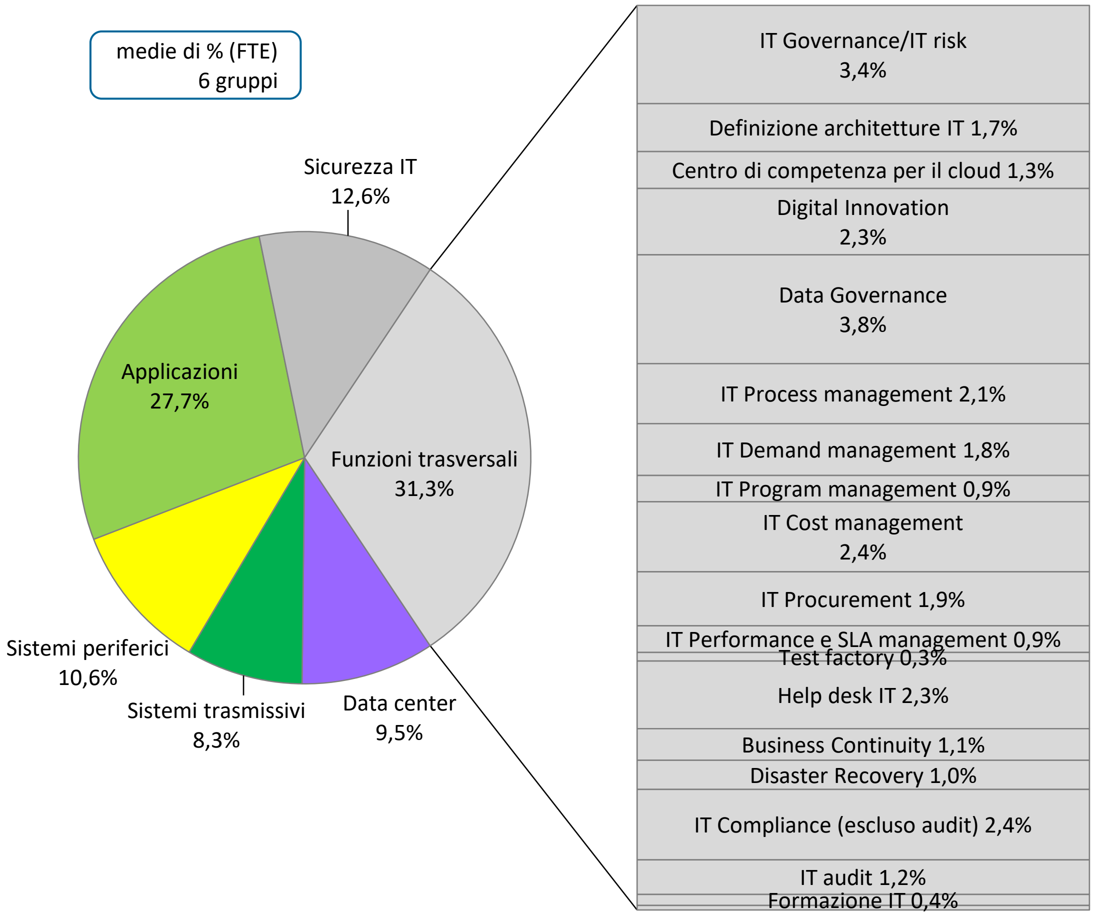


Figura 145 - Formazione IT: costi di formazione / costi del personale IT, per classi di analisi

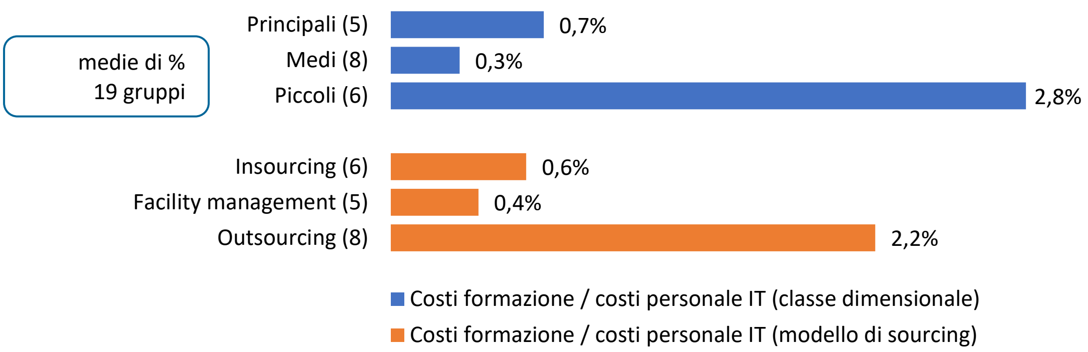


Tabella 15 - Personale IT: ripartizione per genere, età e livello contrattuale (vista 2)

medie di % 16 gruppi	<= 29 anni		30-39 anni		40-49 anni		50-59 anni		>= 60 anni	
	Uomini	Donne	Uomini	Donne	Uomini	Donne	Uomini	Donne	Uomini	Donne
Aree professionali	5,0	2,2	8,5	4,1	8,5	4,5	6,9	3,0	1,2	0,3
Quadri-direttivi	0,2	0,1	4,6	1,6	12,1	3,9	17,8	6,4	6,1	0,9
Dirigenti	0,0	0,0	0,1	0,0	0,3	0,0	1,0	0,1	0,3	0,1

Tabella 16 - Ripartizione del TCO: 21* gruppi (medie di %)

Fattori produttivi			Aree tematiche											
			Data center		Sistemi trasmissivi		Sistemi periferici			Applicazioni		Sicurezza IT	Costi IT non classificabili	Totale consuntivo 2024
			Mainframe	Server farm	Reti dati e fonia fissa	Fonia mobile	Sistemi decentrati e dotazioni individuali	ATM e chioschi	POS	Sviluppo e manutenzione evolutiva	Manutenzione adattativa e correttiva			
			A_1	A_2	B_1	B_2	C_1	C_2	C_3	D_1	D_2	E1	E2	F
1.00	**Hardware**		1,32	1,32	0,44	0,15	1,95	1,67	0,10	0,03	0,01	0,18	0,17	7,35
2.00	**Software** (di base, middleware, applicativo in licenza d'uso)		1,62	2,62	0,09	0,05	2,23	0,16	0,01	9,95	6,27	1,14	0,15	24,28
3.00	**Personale interno**		0,39	0,97	0,26	0,11	0,64	0,13	0,05	4,63	3,09	1,03	1,92	13,21
4.11	**Servizi da terzi**	**Outsourcing IT**	6,24	5,47	1,34	0,05	1,55	1,04	1,37	2,83	10,44	1,14	1,21	32,70
4.12		**Altri servizi**	0,36	0,90	2,01	0,47	0,61	0,22	0,48	4,05	2,14	0,29	1,24	12,80
4.20		**Personale esterno e consulenza**	0,11	0,38	0,03		0,09	0,03	0,01	4,03	1,76	0,47	0,80	7,70
5.00	**Altri costi IT**		0,14	0,24	0,11		0,06	0,04		0,58	0,22	0,11	0,44	1,96
6.00	**Totale costi IT (TCO)**		10,19	11,92	4,29	0,84	7,14	3,29	2,02	26,10	23,92	4,37	5,93	100
7.00	**Ricavi IT posti a rettifica**		0,01	0,23	0,02		0,03	0,01	0,01	0,38	0,02		0,40	1,13
8.00	**Totale costi IT (TCO) netti**		10,18	11,69	4,28	0,83	7,10	3,28	2,00	25,72	23,89	4,37	5,53	98,87
9.00	**Costi di integrazione a valere sul TCO (riga 6.00)**		0,11	0,10	0,02	0,01	0,06	0,04	0,01	0,14	0,31	0,02	0,01	0,82
10.00	**Ammortamenti a valere sul TCO (riga 6.00)**		0,67	1,50	0,33	0,08	1,49	0,76	0,03	14,72	0,87	0,49	0,26	21,20
11.00	**Investimenti IT**		3,99	6,40	1,07	0,41	11,21	4,29	0,13	66,84	2,01	2,56	1,08	100
12.00	**Cash out IT (Spese correnti + Investimenti)**		10,42	11,30	4,09	0,81	6,68	3,31	1,91	28,55	23,05	4,26	5,60	100

* esclusi due gruppi che hanno attribuito alla voce "Costi IT non classificabili" più del 30% dei propri costi IT.

Tabella 17 - Ripartizione del TCO: 6 gruppi Principali (medie di %)

Fattori produttivi			Aree tematiche									Sicurezza IT	Costi IT non classificabili	Totale consuntivo 2024
			Data center		Sistemi trasmissivi		Sistemi periferici			Applicazioni				
			Mainframe	Server farm	Reti dati e fonia fissa	Fonia mobile	Sistemi decentrati e dotazioni individuali	ATM e chioschi	POS	Sviluppo e manutenzione evolutiva	Manutenzione adattativa e correttiva			
			A_1	A_2	B_1	B_2	C_1	C_2	C_3	D_1	D_2	E1	E2	F
1.00	**Hardware**		4,05	2,71	1,04	0,24	2,36	2,46		0,10	0,02	0,29	0,39	13,67
2.00	**Software** (di base, middleware, applicativo in licenza d'uso)		3,14	4,70	0,17	0,02	2,00	0,27	0,01	14,38	9,05	1,91	0,19	35,84
3.00	**Personale interno**		0,64	1,34	0,29	0,09	0,58	0,08		5,22	3,55	1,31	1,83	14,94
4.11	**Servizi da terzi**	**Outsourcing IT**	1,64	2,54	1,41		0,46	0,44	1,06	0,54	4,53	0,64	1,30	14,57
4.12		**Altri servizi**	0,05	0,15	1,14	0,54	0,12	0,08	0,56	4,59	1,41	0,11	0,33	9,08
4.20		**Personale esterno e consulenza**	0,19	0,54	0,09		0,17	0,08	0,02	1,50	2,93	0,68	0,61	6,82
5.00	**Altri costi IT**		0,48	0,75	0,39	0,01	0,12	0,13		1,87	0,45	0,25	0,63	5,09
6.00	**Totale costi IT (TCO)**		10,20	12,73	4,52	0,91	5,81	3,54	1,66	28,20	21,95	5,19	5,29	100
7.00	**Ricavi IT posti a rettifica**		0,04	0,02	0,01	0,01	0,03	0,02		0,07	0,04	0,01	0,98	1,22
8.00	**Totale costi IT (TCO) netti**		10,16	12,71	4,51	0,90	5,79	3,52	1,66	28,13	21,91	5,18	4,31	98,78
9.00	**Costi di integrazione a valere sul TCO (riga 6.00)**		0,03	0,10	0,02		0,02	0,01		0,21	0,12	0,03	0,03	0,59
10.00	**Ammortamenti a valere sul TCO (riga 6.00)**		1,86	3,48	0,75	0,14	2,82	0,91	0,01	18,08	2,16	0,88	0,70	31,78
11.00	**Investimenti IT**		10,01	7,26	1,78	0,43	5,07	4,56	0,05	60,58	4,80	3,37	2,10	100
12.00	**Cash out IT (Spese correnti + Investimenti)**		10,97	11,66	4,18	0,91	4,67	3,94	1,61	30,85	20,87	5,28	5,06	100

Tabella 18 - Ripartizione del TCO: 15 gruppi Principali e Medi (medie di %)

Fattori produttivi			Aree tematiche											
			Data center		Sistemi trasmissivi		Sistemi periferici			Applicazioni		Sicurezza IT	Costi IT non classificabili	Totale consuntivo 2024
			Mainframe	Server farm	Reti dati e fonia fissa	Fonia mobile	Sistemi decentrati e dotazioni individuali	ATM e chioschi	POS	Sviluppo e manutenzione evolutiva	Manutenzione adattativa e correttiva			
			A_1	A_2	B_1	B_2	C_1	C_2	C_3	D_1	D_2	E1	E2	F
1.00	**Hardware**		1,85	1,82	0,62	0,14	1,81	1,80	0,14	0,04	0,01	0,16	0,24	8,64
2.00	**Software** (di base, middleware, applicativo in licenza d'uso)		1,46	3,59	0,10	0,01	1,64	0,22	0,01	11,33	7,64	1,27	0,19	27,46
3.00	**Personale interno**		0,54	1,04	0,26	0,09	0,67	0,13	0,05	5,29	3,70	1,02	1,91	14,69
4.11	Servizi da terzi	Outsourcing IT	4,66	5,37	0,94	0,08	1,21	0,45	0,65	1,72	5,41	0,85	1,67	23,00
4.12		Altri servizi	0,51	1,06	1,76	0,53	0,64	0,12	0,68	5,24	1,53	0,38	0,62	13,06
4.20		Personale esterno e consulenza	0,16	0,53	0,04		0,11	0,04	0,01	5,53	2,46	0,59	1,09	10,56
5.00	Altri costi IT		0,20	0,34	0,16	0,01	0,07	0,05		0,81	0,30	0,16	0,50	2,60
6.00	Totale costi IT (TCO)		9,39	13,75	3,89	0,85	6,14	2,81	1,54	29,97	21,04	4,42	6,20	100
7.00	Ricavi IT posti a rettifica		0,02	0,32	0,02		0,05	0,01	0,02	0,54	0,03	0,01	0,56	1,58
8.00	Totale costi IT (TCO) netti		9,37	13,44	3,87	0,84	6,10	2,79	1,52	29,43	21,00	4,41	5,64	98,42
9.00	Costi di integrazione a valere sul TCO (riga 6.00)		0,06	0,11	0,02	0,01	0,05	0,01		0,18	0,05	0,01	0,01	0,51
10.00	Ammortamenti a valere sul TCO (riga 6.00)		0,94	2,08	0,46	0,09	1,75	0,85	0,05	15,82	1,21	0,60	0,36	24,21
11.00	Investimenti IT		5,59	5,59	1,41	0,42	4,68	3,40	0,18	71,86	2,82	2,54	1,51	100
12.00	Cash out IT (Spese correnti + Investimenti)		9,80	12,94	3,65	0,84	5,46	2,88	1,42	32,69	20,12	4,39	5,82	100

Tabella 19 - Ripartizione del TCO: 9 gruppi Medi (medie di %)

Fattori produttivi			Aree tematiche									Sicurezza IT	Costi IT non classificabili	Totale consuntivo 2024
			Data center		Sistemi trasmissivi		Sistemi periferici			Applicazioni				
			Mainframe	Server farm	Reti dati e fonia fissa	Fonia mobile	Sistemi decentrati e dotazioni individuali	ATM e chioschi	POS	Sviluppo e manutenzione evolutiva	Manutenzione adattativa e correttiva			
			A_1	A_2	B_1	B_2	C_1	C_2	C_3	D_1	D_2	E1	E2	F
1.00	**Hardware**		0,38	1,23	0,34	0,08	1,44	1,36	0,24			0,08	0,14	5,28
2.00	**Software** (di base, middleware, applicativo in licenza d'uso)		0,35	2,86	0,06		1,40	0,19	0,01	9,30	6,69	0,84	0,18	21,87
3.00	**Personale interno**		0,48	0,84	0,24	0,08	0,73	0,16	0,09	5,34	3,79	0,82	1,95	14,53
4.11	Servizi da terzi	**Outsourcing IT**	6,67	7,25	0,63	0,13	1,71	0,45	0,38	2,51	5,99	0,98	1,91	28,62
4.12		**Altri servizi**	0,82	1,67	2,18	0,52	0,99	0,15	0,76	5,67	1,61	0,55	0,81	15,71
4.20		**Personale esterno e consulenza**	0,14	0,52			0,06	0,01		8,22	2,14	0,54	1,41	13,05
5.00	**Altri costi IT**		0,01	0,07	0,01		0,03			0,11	0,21	0,09	0,41	0,94
6.00	**Totale costi IT (TCO)**		8,84	14,44	3,47	0,80	6,36	2,32	1,47	31,15	20,43	3,91	6,81	100
7.00	**Ricavi IT posti a rettifica**			0,52	0,03		0,06	0,01	0,03	0,85	0,03	0,01	0,29	1,82
8.00	**Totale costi IT (TCO) netti**		8,84	13,92	3,44	0,80	6,30	2,31	1,43	30,30	20,40	3,90	6,53	98,18
9.00	**Costi di integrazione a valere sul TCO (riga 6.00)**		0,08	0,11	0,02	0,02	0,07			0,16				0,46
10.00	**Ammortamenti a valere sul TCO (riga 6.00)**		0,32	1,15	0,27	0,05	1,03	0,82	0,07	14,32	0,59	0,41	0,14	19,16
11.00	**Investimenti IT**		2,64	4,48	1,16	0,41	4,43	2,63	0,26	79,38	1,50	1,98	1,12	100
12.00	**Cash out IT (Spese correnti + Investimenti)**		9,01	13,79	3,29	0,79	5,98	2,17	1,30	33,91	19,62	3,80	6,33	100

Tabella 20 - Ripartizione del TCO: 6* gruppi Piccoli (medie di %)

Fattori produttivi			Aree tematiche									Sicurezza IT	Costi IT non classificabili	Totale consuntivo 2024
			Data center		Sistemi trasmissivi		Sistemi periferici			Applicazioni				
			Mainframe	Server farm	Reti dati e fonia fissa	Fonia mobile	Sistemi decentrati e dotazioni individuali	ATM e chioschi	POS	Sviluppo e manutenzione evolutiva	Manutenzione adattativa e correttiva			
			A_1	A_2	B_1	B_2	C_1	C_2	C_3	D_1	D_2	E1	E2	F
1.00	**Hardware**			0,09		0,18	2,31	1,34				0,22		4,14
2.00	**Software** (di base, middleware, applicativo in licenza d'uso)		2,00	0,19	0,07	0,14	3,70			6,48	2,86	0,82	0,06	16,32
3.00	**Personale interno**			0,79	0,27	0,16	0,57	0,13	0,02	2,97	1,56	1,08	1,94	9,50
4.11	**Servizi da terzi**	**Outsourcing IT**	10,20	5,73	2,32		2,40	2,54	3,18	5,61	23,04	1,89	0,07	56,96
4.12		**Altri servizi**		0,51	2,64	0,34	0,54	0,49		1,09	3,66	0,09	2,81	12,15
4.20		**Personale esterno e consulenza**		0,02			0,04			0,28		0,15	0,07	0,55
5.00	**Altri costi IT**						0,06						0,31	0,37
6.00	**Totale costi IT (TCO)**		12,20	7,32	5,30	0,82	9,62	4,49	3,20	16,43	31,12	4,25	5,25	100
7.00	**Ricavi IT posti a rettifica**													
8.00	**Totale costi IT (TCO) netti**		12,20	7,32	5,30	0,82	9,62	4,49	3,20	16,43	31,12	4,25	5,25	100,00
9.00	**Costi di integrazione a valere sul TCO (riga 6.00)**		0,24	0,08	0,02		0,10	0,11	0,03	0,03	0,97	0,02		1,60
10.00	**Ammortamenti a valere sul TCO (riga 6.00)**			0,04		0,08	0,85	0,52		11,96		0,24		13,69
11.00	**Investimenti IT**			8,43	0,23	0,39	27,52	6,50		54,30		2,63		100
12.00	**Cash out IT (Spese correnti + Investimenti)**		11,98	7,21	5,21	0,75	9,75	4,38	3,13	18,20	30,39	3,94	5,06	100

* esclusi due gruppi che hanno attribuito alla voce “Costi IT non classificabili” più del 30% dei propri costi IT.

Tabella 21 - Ripartizione del TCO: 7 gruppi Insourcing (medie di %)

Fattori produttivi			Aree tematiche											
			Data center		Sistemi trasmissivi		Sistemi periferici			Applicazioni		Sicurezza IT	Costi IT non classificabili	Totale consuntivo 2024
			Mainframe	Server farm	Reti dati e fonia fissa	Fonia mobile	Sistemi decentrati e dotazioni individuali	ATM e chioschi	POS	Sviluppo e manutenzione evolutiva	Manutenzione adattativa e correttiva			
			A_1	A_2	B_1	B_2	C_1	C_2	C_3	D_1	D_2	E1	E2	F
1.00	**Hardware**		3,77	3,07	1,15	0,23	2,54	2,07	0,31	0,01		0,27	0,49	13,91
2.00	**Software** (di base, middleware, applicativo in licenza d'uso)		2,95	4,71	0,18	0,02	1,94	0,33	0,02	15,46	8,66	1,30	0,36	35,93
3.00	**Personale interno**		0,71	1,44	0,39	0,10	0,93	0,23	0,11	6,44	3,22	1,03	2,22	16,82
4.11	**Servizi da terzi**	**Outsourcing IT**	0,44	2,08	0,82		0,49	0,30	0,23	0,45	2,92	0,74	2,70	11,17
4.12		**Altri servizi**	0,04	0,15	1,84	0,71	0,58	0,06	1,34	4,03	1,47	0,18	0,67	11,07
4.20		**Personale esterno e consulenza**	0,17	0,45	0,07		0,09	0,08		1,17	2,82	0,58	1,78	7,20
5.00	**Altri costi IT**		0,36	0,63	0,14	0,01	0,07	0,11		1,45	0,27	0,14	0,71	3,89
6.00	**Totale costi IT (TCO)**		8,43	12,54	4,59	1,07	6,64	3,18	2,01	29,01	19,36	4,23	8,94	100
7.00	**Ricavi IT posti a rettifica**		0,03	0,64	0,04	0,01	0,08	0,03	0,04	1,02	0,05	0,01	1,20	3,14
8.00	**Totale costi IT (TCO) netti**		8,39	11,91	4,55	1,07	6,56	3,15	1,97	27,99	19,31	4,22	7,74	96,86
9.00	**Costi di integrazione a valere sul TCO (riga 6.00)**		0,03	0,09	0,02		0,02	0,01		0,18	0,10	0,03	0,03	0,50
10.00	**Ammortamenti a valere sul TCO (riga 6.00)**		1,82	3,58	0,83	0,14	2,62	0,73	0,10	17,72	2,25	0,71	0,75	31,25
11.00	**Investimenti IT**		11,00	8,85	2,24	0,50	4,38	3,11	0,37	59,54	5,10	2,60	2,31	100
12.00	**Cash out IT (Spese correnti + Investimenti)**		9,39	11,45	4,18	1,05	5,29	3,39	1,76	33,23	17,98	4,18	8,11	100

Tabella 22 - Ripartizione del TCO: 7 gruppi Facility management (medie di %)

Fattori produttivi			Aree tematiche									Sicurezza IT	Costi IT non classificabili	Totale consuntivo 2024
			Data center		Sistemi trasmissivi		Sistemi periferici			Applicazioni				
			Mainframe	Server farm	Reti dati e fonia fissa	Fonia mobile	Sistemi decentrati e dotazioni individuali	ATM e chioschi	POS	Sviluppo e manutenzione evolutiva	Manutenzione adattativa e correttiva			
			A_1	A_2	B_1	B_2	C_1	C_2	C_3	D_1	D_2	E1	E2	F
1.00	**Hardware**		0,20	0,83	0,15	0,06	1,38	1,78		0,07	0,02	0,09	0,02	4,60
2.00	**Software** (di base, middleware, applicativo in licenza d'uso)		0,19	2,53	0,04	0,13	1,58	0,03		11,14	7,89	1,66	0,08	25,26
3.00	**Personale interno**		0,37	0,88	0,13	0,08	0,42	0,04		5,75	3,77	1,45	1,17	14,07
4.11	**Servizi da terzi**	**Outsourcing IT**	8,58	7,81	0,97	0,03	1,95	0,66	1,16	4,33	3,91	0,77	0,91	31,09
4.12		**Altri servizi**	0,65	1,42	1,73	0,31	0,72	0,16		3,89	0,91	0,43	0,75	10,97
4.20		**Personale esterno e consulenza**	0,18	0,43	0,01		0,14		0,02	9,11	2,05	0,55	0,32	12,82
5.00	**Altri costi IT**		0,07	0,09	0,20		0,06			0,25	0,19	0,10	0,22	1,19
6.00	**Totale costi IT (TCO)**		10,24	13,98	3,22	0,61	6,25	2,68	1,19	34,55	18,75	5,07	3,47	100
7.00	**Ricavi IT posti a rettifica**			0,05	0,01		0,02			0,14	0,02	0,01	0,01	0,25
8.00	**Totale costi IT (TCO) netti**		10,24	13,94	3,22	0,61	6,23	2,68	1,19	34,41	18,72	5,06	3,46	99,75
9.00	**Costi di integrazione a valere sul TCO (riga 6.00)**		0,10	0,14	0,02	0,02	0,09			0,21				0,59
10.00	**Ammortamenti a valere sul TCO (riga 6.00)**		0,19	0,79	0,14	0,03	0,83	1,10		21,47	0,35	0,62	0,03	25,54
11.00	**Investimenti IT**		0,97	3,07	0,60	0,25	5,40	4,19	0,01	81,60	0,94	2,56	0,42	100
12.00	**Cash out IT (Spese correnti + Investimenti)**		10,08	13,24	3,11	0,62	6,33	2,61	1,17	36,72	17,72	4,95	3,43	100

Tabella 23 - Ripartizione del TCO: 7* gruppi Outsourcing (medie di %)

Fattori produttivi			Aree tematiche											
			Data center		Sistemi trasmissivi		Sistemi periferici			Applicazioni		Sicurezza IT	Costi IT non classificabili	Totale consuntivo 2024
			Mainframe	Server farm	Reti dati e fonia fissa	Fonia mobile	Sistemi decentrati e dotazioni individuali	ATM e chioschi	POS	Sviluppo e manutenzione evolutiva	Manutenzione adattativa e correttiva			
			A_1	A_2	B_1	B_2	C_1	C_2	C_3	D_1	D_2	E1	E2	F
1.00	**Hardware**			0,07	0,03	0,16	1,94	1,15				0,19		3,54
2.00	**Software** (di base, middleware, applicativo in licenza d'uso)		1,72	0,63	0,06		3,17	0,12		3,24	2,26	0,45		11,64
3.00	**Personale interno**		0,08	0,58	0,27	0,14	0,58	0,12	0,02	1,68	2,28	0,62	2,36	8,73
4.11	Servizi da terzi	**Outsourcing IT**	9,71	6,52	2,22	0,13	2,21	2,17	2,73	3,72	24,49	1,92	0,02	55,84
4.12		**Altri servizi**	0,40	1,15	2,48	0,39	0,54	0,45	0,11	4,24	4,03	0,27	2,30	16,36
4.20		**Personale esterno e consulenza**		0,27			0,04			1,82	0,39	0,27	0,29	3,08
5.00	**Altri costi IT**				0,01		0,06			0,05	0,19	0,09	0,40	0,81
6.00	**Totale costi IT (TCO)**		11,90	9,22	5,06	0,83	8,52	4,01	2,85	14,75	33,65	3,82	5,38	100
7.00	**Ricavi IT posti a rettifica**													
8.00	**Totale costi IT (TCO) netti**		11,90	9,22	5,06	0,83	8,52	4,01	2,85	14,75	33,65	3,82	5,38	100,00
9.00	**Costi di integrazione a valere sul TCO (riga 6.00)**		0,21	0,07	0,02		0,08	0,10	0,03	0,03	0,83	0,02		1,37
10.00	**Ammortamenti a valere sul TCO (riga 6.00)**			0,11	0,03	0,08	1,02	0,45		4,98		0,15		6,82
11.00	**Investimenti IT**			7,29	0,38	0,48	23,84	5,57		59,38		2,54	0,52	100
12.00	**Cash out IT (Spese correnti + Investimenti)**		11,79	9,23	4,99	0,77	8,43	3,93	2,79	15,69	33,46	3,65	5,27	100

* esclusi due gruppi che hanno attribuito alla voce "Costi IT non classificabili" più del 30% dei propri costi IT.

Tabella 24 - Ripartizione del TCO: 27* banche (medie di %)

Fattori produttivi				Aree tematiche											
				Data center		Sistemi trasmissivi		Sistemi periferici			Applicazioni		Sicurezza IT	Costi IT non classificabili	Totale consuntivo 2024
				Mainframe	Server farm	Reti dati e fonia fissa	Fonia mobile	Sistemi decentrati e dotazioni individuali	ATM e chioschi	POS	Sviluppo e manutenzione evolutiva	Manutenzione adattativa e correttiva			
				A_1	A_2	B_1	B_2	C_1	C_2	C_3	D_1	D_2	E_1	E_2	F
1.00	**Hardware**			0,89	0,73	0,30	0,26	1,52	0,99		0,02		0,16	0,01	4,88
2.00	**Software** (di base, middleware, applicativo in licenza d'uso)			1,29	1,62	0,05	0,01	1,63	0,07		9,18	4,42	0,83	0,05	19,15
3.00	**Personale interno**			0,35	0,77	0,19	0,09	0,50	0,08	0,01	4,69	2,11	0,82	1,42	11,04
4.01	Servizi da terzi	Banche o società strumentali del gruppo	Outsourcing IT	0,65	2,27	0,56	0,01	0,96	0,09		6,55	5,11	0,63	1,36	18,20
4.02			Altri servizi		0,08	0,29	0,05	0,35	0,06		4,14	0,79	0,28	0,14	6,19
4.11		Fornitori esterni	Outsourcing IT	6,13	2,82	0,95	0,03	0,85	0,72	1,11	2,25	7,83	0,78	0,17	23,64
4.12			Altri servizi	0,29	0,61	1,91	0,45	0,96	0,14	0,49	4,68	2,01	0,17	0,86	12,56
4.20		Personale esterno e consulenza		0,06	0,25	0,01		0,15		0,01	1,80	0,63	0,30	0,21	3,42
5.00	**Altri costi IT**			0,05	0,07	0,19		0,05	0,01		0,14	0,15	0,07	0,19	0,92
6.00	**Totale costi IT (TCO)**			9,72	9,22	4,45	0,91	6,95	2,16	1,62	33,46	23,06	4,04	4,42	100
7.00	**Ricavi IT posti a rettifica**			0,01	0,01	0,02		0,03	0,01	0,01	0,36	0,68	0,01	0,01	1,14
8.00	**Totale costi IT (TCO) netti**			9,71	9,22	4,43	0,91	6,92	2,15	1,60	33,10	22,38	4,03	4,40	98,86

10.00	**Ammortamenti a valere sul TCO (riga 6.00)**	0,42	0,94	0,23	0,11	1,21	0,52		11,47	0,79	0,36	0,10	16,15
11.00	**Investimenti IT****	1,75	6,17	2,79	1,30	11,24	3,56	0,03	60,87	2,91	2,57	6,80	100
12.00	**Cash out IT (Spese correnti + Investimenti)**	9,27	8,92	4,28	0,87	6,72	2,15	1,55	33,50	23,02	4,04	5,66	100

* escluse cinque banche che hanno attribuito alla voce “Costi IT non classificabili” più del 30% dei propri costi IT.

** valori calcolati su 22 banche (cinque non hanno segnalato investimenti).

Tabella 25 - Ripartizione del TCO: 8 banche Maggiori (medie di %)

Fattori produttivi				Aree tematiche									Sicurezza IT	Costi IT non classificabili	Totale consuntivo 2024
				Data center		Sistemi trasmissivi		Sistemi periferici			Applicazioni				
				Mainframe	Server farm	Reti dati e fonia fissa	Fonia mobile	Sistemi decentrati e dotazioni individuali	ATM e chioschi	POS	Sviluppo e manutenzione evolutiva	Manutenzione adattativa e correttiva			
				A_1	A_2	B_1	B_2	C_1	C_2	C_3	D_1	D_2	E_1	E_2	F
1.00	**Hardware**			3,02	1,72	0,68	0,21	1,93	2,20		0,08	0,02	0,13	0,02	10,01
2.00	**Software** (di base, middleware, applicativo in licenza d'uso)			2,11	3,11	0,12	0,02	1,80	0,08	0,01	10,76	6,53	1,51	0,09	26,13
3.00	**Personale interno**			0,57	1,08	0,21	0,11	0,59	0,07		3,41	2,37	1,24	1,23	10,87
4.01	**Servizi da terzi**	**Banche o società strumentali del gruppo**	**Outsourcing IT**	1,21	3,76	0,34	0,05	1,17	0,29		6,11	6,24	0,97	2,36	22,50
4.02			**Altri servizi**			0,10	0,02	0,21	0,21						0,54
4.11		**Fornitori esterni**	**Outsourcing IT**	3,10	1,96	0,60		0,57	0,32	0,99	0,60	3,25	0,36	0,14	11,89
4.12			**Altri servizi**	0,62	0,58	0,98	0,50	0,40	0,03	0,42	5,33	1,08	0,13	0,07	10,14
4.20		**Personale esterno e consulenza**		0,20	0,44	0,01		0,13	0,01	0,02	3,51	1,10	0,55	0,21	6,20
5.00	**Altri costi IT**			0,17	0,24	0,19	0,01	0,09	0,03		0,34	0,27	0,15	0,22	1,72
6.00	**Totale costi IT (TCO)**			10,99	12,90	3,24	0,92	6,90	3,24	1,44	30,13	20,85	5,05	4,34	100
7.00	**Ricavi IT posti a rettifica**			0,04	0,02	0,04	0,01	0,06	0,01		0,37	0,35	0,03	0,05	0,97
8.00	**Totale costi IT (TCO) netti**			10,95	12,88	3,20	0,91	6,84	3,23	1,44	29,77	20,50	5,02	4,30	99,03
10.00	**Ammortamenti a valere sul TCO (riga 6.00)**			1,39	2,52	0,52	0,13	2,28	0,85	0,01	15,04	1,90	0,78	0,09	25,51
11.00	**Investimenti IT***			5,48	6,90	1,30	0,55	4,55	3,60	0,04	69,48	4,33	3,45	0,32	100
12.00	**Cash out IT (Spese correnti + Investimenti)**			10,98	12,66	3,07	0,93	5,95	3,35	1,41	31,53	20,57	5,20	4,34	100

* valori calcolati su sette banche (una non ha segnalato investimenti).

Tabella 26 - Ripartizione del TCO: 4* banche Grandi (medie di %)

Fattori produttivi				Aree tematiche									Sicurezza IT	Costi IT non classificabili	Totale consuntivo 2024
				Data center		Sistemi trasmissivi		Sistemi periferici			Applicazioni				
				Mainframe	Server farm	Reti dati e fonia fissa	Fonia mobile	Sistemi decentrati e dotazioni individuali	ATM e chioschi	POS	Sviluppo e manutenzione evolutiva	Manutenzione adattativa e correttiva			
				A_1	A_2	B_1	B_2	C_1	C_2	C_3	D_1	D_2	E_1	E_2	F
1.00	**Hardware**				0,81	0,22	0,02	0,96	0,87				0,09		2,97
2.00	**Software** (di base, middleware, applicativo in licenza d'uso)			0,27	3,34	0,01	0,01	1,50	0,23		9,29	4,18	0,52	0,06	19,40
3.00	**Personale interno**			0,38	0,51	0,18	0,05	0,26	0,06		5,68	4,41	0,71	1,92	14,15
4.01	Servizi da terzi	Banche o società strumentali del gruppo	Outsourcing IT												
4.02			Altri servizi												
4.11		Fornitori esterni	Outsourcing IT	8,28	6,22	0,47	0,22	0,29	0,14	0,05	2,58	8,68	1,46	0,70	29,08
4.12			Altri servizi	0,70	2,15	2,82	0,35	0,66	0,12	0,19	10,27	5,26	0,43	1,11	24,07
4.20		Personale esterno e consulenza		0,04	0,71	0,01		0,07			4,84	1,83	0,60	0,90	9,01
5.00	**Altri costi IT**			0,03	0,02	0,02		0,04	0,01		0,25	0,46	0,18	0,33	1,32
6.00	**Totale costi IT (TCO)**			9,69	13,76	3,74	0,65	3,76	1,43	0,24	32,89	24,82	4,00	5,01	100
7.00	**Ricavi IT posti a rettifica**					0,02		0,07			1,67	0,24	0,01		2,01
8.00	**Totale costi IT (TCO) netti**			9,69	13,76	3,72	0,65	3,69	1,43	0,24	31,23	24,58	3,99	5,01	97,99

10.00	**Ammortamenti a valere sul TCO (riga 6.00)**	0,03	0,70	0,21	0,04	0,93	0,53		12,74	0,27	0,14	0,02	15,62
11.00	**Investimenti IT**	0,03	3,61	0,80	0,38	3,56	2,12		85,76	1,25	1,54	0,94	100
12.00	**Cash out IT (Spese correnti + Investimenti)**	9,51	13,65	3,57	0,66	3,54	1,37	0,25	33,60	24,90	4,03	4,93	100

* escluse due banche che hanno attribuito alla voce “Costi IT non classificabili” più del 30% dei propri costi IT.

Tabella 27 - Ripartizione del TCO: 5* banche Medie (medie di %)

	Fattori produttivi	Aree tematiche – Data center: Mainframe A1	Aree tematiche – Data center: Server farm A2	Aree tematiche – Sistemi trasmissivi: Reti dati e fonia fissa B1	Aree tematiche – Sistemi trasmissivi: Fonia mobile B2	Aree tematiche – Sistemi periferici: Sistemi decentrati e dotazioni individuali C1	Aree tematiche – Sistemi periferici: ATM e chioschi C2	Aree tematiche – Sistemi periferici: POS C3	Aree tematiche – Applicazioni: Sviluppo e manutenzione evolutiva D1	Aree tematiche – Applicazioni: Manutenzione adattativa e correttiva D2	Sicurezza IT E1	Costi IT non classificabili E2	Totale consuntivo 2024 F
1.00	**Hardware**			0,08	0,20	1,73	1,03					0,02	3,06
2.00	**Software** (di base, middleware, applicativo in licenza d'uso)	2,41	0,12			2,58	0,02		7,95	2,37	0,45		15,89
3.00	**Personale interno**		0,40	0,16	0,11	0,21	0,08	0,03	0,92	0,67	0,57	2,85	6,01
4.01	**Servizi da terzi – Banche o società strumentali del gruppo – Outsourcing IT**	0,57	4,12	0,50		0,41			7,27		0,31	1,01	14,19
4.02	**Servizi da terzi – Banche o società strumentali del gruppo – Altri servizi**		0,43	1,41	0,26	1,56			22,37	4,27	1,52	0,74	32,56
4.11	**Servizi da terzi – Fornitori esterni – Outsourcing IT**	6,36	3,16	0,23		2,03	0,16	0,48	2,44	5,49	0,94	0,05	21,34
4.12	**Servizi da terzi – Fornitori esterni – Altri servizi**		0,13	1,92	0,66	0,56	0,58	1,82		0,54	0,09	0,12	6,42
4.20	**Servizi da terzi – Personale esterno e consulenza**		0,02						0,01	0,02	0,01	0,08	0,14
5.00	**Altri costi IT**					0,01						0,37	0,38
6.00	**Totale costi IT (TCO)**	9,34	8,37	4,30	1,23	9,09	1,87	2,33	40,97	13,36	3,89	5,25	100
7.00	**Ricavi IT posti a rettifica**						0,01	0,06	0,03				0,10
8.00	**Totale costi IT (TCO) netti**	9,34	8,37	4,30	1,23	9,09	1,87	2,27	40,94	13,36	3,89	5,24	99,90
10.00	**Ammortamenti a valere sul TCO (riga 6.00)**			0,10	0,14	1,21	0,88		7,04			0,03	9,39
11.00	**Investimenti IT****		0,41	12,00	5,64	18,46	11,16	0,09	46,51			5,74	100
12.00	**Cash out IT (Spese correnti + Investimenti)**	9,23	8,24	4,26	1,13	9,03	1,89	2,12	41,95	13,10	3,84	5,21	100

* escluse due banche che hanno attribuito alla voce "Costi IT non classificabili" più del 30% dei propri costi IT.

** valori calcolati su quattro banche (una non ha segnalato investimenti).

Tabella 28 - Ripartizione del TCO: 10* banche Piccole A e B (medie di %)

Fattori produttivi				Aree tematiche									Sicurezza IT	Costi IT non classificabili	Totale consuntivo 2024
				Data center		Sistemi trasmissivi		Sistemi periferici			Applicazioni				
				Mainframe	Server farm	Reti dati e fonia fissa	Fonia mobile	Sistemi decentrati e dotazioni individuali	ATM e chioschi	POS	Sviluppo e manutenzione evolutiva	Manutenzione adattativa e correttiva			
				A_1	A_2	B_1	B_2	C_1	C_2	C_3	D_1	D_2	E_1	E_2	F
1.00	**Hardware**				0,26	0,12	0,42	1,31	0,04				0,30	0,01	2,45
2.00	**Software** (di base, middleware, applicativo in licenza d'uso)			0,48	0,49	0,04		1,06	0,03		8,49	3,87	0,61	0,04	15,10
3.00	**Personale interno**			0,33	0,82	0,20	0,09	0,67	0,10		7,21	1,71	0,65	0,65	12,44
4.01	**Servizi da terzi**	**Banche o società strumentali del gruppo**	**Outsourcing IT**	0,51	1,05	1,00		1,44	0,01		9,17	8,82	0,77	1,29	24,04
4.02			**Altri servizi**												
4.11		**Fornitori esterni**	**Outsourcing IT**	7,58	1,98	1,78		0,71	1,55	1,95	3,35	12,32	0,75	0,05	32,03
4.12			**Altri servizi**		0,26	2,29	0,35	1,72			4,26	2,19	0,12	1,77	12,96
4.20		**Personale esterno e consulenza**			0,03			0,27			0,13	0,07	0,11		0,60
5.00	**Altri costi IT**					0,34		0,03						0,01	0,38
6.00	**Totale costi IT (TCO)**			8,90	4,89	5,76	0,86	7,20	1,73	1,95	32,60	28,97	3,31	3,82	100
7.00	**Ricavi IT posti a rettifica**											1,46			1,46
8.00	**Totale costi IT (TCO) netti**			8,90	4,89	5,76	0,86	7,20	1,73	1,95	32,60	27,51	3,31	3,82	98,54

10.00	**Ammortamenti a valere sul TCO (riga 6.00)**		0,24	0,08	0,12	0,46	0,07		10,31	0,50	0,30	0,17	12,24
11.00	**Investimenti IT****		10,19	0,16	0,11	18,20			46,25	4,10	3,75	17,24	100
12.00	**Cash out IT (Spese correnti + Investimenti)**	7,83	4,38	5,55	0,79	7,46	1,62	1,90	30,82	29,20	3,22	7,24	100

* esclusa una banca che ha attribuito alla voce "Costi IT non classificabili" più del 30% dei propri costi IT.

** valori calcolati su sette banche (tre non hanno segnalato investimenti).

Tabella 29 - Ripartizione del TCO: 5 banche Piccole A (medie di %)

	Fattori produttivi	Aree tematiche									Sicurezza IT	Costi IT non classificabili	Totale consuntivo 2024
		Data center		Sistemi trasmissivi		Sistemi periferici			Applicazioni				
		Mainframe	Server farm	Reti dati e fonia fissa	Fonia mobile	Sistemi decentrati e dotazioni individuali	ATM e chioschi	POS	Sviluppo e manutenzione evolutiva	Manutenzione adattativa e correttiva			
		A_1	A_2	B_1	B_2	C_1	C_2	C_3	D_1	D_2	E_1	E_2	F
1.00	**Hardware**		0,45	0,19	0,25	2,19	0,08				0,60	0,01	3,77
2.00	**Software** (di base, middleware, applicativo in licenza d'uso)	0,96	0,99	0,08		2,13	0,05		9,83	6,56	1,09	0,07	21,76
3.00	**Personale interno**	0,67	1,64	0,33	0,19	1,21	0,14		8,12	3,30	1,24	0,69	17,53
4.01	**Servizi da terzi** - **Banche o società strumentali del gruppo** - **Outsourcing IT**		1,07	0,17		0,47			1,87		0,29	0,45	4,31
4.02	**Servizi da terzi** - **Banche o società strumentali del gruppo** - **Altri servizi**												
4.11	**Servizi da terzi** - **Fornitori esterni** - **Outsourcing IT**	3,80	3,24	2,39		0,88	2,14	2,52	4,52	16,69	1,26	0,09	37,54
4.12	**Servizi da terzi** - **Fornitori esterni** - **Altri servizi**	0,01	0,52	3,72	0,50	3,43			1,23	4,37	0,25	0,37	14,39
4.20	**Servizi da terzi** - **Personale esterno e consulenza**		0,06			0,05			0,25	0,13	0,11		0,61
5.00	**Altri costi IT**					0,06						0,02	0,09
6.00	**Totale costi IT (TCO)**	5,43	7,96	6,88	0,94	10,43	2,42	2,52	25,82	31,06	4,83	1,71	100
7.00	**Ricavi IT posti a rettifica**									2,92			2,92
8.00	**Totale costi IT (TCO) netti**	5,43	7,96	6,88	0,94	10,43	2,42	2,52	25,82	28,14	4,83	1,71	97,08

10.00	**Ammortamenti a valere sul TCO (riga 6.00)**		0,48	0,16	0,24	0,51	0,13		15,79	0,99	0,60		18,90
11.00	**Investimenti IT***		17,84	0,29	0,19	20,66			42,12	7,17	6,57	5,17	100
12.00	**Cash out IT (Spese correnti + Investimenti)**	5,48	6,92	6,56	0,73	9,95	2,26	2,50	24,96	31,83	4,66	4,16	100

* valori calcolati su quattro banche (una non ha segnalato investimenti).

Tabella 30 - Ripartizione del TCO: 5* banche Piccole B (medie di %)

	Fattori produttivi	Aree tematiche											
		Data center		Sistemi trasmissivi		Sistemi periferici			Applicazioni		Sicurezza IT	Costi IT non classificabili	Totale consuntivo 2024
		Mainframe	Server farm	Reti dati e fonia fissa	Fonia mobile	Sistemi decentrati e dotazioni individuali	ATM e chioschi	POS	Sviluppo e manutenzione evolutiva	Manutenzione adattativa e correttiva			
		A_1	A_2	B_1	B_2	C_1	C_2	C_3	D_1	D_2	E_1	E_2	F
1.00	**Hardware**		0,06	0,06	0,58	0,42							1,13
2.00	**Software** (di base, middleware, applicativo in licenza d'uso)								7,14	1,18	0,12		8,44
3.00	**Personale interno**			0,06		0,13	0,06		6,29	0,13	0,06	0,62	7,35
4.01	Servizi da terzi – Banche o società strumentali del gruppo – Outsourcing IT	1,01	1,03	1,82		2,41	0,01		16,48	17,63	1,25	2,12	43,77
4.02	Servizi da terzi – Banche o società strumentali del gruppo – Altri servizi												
4.11	Servizi da terzi – Fornitori esterni – Outsourcing IT	11,36	0,73	1,16		0,54	0,95	1,37	2,18	7,95	0,25	0,02	26,52
4.12	Servizi da terzi – Fornitori esterni – Altri servizi			0,86	0,20				7,29			3,18	11,52
4.20	Servizi da terzi – Personale esterno e consulenza					0,48					0,11		0,59
5.00	Altri costi IT			0,68									0,68
6.00	Totale costi IT (TCO)	12,37	1,83	4,65	0,78	3,98	1,03	1,37	39,38	26,88	1,79	5,93	100
7.00	Ricavi IT posti a rettifica												
8.00	Totale costi IT (TCO) netti	12,37	1,83	4,65	0,78	3,98	1,03	1,37	39,38	26,88	1,79	5,93	100,00

10.00	Ammortamenti a valere sul TCO (riga 6.00)					0,40			4,84			0,34	5,58
11.00	Investimenti IT**					14,92			51,74			33,33	100
12.00	Cash out IT (Spese correnti + Investimenti)	10,18	1,84	4,54	0,84	4,98	0,97	1,30	36,68	26,57	1,79	10,31	100

* esclusa una banca che ha attribuito alla voce "Costi IT non classificabili" più del 30% dei propri costi IT.
** valori calcolati su tre banche (due non hanno segnalato investimenti).

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TU Delft

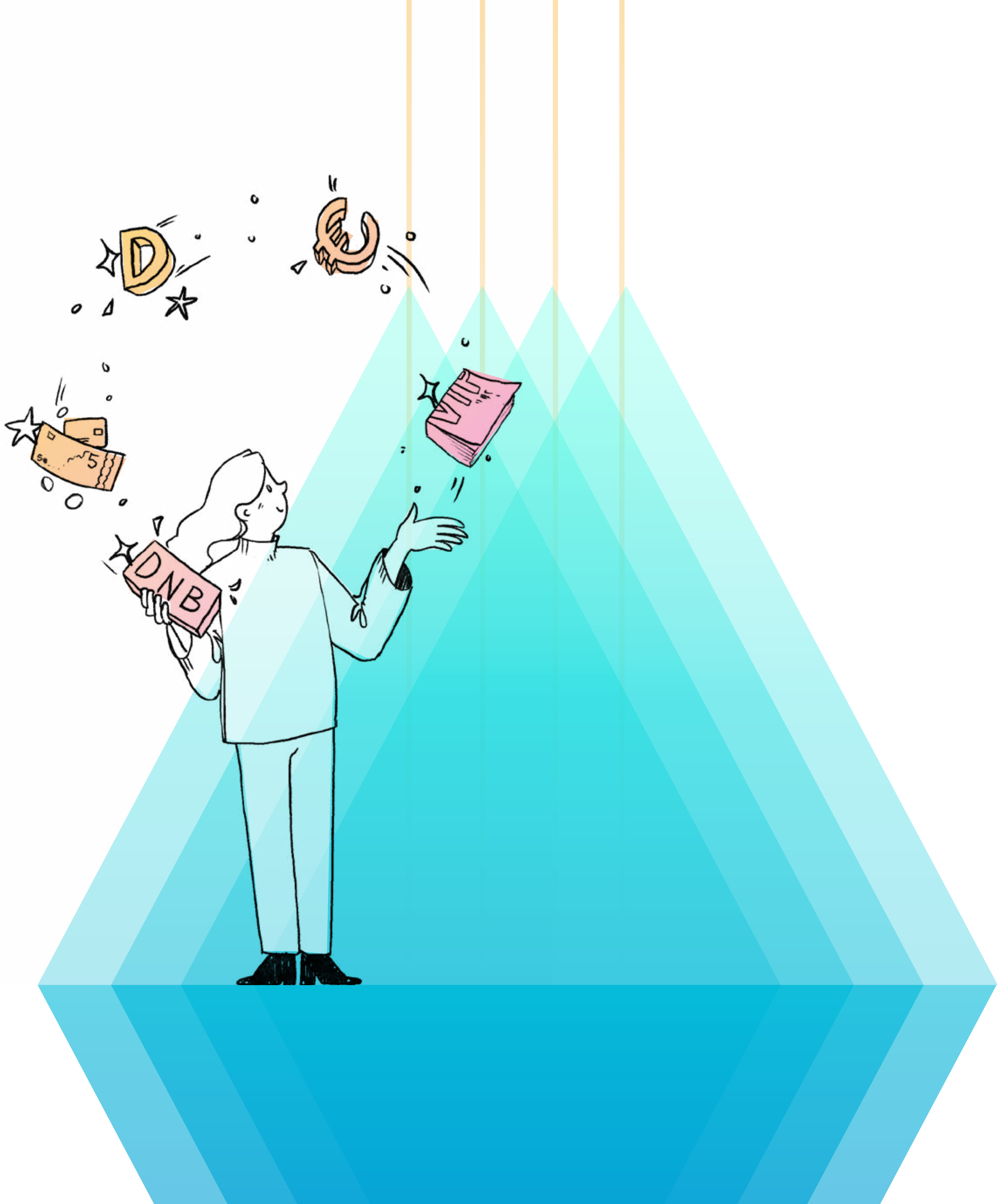
DeNederlandscheBank
EUROSYSTEEM

INVESTIGATING THE DESIGN OF A DIGITAL EURO

Exploring the interplay between agency and trust in the future of digital payments

Master Thesis
Sterre Witlox
MSc. Integrated Product Design

February 2025



INVESTIGATING THE DESIGN OF A DIGITAL EURO

Exploring the interplay between agency and trust in the future of digital payments

Sterre Binskjen Anne Witlox

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Delft University of Technology

Supervisory team
Prof. ir. Matthijs van Dijk
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February 2025

PREFACE

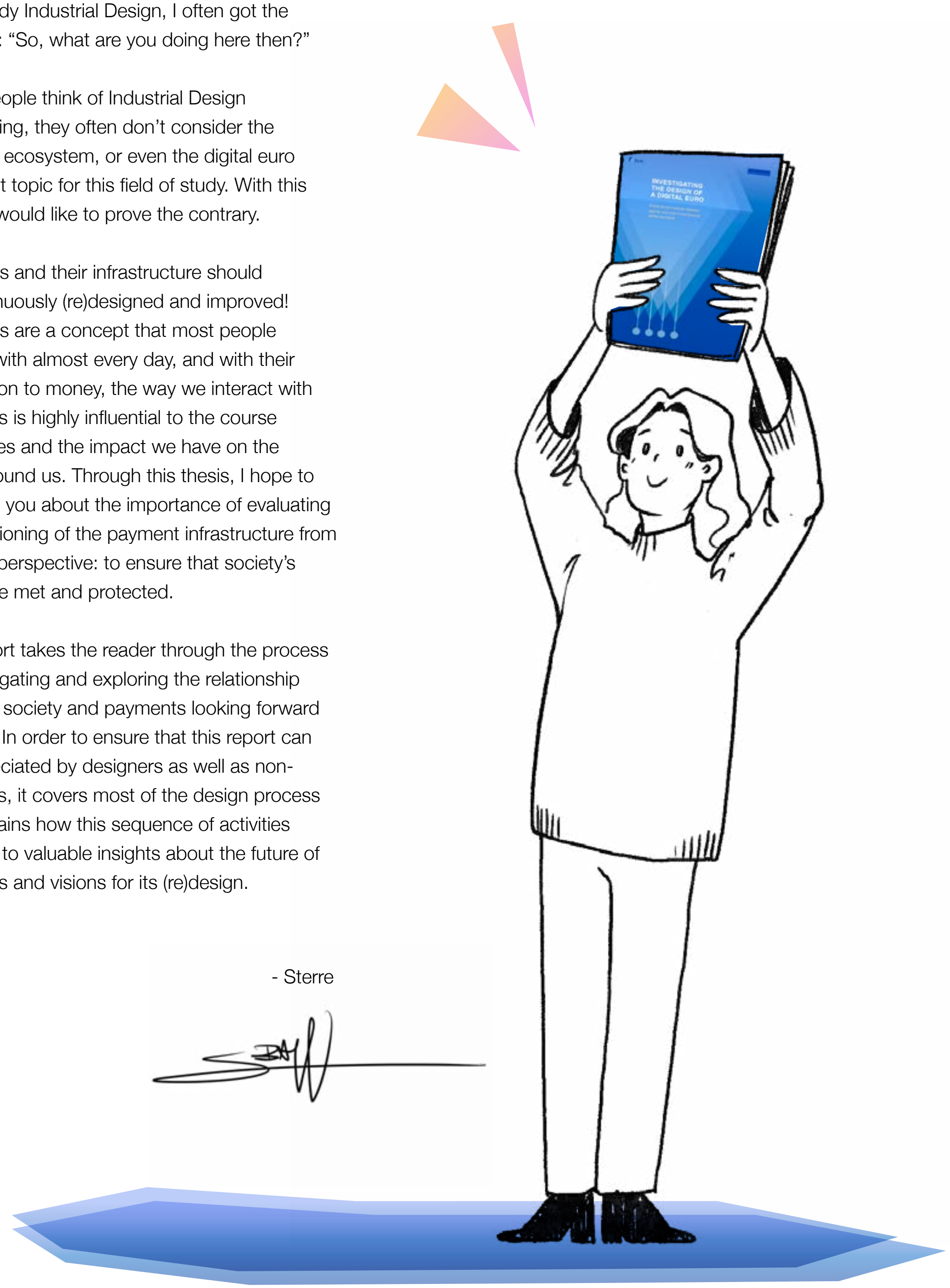
When I told people at De Nederlandsche Bank that I study Industrial Design, I often got the question: “So, what are you doing here then?”

When people think of Industrial Design Engineering, they often don’t consider the payment ecosystem, or even the digital euro a relevant topic for this field of study. With this thesis, I would like to prove the contrary.

Payments and their infrastructure should be continuously (re)designed and improved! Payments are a concept that most people interact with almost every day, and with their connection to money, the way we interact with payments is highly influential to the course of our lives and the impact we have on the world around us. Through this thesis, I hope to convince you about the importance of evaluating the functioning of the payment infrastructure from a public perspective: to ensure that society’s needs are met and protected.

This report takes the reader through the process of investigating and exploring the relationship between society and payments looking forward to 2035. In order to ensure that this report can be appreciated by designers as well as non-designers, it covers most of the design process and explains how this sequence of activities can lead to valuable insights about the future of payments and visions for its (re)design.

- Sterre



ACKNOWLEDGMENTS

I feel highly fortunate to conclude my time as an industrial design engineering student with this project. The topic of payments and the philosophical questions surrounding it have engaged me deeply, but especially the support I have received in the process has allowed me to work on it with joy until the last minute.

First, I would like to express my gratitude to my supervisory team from TU Delft, Matthijs van Dijk and Jaap Daalhuizen, who have supported me from the design side.

I would like to thank Matthijs for his enthusiasm for the project from the very first moment. Our meetings had an extremely energizing effect on me, and it was a pleasure learning about the ViP methodology from you. I really enjoyed our meetings at your office, pulling me out of my regular context, even though the road there was not always the smoothest ;)

Jaap, I would like to thank for our low-stress weekly meetings that gave me an opportunity to land and gather my thoughts at such regular intervals. The wide domain of this project and the complexities of the surrounding context were often a source of confusion. Your ability to summarize my barrage of thoughts with a simple sentence: “So what I think you are saying is....”, was extremely helpful in organizing this chaos. I also appreciate your tendency to say “have fun” rather than “good luck” whenever we went our separate ways. I think that reminder to enjoy the process greatly contributed to the results that were ultimately achieved.

I would also like to thank the supervisors assigned to me from De Nederlandsche Bank, Anneloes van Gent and Huib Klarenbeek, for their enthusiastic engagement with the topic and their open-mindedness toward the creative design process. For non-designers, the design process can be difficult to follow at times, especially the Vision in Product design methodology. Huib and Anneloes’ enthusiasm and open-mindedness allowed me to create with high levels of creative freedom while receiving frequent and valuable insights about the world of payments. I also felt highly welcomed into the wider RBO team and will look back fondly on the weekly stand-ups, where we extensively discussed the highlights of the past weekend.

Next, I would like to thank anyone with whom I spoke about my project during the last six months. This thesis occupied most of my thoughts and actions, and I’m sure my friends, family, and acquaintances noticed. As payments are a concept that virtually everyone interacts with, and the digital euro is especially mysterious and intriguing, I have been able to enthusiastically and extensively discuss my project with many people, greatly helping me develop my position as a designer in this domain.

Of those who had to be bothered with my endless philosophizing about payments, I would specifically like to thank a couple of people. Matthias, who has supported me greatly and who will be pleased to know his girlfriend’s brain is returning from thesis-land; My parents, who have always supported my creative and academic passions and whom I can count to lean upon; and my friends from industrial design, who have filled many coffee breaks with inspiring conversations.

The last honorable mention is the Design Drawing Staff, not only for their (emotional) support during this thesis but especially for the past six years, during which I have had the pleasure of assisting in drawing classes. Their confidence in me as a second-year student to become a teaching assistant has allowed me to grow and become the designer I am today.

EXECUTIVE SUMMARY

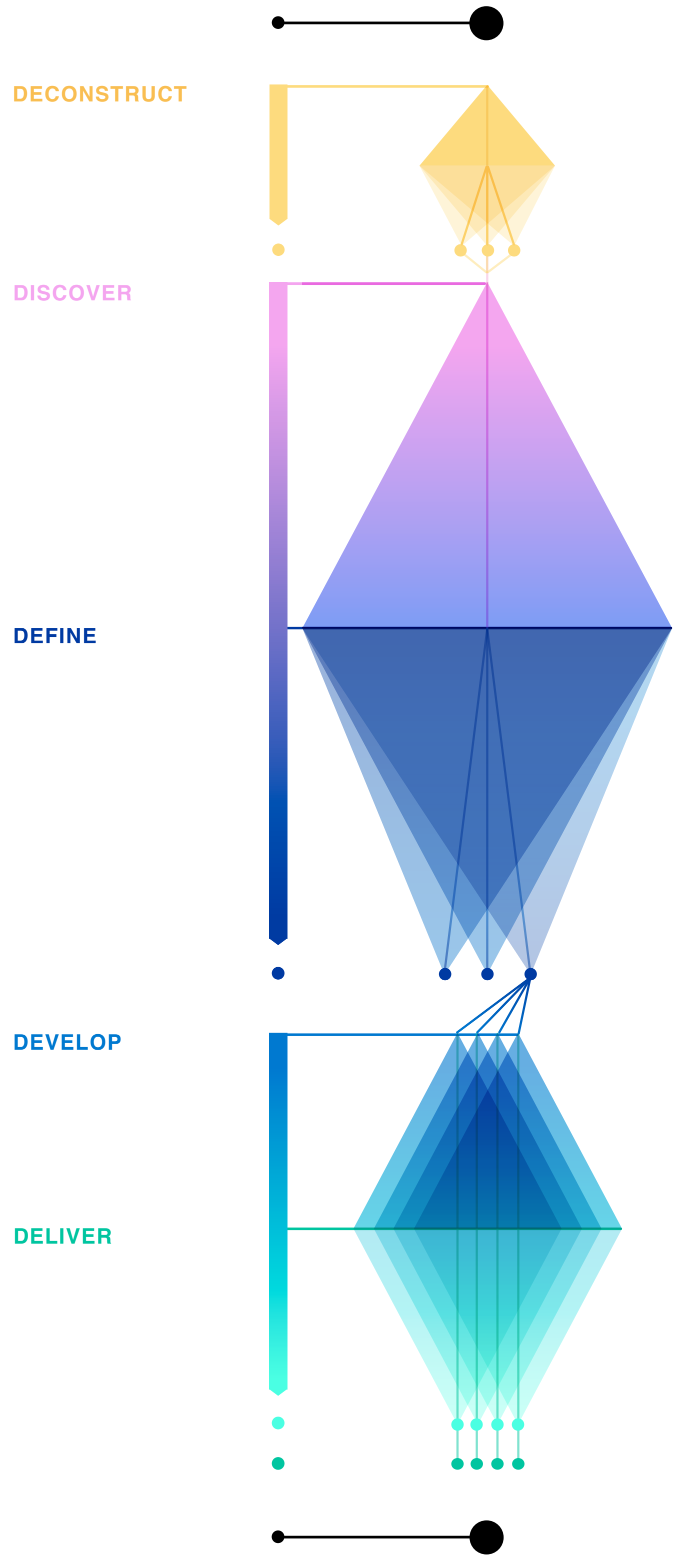
Society is becoming increasingly digital and as a result, digital means of payment are rising in importance. Faster, more efficient, and increasingly accessible payments in the Netherlands have caused a decline in the use of cash, as many consumers and merchants choose private payment methods over central bank money (Betaalvereniging, 2024). As the use of cash dwindles, the key values associated with central bank money such as inclusivity, privacy, resilience, or usability across Europe might no longer be secured.

In response, the euro system, consisting of 20 central banks of the euro area including the European Central Bank and the Dutch Central Bank, is working on the introduction of the Digital Euro: a new form of central bank money designed to address these challenges (European Central Bank, 2024). While the policy level vision for the digital euro is strong, improving resilience of the European payment infrastructure, vision about the value on an individual level should be deepened and translated to the design of the Digital Euro. In order to achieve this policy level vision it is important that consumers and merchants adopt the payment method as a result of the value it brings them.

This thesis investigates how society interacts with payments today, anticipates how these interactions are likely to evolve, and identifies how DNB and other stakeholders in the Netherlands' payment infrastructure should intervene through the design of the digital euro.

The study is approached using the Vision in Product Design methodology, to create a design vision for the Digital Euro based on the emerging challenges from the investigated likely future vision. This project answers the following 3 research questions:

- "What are the main design challenges in the current relationship between society and payments?"
- "Which design challenges emerge as a result of the changing relationship between society and payments in the Netherlands by 2035?"
- "Upon which of the challenges emerging from the changing relationship between society and payments can DNB intervene through the design of the digital euro?"



DECONSTRUCT

To better understand the starting point of this thesis, the product "payments" is analyzed on three interconnected levels: product, interaction and context level. The shift from public to private payments has intensified the conflict between the public role of the payment infrastructure and private actors facilitating it. Three challenges impairing the current relationship between society and payments are identified:

1. **MARKET LIMITATIONS FOR ACCESSIBILITY**
2. **(DIGITAL) FINANCIAL LITERACY**
3. **TRUST**

DISCOVER AND DEFINE

This thesis explores the evolving relationship between society and payments, with a focus on the interplay between *agency* and *trust*: The digitization of payments has shifted the power dynamic, often positioning users as either the product or the consumer in financial transactions. In this opaque digital system, individuals must rely on trust. However, identifying who or what to trust remains challenging for many. Three key challenges for payments in general arise based on three trust attitudes identified in the re-framing:

	Emerging Challenges	Future Visions
A.	**UNSAFE FINANCIAL BEHAVIOR** Blind reliance on systems not designed in the best interest of individuals.	**RESPONSIBLE DIGITAL FINANCIAL INCLUSION** Payments should empower individuals to make informed financial decisions, ensuring they understand risks and can navigate digital transactions safely.
B.	**FEELING STAGNANT AND INSIGNIFICANT** Functional use of payments without tangible connection to their broader impact.	**EXPERIENCING IMPACT THROUGH PAYMENTS** Payment systems should allow individuals to see and influence the broader effects of their financial choices, fostering a sense of agency and contribution to society.
C.	**LOW TRUST IN OTHERS AND INSTITUTIONS** Distrust and individualism that undermine collective action and social cohesion.	**TRUSTWORTHY PAYMENT INFRASTRUCTURE** A reliable, transparent, and publicly governed payment system should reinforce trust in financial institutions and ensure stability for all users.

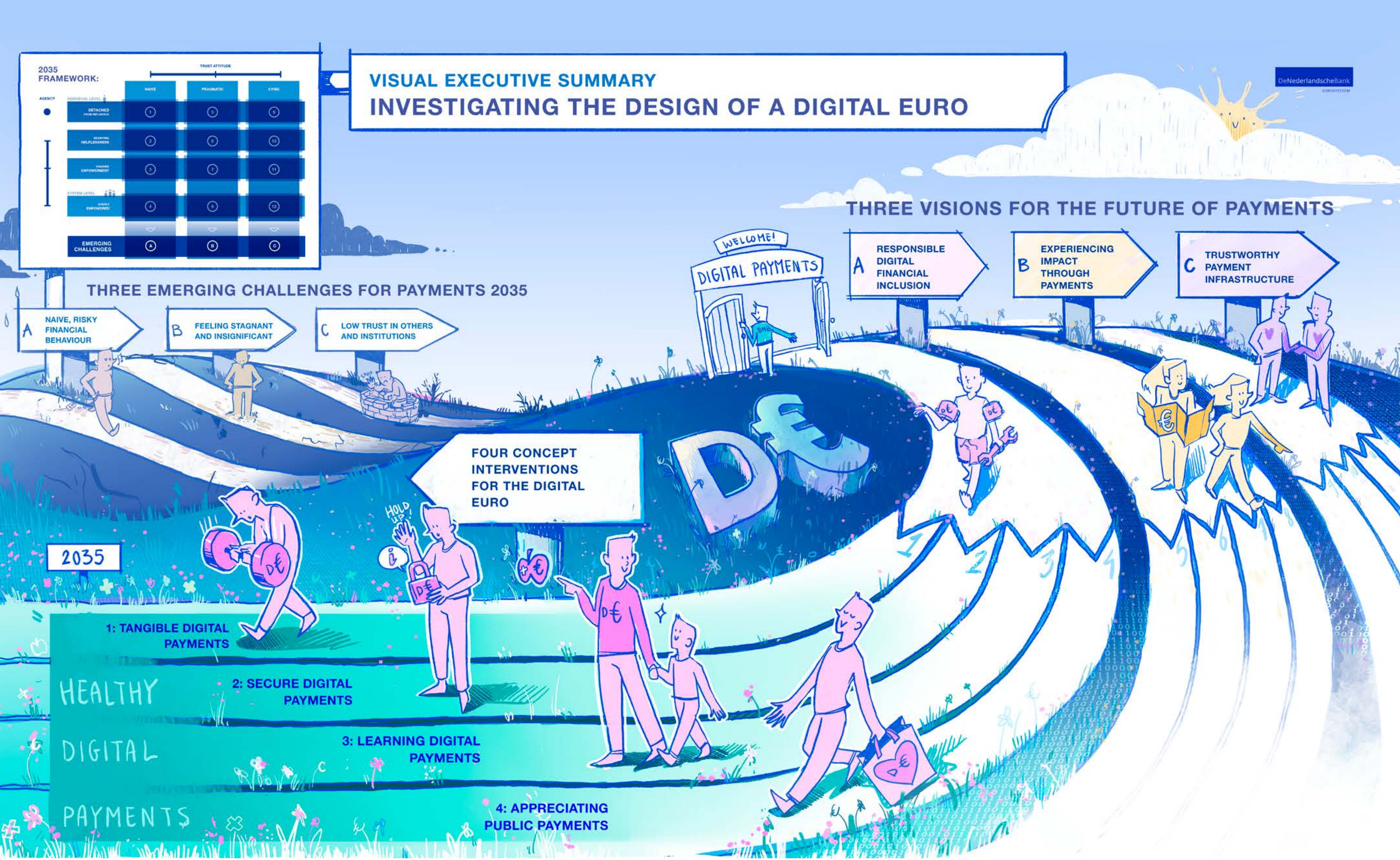
DEVELOP AND DELIVER

From the three identified challenges, one is selected for deeper exploration and design. The designed interventions for the digital euro, illustrate solutions that are in line with DNB's mission to restore the values of central bank money while adapting to the needs of a digital society.

1. **TANGIBLE DIGITAL PAYMENTS -**
2. **SECURE DIGITAL PAYMENTS -**
3. **LEARNING DIGITAL PAYMENTS -**
4. **TANGIBLE VALUE FOR DIGITAL PAYMENTS -**

To conclude this project, the designed interventions are validated within DNB and projected along a roadmap for further development.

Rather than a conclusion, the outcomes from this thesis serve as a starting point for DNB to address the challenges emerging from the changing relationship between society and payment, through the digital euro or otherwise.


VISUAL EXECUTIVE SUMMARY
INVESTIGATING THE DESIGN OF A DIGITAL EURO
DeNederlandscheBank
2035 FRAMEWORK:
EMERGING CHALLENGES
THREE EMERGING CHALLENGES FOR PAYMENTS 2035
A NAIVE, RISKY FINANCIAL BEHAVIOUR
B FEELING STAGNANT AND INSIGNIFICANT
C LOW TRUST IN OTHERS AND INSTITUTIONS
WELCOME!
DIGITAL PAYMENTS
THREE VISIONS FOR THE FUTURE OF PAYMENTS
A RESPONSIBLE DIGITAL FINANCIAL INCLUSION
B EXPERIENCING IMPACT THROUGH PAYMENTS
C TRUSTWORTHY PAYMENT INFRASTRUCTURE
FOUR CONCEPT INTERVENTIONS FOR THE DIGITAL EURO
HOLD UP!
2035
1: TANGIBLE DIGITAL PAYMENTS
2: SECURE DIGITAL PAYMENTS
3: LEARNING DIGITAL PAYMENTS
4: APPRECIATING PUBLIC PAYMENTS
HEALTHY
DIGITAL
PAYMENTS

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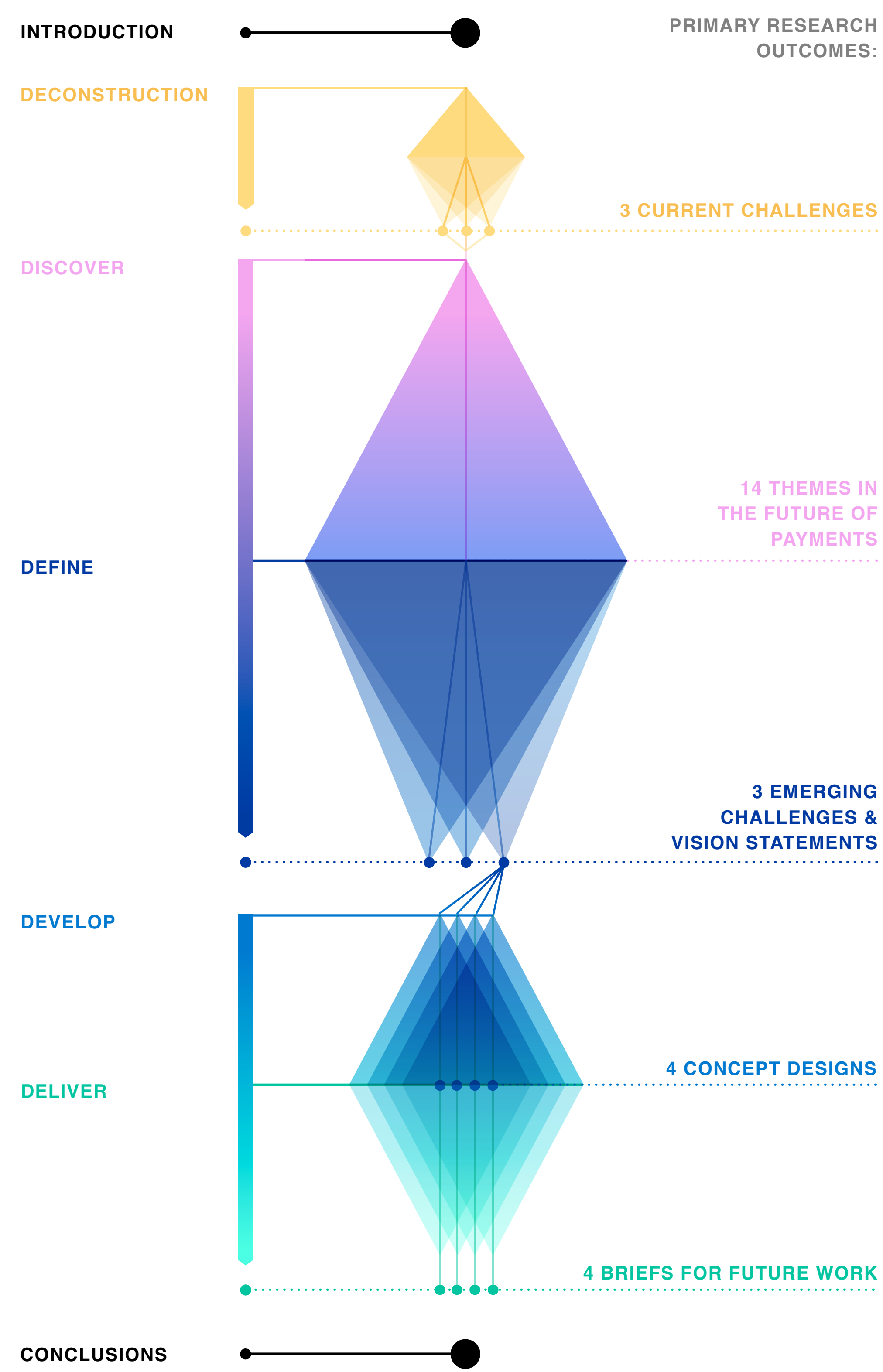


DEFINITIONS

This thesis explores concepts that may be unfamiliar to those outside the (central) banking sector. To ensure clarity for the readers of this thesis, key terms are defined to provide a common understanding and avoid confusion.

De Nederlandsche Bank (DNB) is the Dutch central bank, and a collaborator on this thesis. Their main responsibility is managing financial stability in The Netherlands.

European central bank (ECB) is the European counterpart of DNB. This institution started around the introduction of the euro system, where some countries in the European union decided to adopt one collective currency: the euro.

Central bank money is a type of money that is brought into circulation by central banks. At the time of writing this thesis, the only form of central bank money accessible for end users, consumers and merchants, is cash. The digital version of this is currently under investigation at the European Central bank: the Digital Euro.

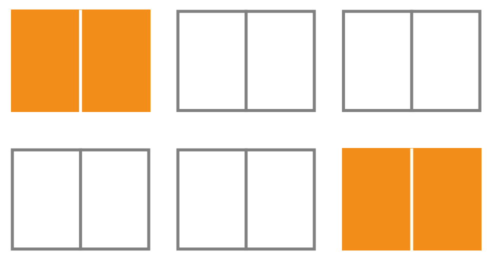
Private money is money issued by a private entity, such as commercial banks (European Central Bank, 2023). Due to the decline of cash in our payments, 7% of our money is being created though parties such as commercial banks.

Digital Euro (D€) is currently being considered to be a digital version of central bank money. The D€ is not a new currency, like crypto currencies. The value of a D€ is one on one convertible to the Euro. This definition is subject to change as a result of political or policy decisions from the D€ project at the European Central Bank.

READING GUIDE

Each chapter in this thesis represents a phase in the research approach. At the end of each phase the conclusions are separated as research outcomes.

INTRODUCTION



CONCLUSION
RESEARCH OUTCOMES

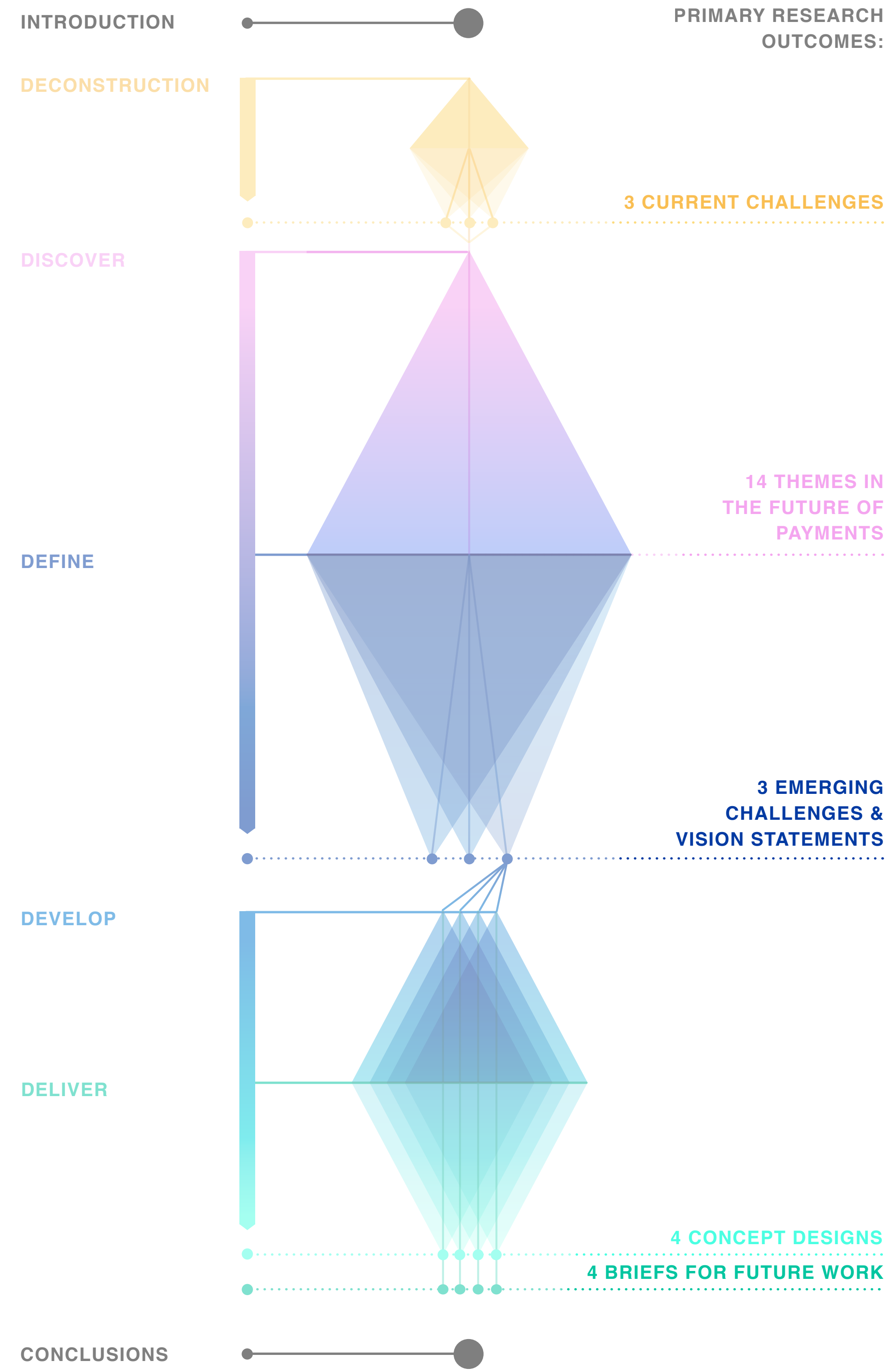
The colored pages at the beginning of each phase indicate the introduction of the purpose of this chapter and the research questions that are answered based on the body contents and the research outcomes.

The main body of the report is found on the white pages. Here you can find the explicit steps undergone during the research process and a largely chronological overview of the research.

The darker colored pages indicate the conclusions and present the primary research outcomes of each phase.

SHORT ON TIME? Please read only the introduction and concluding pages. This should give you a general overview of the outcomes of this research and their implications/purpose.

INTERESTED IN FULL APPROACH/ PROCESS? The body takes the reader along, and clarifies the research methodology better. Explanations are suitable not only for designers, but also laypersons in the field of design.



1. INTRODUCTION

With the first PIN transaction in 1985 the Netherlands saw the beginning of a transformative shift in how people interact with money. Over the years, cultural and policy changes and technological advancements have driven society away from cash towards digital payments, fundamentally altering the landscape of everyday interactions with money.

This transition has been instrumental in modernizing the Dutch payment ecosystem, offering faster, more efficient, and increasingly accessible payments through private payment providers. But is “faster, more efficient and increasingly accessible” what society needs from payments? In a world where we are becoming increasingly dependent on private companies for the design of payments, it might be valuable to take a step back and evaluate what payments should be designed for, from a public perspective.

INTRODUCTION CONTENTS **P.**

1.1 CONTEXT OF THE STUDY

In 2021, the European Central Bank (ECB) began exploring the idea of a "Digital Euro": A digital form of central bank money, similar to a digital version of cash. As the project has evolved over the past few years, it has become clear that the Digital Euro would be a digital form of central bank money intended to complement the existing payment ecosystem with the primary goal of improving the resilience of the European payment infrastructure (European Central Bank, 2024). It aims to offer a payment method aside from cash and digital payments in stores, as well as an alternative for credit and debit cards in e-commerce transactions.

The Dutch Central Bank (DNB), a key player in this initiative, is part of the ECB's governing council, which includes representatives from all European central banks. The DNB is actively involved in the conceptualization, development, and decision-making processes surrounding the Digital Euro.

Aside from supervision of banks, insurance companies and pension funds, DNB is responsible for the distribution and maintenance of the Dutch payment infrastructure for public and private money: Cash and digital money respectively.

In the Netherlands we see a steady decline in the use of central bank money, where currently only 20% of payments in stores are done with cash (Betaalvereniging, 2024). Additionally in an attempt to reduce money laundering and tax evasion, the Dutch government has recently voted (24 sept 2024) to limit cash purchases to 3000 euro starting April 2025. Hereby further limiting the usability of cash.

As an immediate implication of the reduced use of cash, we see the use of digital, private money increasing: more than 90% of total Dutch payments are done digitally (Betaalvereniging, 2024). This market of digital payments is currently completely in the hands of private companies such as commercial banks and private payment providers like Visa and MasterCard. This also raises concerns as the global payment infrastructure is becoming increasingly dependent on non-European companies (VISA & MasterCard)(Westberg, 2024b).

The Dutch Central Bank (DNB) recognizes and appreciates several key values of central bank money, including inclusivity, privacy, resilience, and usability across Europe. As cash use decreases, the unique benefits of central bank money are at risk of disappearing, since these values are not inherently provided by private, digital money. To maintain these values in a digital version of central bank money, DNB is lobbying for a "cash-like" Digital Euro.

The ongoing development of the Digital Euro (D€) offers an opportunity to re-evaluate the relationship between society and payments from a "public perspective". By designing digital central bank money to meet evolving societal needs, we can ensure that the values of central bank money are preserved and strengthened in an increasingly digital world.

Figure 1: DNB's current/previous design goal for D€: *"Cash in een digitaal jasje" (Cash in a digital jacket)*

1.2 PROBLEM DEFINITION

DNB seeks to investigate the changing payment needs within the Netherlands in order to better define the strategic direction of the Digital Euro. This initiative marks a shift in DNB's role within the Dutch digital payment ecosystem. Traditionally focused on oversight and maintenance of this payment infrastructure, DNB is now taking on an active role in designing a new digital means of payment. Rather than merely monitoring, DNB is working on the introduction of a new element aimed at enhancing the payment landscape from a perspective of public interest.

A public means of digital payment presents an opportunity to address challenges arising from the dominance of private payment providers. The current infrastructure relies on profit-driven entities, meaning not all societal needs are guaranteed to be met: if a required intervention/product is not profitable, it risks being overlooked. The Digital Euro could introduce a more balanced payment infrastructure, ensuring accessibility and stability beyond profit incentives.

Pending political approval, the Digital Euro is expected to launch around 2030 (Nagel, 2024a). To ensure a forward-looking yet practical approach, the future visioning focuses on the year 2035. This time-frame allows us to address both the challenges anticipated at the time of the Digital Euro's introduction and those emerging in the subsequent years. Looking further ahead would introduce greater uncertainty, reducing the accuracy and reliability of the framework.

Based on this prior information and timeline, we can derive the problem statement:

DNB seeks to investigate a design vision for the Digital Euro, addressing challenges emerging from the changing relationship between society and payments in the Netherlands in 2035.

1.3 RESEARCH QUESTIONS

Given DNB's mandate to regulate the Dutch payment infrastructure, it was decided to focus the research and design towards the context of The Netherlands. To provide an answer to the problem stated previously, this thesis answers 3 research questions in chronological order.

DECONSTRUCT:
In order to determine how the relationship between society and payments is changing, it is relevant to understand payments as they exist now. In the deconstruction phase of this project the existing products, interactions and context surrounding (digital) payments are analyzed to answer the first research question:

RQ1: "What are the main design challenges in the current relationship between society and payments?"

DISCOVER & DEFINE:
In discover and define we look towards the future by collecting context factors that are expected to influence the relationship between society and payments in 2035. Based on clusters of these context factors we can define what are the underlying, driving forces behind this changing relationship, and which challenges emerge as a result, thereby answering the second research question:

RQ2: "Which design challenges emerge as a result of the changing relationship between society and payments in the Netherlands by 2035?"

DEVELOP & DELIVER:
In the develop and deliver phase, one of these emerging challenges is addressed and translated to a series of interventions, illustrating how these challenges can be used as a starting point for further design. Addressing all emerging challenges within the scope of this project is unrealistic, therefore it is valuable to support further research, which will have the opportunity to address the challenges more completely. 4 briefs for future work are developed in order to answer the third research question:

RQ3: "On which of the challenges emerging from the changing relationship between society and payments can DNB intervene through the design of the digital euro?"

It is important to note that Research Question 3 focuses specifically on interventions through the design of the Digital Euro. This deliberate choice complements the ongoing work already undertaken by DNB and aligns with the unique design opportunity presented by the introduction of a new means of payment and a new form of central bank money. However, this focus also introduces a limitation to the design space. By linking the interventions to the context of the Digital Euro, the exploration is inherently constrained. Designing without this limitation could potentially lead to alternative, innovative results and diverse forms of interventions, broadening the scope of possibilities beyond the Digital Euro.

1.4 GENERAL PROJECT APPROACH

The Digital Euro project has a clear vision at the policy level, rooted in the needs of the European Central Bank (ECB): "*to maintain financial stability within the euro system at a macroeconomic scale. As a tool, the Digital Euro aims to strengthen the euro area's strategic autonomy and monetary sovereignty by enhancing the overall efficiency of the European payments ecosystem"* (European Central Bank, 2024). However, for this "policy level vision" to succeed, widespread public support for the introduction and adoption of the Digital Euro is critical.

At the individual level, the design vision should be expanded and explored further. What unique value does the Digital Euro bring to everyday payments? What value can a form of digital central bank money bring to society? DNB is interested in the answers to these questions, particularly focused on the Dutch payment infrastructure. The absence of a well-defined vision for how individuals will interact with and benefit from the Digital Euro highlights an opportunity to leverage the Vision in Product Design (ViP) method, developed by Van Dijk and Hekkert (2016).

According to the Vision in Product design (ViP) methodology: *"Designing is about exploring what is possible tomorrow, instead of solving the problems of today"* (Hekkert & Van Dijk, 2016). This forward-looking approach enables designers to imagine and shape future relationships between society and products. By exploring how the relationship between society and payments may evolve, we can intervene more meaningfully and steer developments toward a desirable future vision.

The introduction of the Digital Euro has sparked debate, with some viewing it as an unnecessary addition to the payment infrastructure, or even a potential threat (Nagel, 2024). However, the ViP methodology emphasizes that designing is not merely about creating products; "*design is fundamentally about developing value for society and designing products that have a reason to exist"* (Hekkert & Van Dijk, 2016). The investigation of the Digital Euro offers a unique opportunity to re-examine the meaning of central bank money. Why should central bank money exist in a digital form? What role should it play in a future payment system?

The ViP approach offers a structured way to explore and define the likely and desirable future, ensuring the design of a Digital Euro aligns with both societal and individual payment needs. The pending implementation timeline of the Digital Euro (D€), expected in four to five years (Nagel, 2024a), makes this methodology particularly relevant; focusing solely on today's issues might not adequately address the challenges of tomorrow's context.

The ViP methodology is structured around two phases: deconstructing and designing. These phases involve analyzing and working across three levels: product, interaction, and context level.

In the deconstruction/preparation phase, the aim is to understand why payments exist as they do today. What qualities define current payment methods, how do people interact with them, and what contextual forces have shaped these dynamics? Through this we can understand how the context of today has shaped payments as we know it.

After the preparation phase, the process shifts direction towards designing. Instead of designing products based on the current context, ViP encourages designers to envision the conditions of a future context that should guide product development. This "context-to-product" approach, illustrated in the second half of the ViP model (figure 2), allows designers to create products that align with the aspirations and values of a future society, ensuring their relevance and impact.

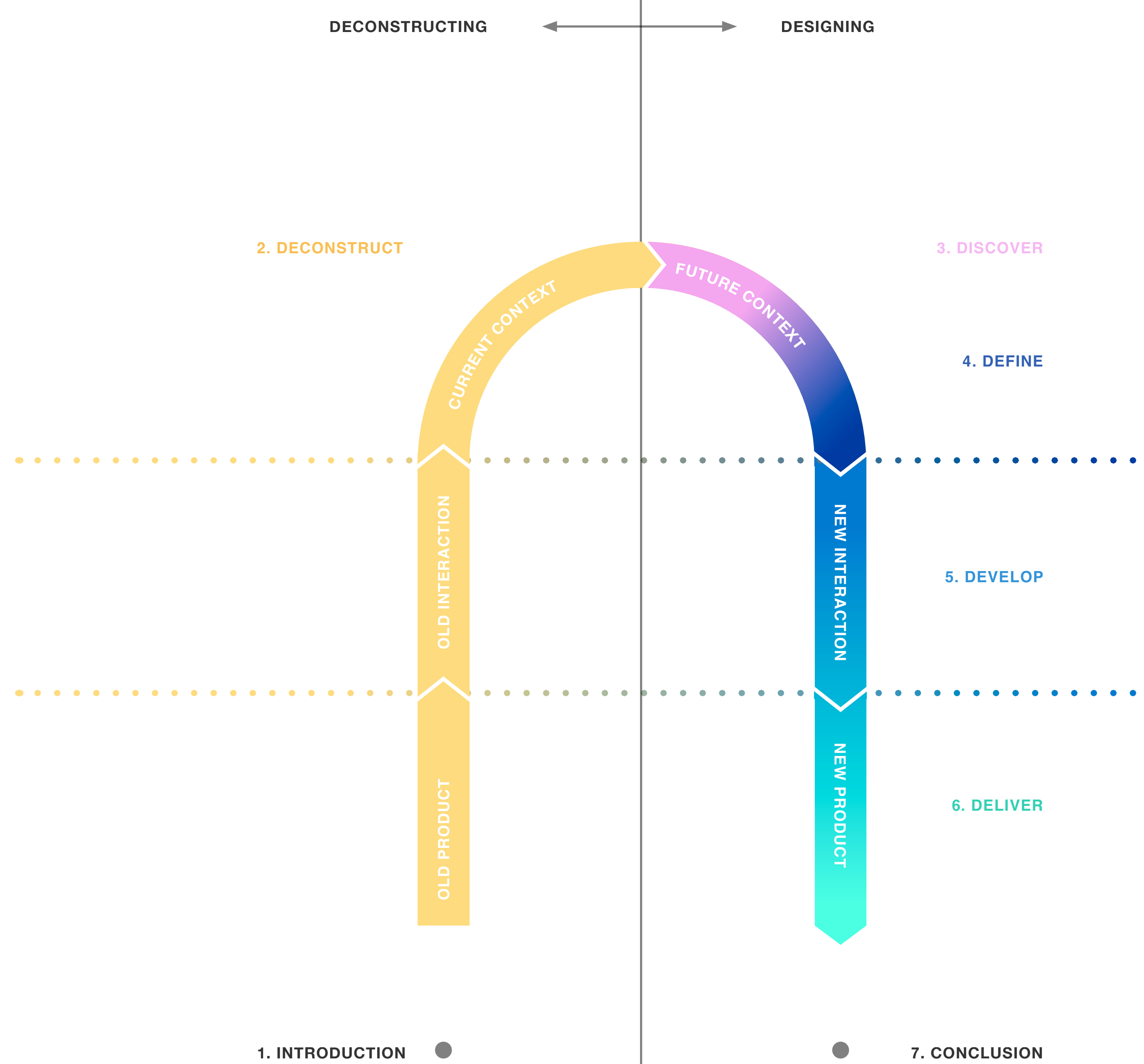
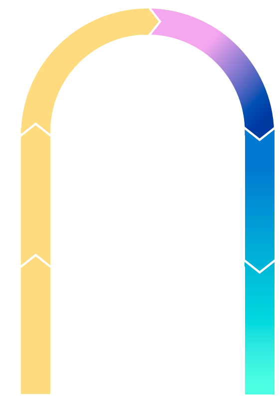


Figure 2: Visualisation ViP methodology

1.5 REPORT STRUCTURE

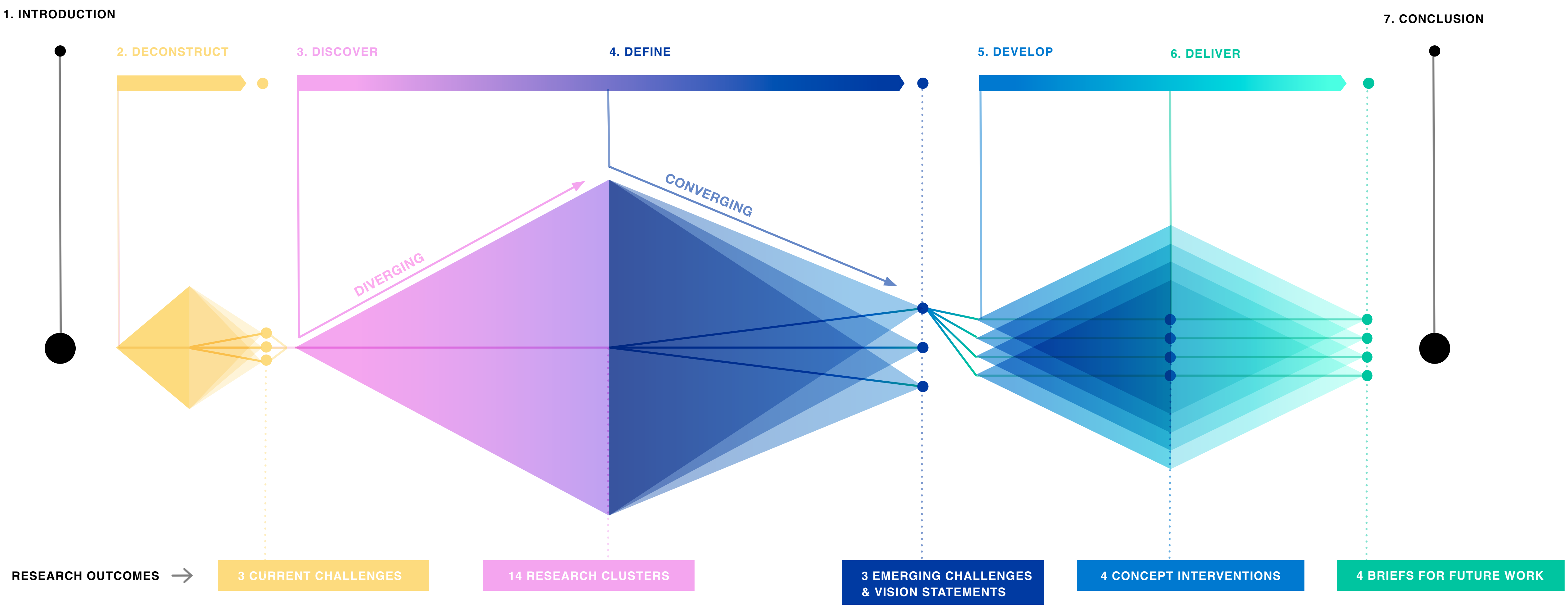
While Vision in Product Design (ViP) is the primary design methodology used in this thesis, it was decided to communicate the general the design process using the Double Diamond model (Design Council, 2005). The ViP process follows a distinctive down-up-down direction (as seen in see figure 2), which can be difficult to track in a linear report format. To enhance clarity, this thesis represents the process through the Double Diamond framework, which visually distinguishes the diverging and converging phases of design:

- **DIVERGING** involves gathering insights, exploring possibilities, and postponing judgment to foster creativity.
- **CONVERGING** focuses on structuring, decision-making, and synthesizing the most valuable outcomes from the previous phase (Design Council, 2005).



When aligning the ViP process with the Double Diamond structure, a third diverging-converging iteration emerges: “deconstruct”, also known as the deconstruction phase in ViP. ViP begins with an analysis of the current product-interaction-context, and the insights from this phase can be synthesized separately. This clearly defines the starting point of the “discover” phase where we investigate future developments. This separation allows for distinct conclusions about the current relationship between society and payments and enables a structured comparison with the designed likely future scenario later in the report.

At the end of each diamond, research outcomes are presented.



1.6 APPROACH PER PHASE

Each chapter follows a distinct section of the Vision in Product Design (ViP) framework. This chapter provides an overview of the methods used in each phase of the process.

DECONSTRUCT

Deconstruct follows the first half of the ViP curve, analyzing the existing payment landscape on three levels: product, interaction, and context. This was done through:

- Historical analysis – Examining how forms of money have evolved over time.
- Journey mapping – Understanding how people currently interact with payment systems.
- (Simplified) Stakeholder mapping – Identifying key parties involved in payments.
- Attending stakeholder meetings and debates – Investigating the challenges that concern payment industry stakeholders.

By deconstructing current payment methods, this phase establishes a baseline understanding necessary for designing a new payment system. Additionally, three key challenges are identified, which later serve as a comparison point for the challenges emerging from the framework developed in the Define phase.

DISCOVER

This phase marks the beginning of the second half of the ViP process: designing. Starting at the context level, the goal is to identify context factors likely to influence the future relationship between people and payments. These factors—trends, developments, states, and principles—are identified through:

- Desk research – Exploring external reports, literature, and studies.
- Co-creation with mentors from DNB – Leveraging domain expertise.
- Expert interviews – Engaging with professionals beyond DNB's core economic and payment-related focus.

The insights gathered from these activities were clustered into 14 themes that define influential factors for the future context of payments.

DEFINE

Building upon the identified clusters, this phase focuses on uncovering underlying dimensions that act as driving forces. This was done through:

- Exploring a variety of dimensions – Identifying potential structuring principles.
- Evaluation with DNB mentors – Assessing relevance and applicability.
- Testing design potential – Understanding the interplay between dimensions.

Two key dimensions were selected and combined into a framework, leading to the identification of 12 potential future payment situations. Based on this framework, vision statements were formulated for three emerging challenges, outlining what DNB should focus on and how these challenges should be addressed.

DEVELOP

From the three emerging challenges, one was selected for further development to illustrate how DNB can apply the framework to re-think and re-design payments and the payment infrastructure in the Netherlands.

Each challenge consists of four specific payment situations, each of which was designed using the ViP method, focusing on shaping a desired user interaction. The main design methodology centers around using an "interaction analogy", where we analyze an existing interaction and distill the desirable qualities to translate to the interaction with payments.

By the end of this phase, four concept interventions were developed.

DELIVER

The final phase involved validating and refining the framework and developed concepts through:

- Interviews with relevant DNB stakeholders – Gathering feedback and assessing feasibility.

Based on these insights, a roadmap is outlined and project briefs were written to guide further research and implementation. Thereby making the continuation of this research more accessible for DNB.

1.7 CONTINUOUS CO-CREATION

This project was carried out under the supervision of two policy advisors from DNB who played an active role throughout the process. Our weekly meetings served as an ongoing form of co-creation, where we discussed progress, debated emerging questions, and navigated the complexities surrounding payments.

Co-creation within this project served three key purposes:

1. FACT-CHECKING AND UNDERSTANDING COMPLEX TOPICS
Payments, money, central banking, and the broader European economic system are intricate and multifaceted topics. Weekly discussions provided an opportunity to clarify concepts that were difficult to grasp independently. These conversations often evolved into philosophical explorations of the principles underlying payments, ultimately helping me refine my position on the topic.

2. COMMUNICATING THE PROJECT APPROACH
The steps taken in the ViP methodology are usually not immediately intuitive, especially for those unfamiliar with the process or the design process in general. Through providing weekly updates on the steps taken and how they interconnected, it was ensured that the supervisors remained aligned with the process and understood the logical connections in the sequence of conclusions that emerged.

3. SPARRING ON VISION AND CONCEPT DIRECTIONS
Designing for a vast infrastructure like payments posed challenges with solutions outside the field of expertise of a typical design student. Through discussions with my mentors, I was able to filter out less promising directions while strengthening the most viable ones with their expert knowledge. Their insights not only refined the scope of my work but also inspired new approaches to shaping the relationship between people and payments.

Figure 3: Illustration weekly check up sessions with Huib and Anneloes

2. DECONSTRUCT

This chapter addresses the first research question: “What are the main design challenges in the current relationship between society and payments?” The objective is to analyze the historical, technological, and social contexts that have shaped payments as we know them today. This includes investigating why payment systems have developed the way they have, how people interact with these systems, and the broader forces at play driving these interactions. By breaking down these elements, we aim to gain a deeper understanding of the relationship between society and payments in their current form.

To achieve this, the chapter is structured around three sub questions that explore payments from distinct but interconnected perspectives:

PRODUCT LEVEL:
“Why have means of payments evolved over time?”

INTERACTION LEVEL:
“How do people interact with payments?”

CONTEXT LEVEL:
“Who are the actors shaping payments, and who are the stakeholders?”

By addressing these subquestions, we create an overview of today’s design challenges in the relationship between society and payments. This understanding allows us to compare current challenges with the challenges identified in the following research phase, focusing on future developments.

DECONSTRUCTION CONTENTS **P.**

2.1 CURRENT MEANS OF PAYMENT

In this chapter we deconstruct the current *product* of payments “means of payment”. This is done through identifying the qualities of payments as we know them today and how they have come to be this way. From these qualities we aim to answer the following subquestion:

WHAT DRIVES THE CHANGE IN MEANS OF PAYMENTS?

“Payments” are one of the mediums through which individuals and society at large interact with money. The product associated with this can be named the *“means of payment”*. Over the course of history these means of payment through which we interact with money have evolved based on the technological advancements of the time as well as cultural developments. Figure 4 shows a summary of the key moments in history where the means of payment change (Stringer, 2016).

Most notably we see that the concept of “money” has gotten increasingly abstract as we move towards a more convenient and efficient monetary system. While trading a cow for a sheep would take considerable effort and time, people can now able to pay thousands of euro’s in a fraction of a second, while nothing tangible is transferred.

The products representing our money have not only lost tangibility in a physical sense, but are also increasingly distanced from the commodity value they once represented: digital money has no intrinsic value. Commodity money like livestock and grains maintains value even if it can’t be traded, but modern means of payment are purely a “story” shared between all members of society. Money is an “inter-subjective concept”: it only holds value because we collectively agree it does (Harari, 2014). This belief in the value of money is a shared understanding that binds society together, despite the lack of any material foundation behind it.

In conclusion, this timeline illustrates that the change in means of payment is predominantly driven by technological advancements and a pursuit of efficiency and convenience. As a result, the concept of money is becoming further removed from intrinsic value, thereby increasing the amount of trust needed in the functioning of our means of payment.

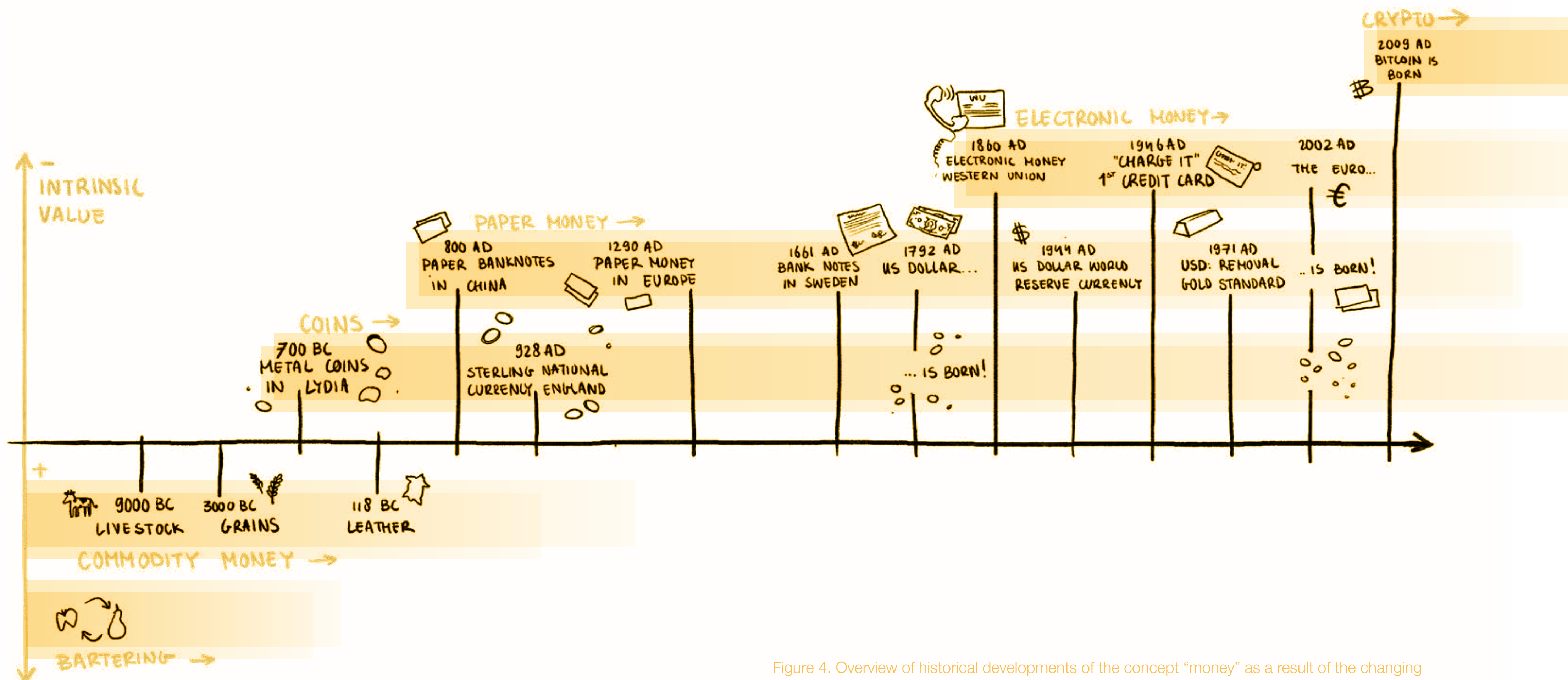


Figure 4. Overview of historical developments of the concept “money” as a result of the changing means of payment (Stringer, 2016).

2.2 INTERACTIONS WITH PAYMENTS

The ViP methodology considers products as a means to accomplish or develop “interactions” (Hekkert & Van Dijk, 2016). They define interaction as *“a qualitative description of the relationship between a product and a user.”* In this context, the product being analyzed is the means of payment, and the user includes virtually everyone, given it is essential for any form of autonomy in the current social and financial system.

Due to the broad user base and diverse payment methods, numerous payment interactions could be studied. However, this research focuses specifically on in-store payment interactions, as DNB is currently prioritizing this function for the Digital Euro. While the D€ is expected to support additional functionalities such as peer-to-peer transfers (P2P) and e-commerce payments, the primary emphasis remains on in-store transactions. According to the most recent source from the Betaalvereniging (2024), the most commonly used in-store payment methods today include cash, card (inserted), contactless card, and mobile contactless payments.

On the following pages, the way people interact with each means of payment are illustrated. From this, interaction qualities are distilled. These are used to explicitly define the interaction between user and product. A variety of interaction qualities were identified during brainstorming, but ultimately the deciding terms were determined by the designer.

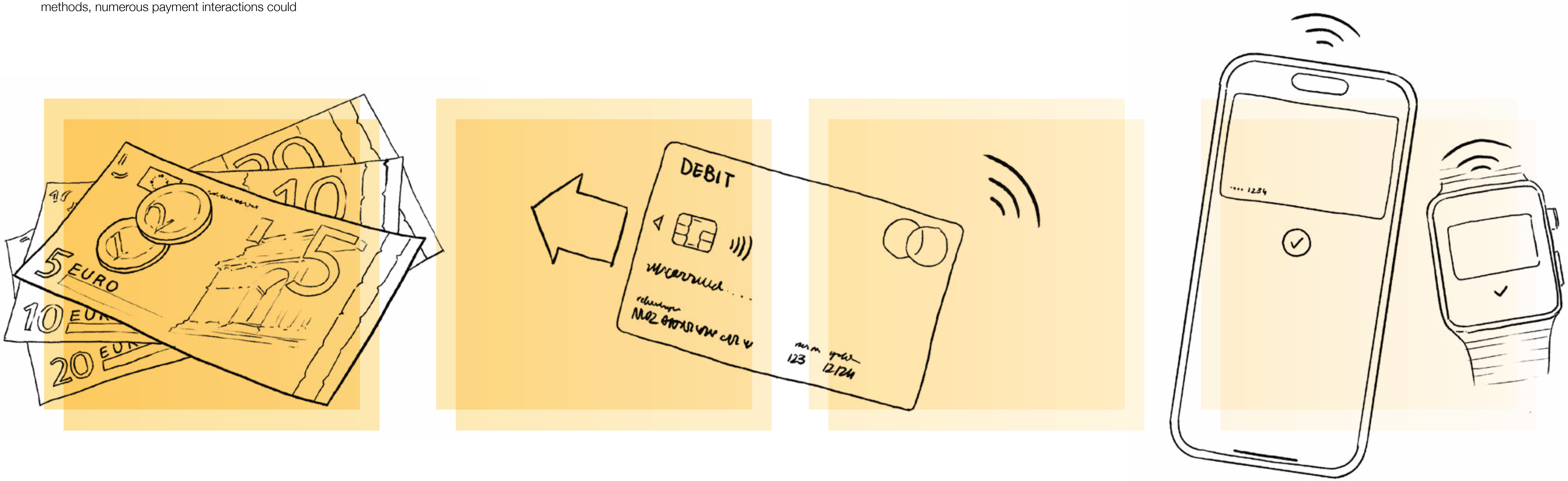


FIGURE 5: DISTRIBUTION TOTAL PAYMENTS NL 2023 (BETAALVERENIGING, 2024).

20 % CASH

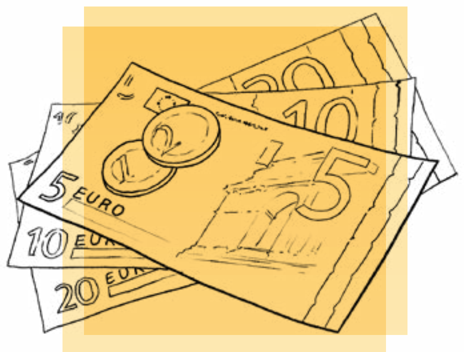
8% CARD (INSERTION)

43 % CARD CONTACTLESS

29% MOBILE AND WEARABLES CONTACTLESS

72 % CONTACTLESS

2.2.1 CASH



Cash payments are characterized by a **deliberate** and **reflective** interaction, inherently tied to a **sense of payment pain.** Unlike digital transactions, paying with cash requires individuals to plan ahead, ensuring they have sufficient funds before making a purchase. The inherent need for planning and foresight fosters a continuous evaluation of spending habits, as users must decide when to withdraw more cash and how to allocate it. Additionally, the physical act of handing over tangible money reinforces the awareness of expenditure, making each transaction feel more significant. This sense of payment pain can lead to more deliberate spending habits, as individuals are constantly reminded of the limitations of the money in their wallet.

INTERACTION QUALITIES:

DELIBERATE | **REFLECTIVE** | **PAINFUL**

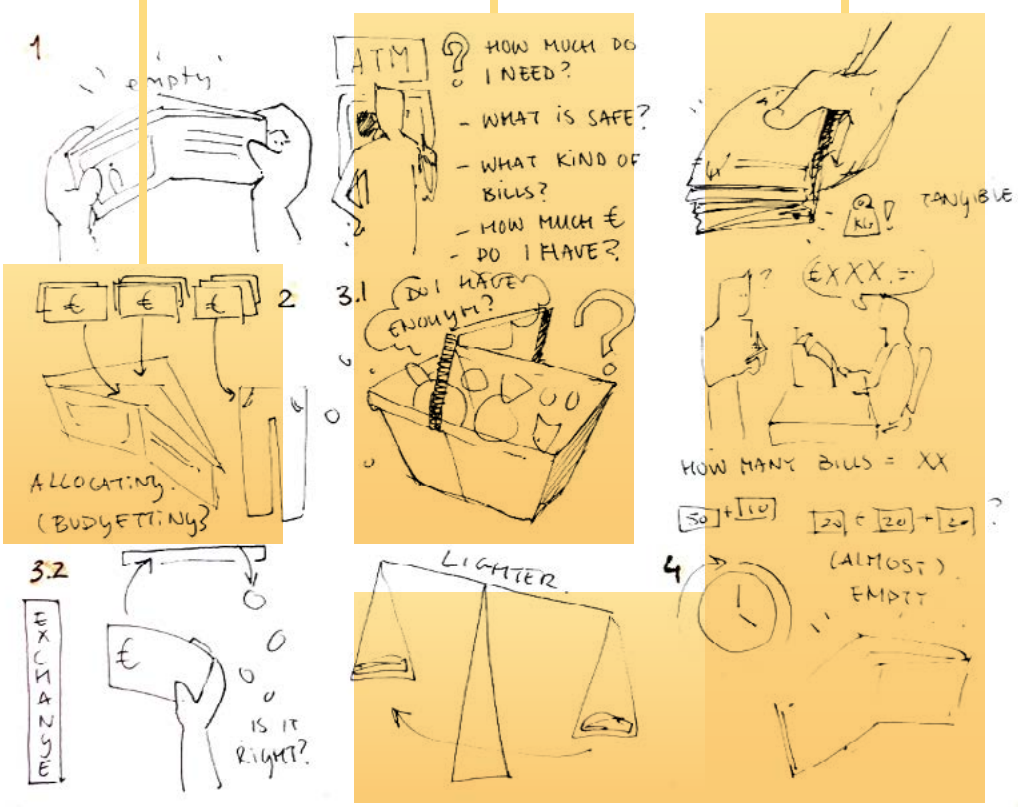


Figure 6: exploration of steps in the interaction with cash for in-store purchases

2.2.2 CARD BY INSERTING

Card insertion payments are defined by a **safe** and **focused** interaction. The requirement to enter a personal pass-code adds a protective layer, ensuring that only the cardholder can authorize transactions. This security feature provides peace of mind, as stolen or lost cards remain unusable without the correct PIN.

Additionally, the act of entering the pass-code demands attention, directing the user's eyes to the screen displaying the transaction amount. This moment of focus reinforces awareness of spending, making each payment a more conscious decision rather than an automatic action.

INTERACTION QUALITIES:

SECURE | **FOCUSED**

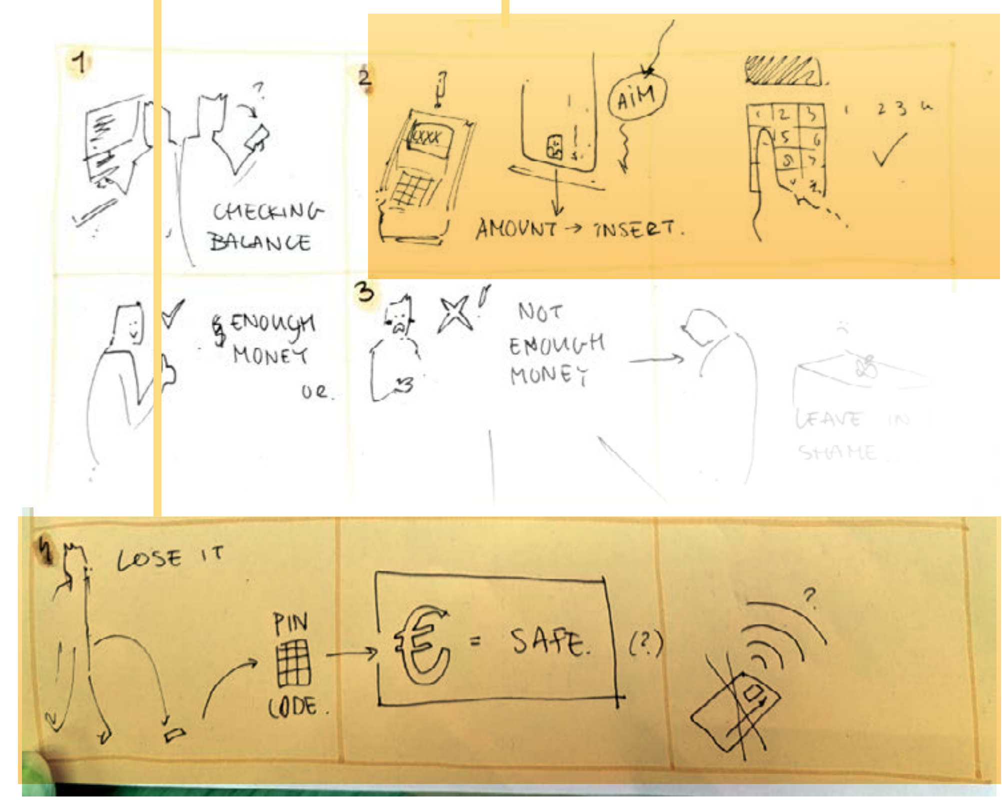
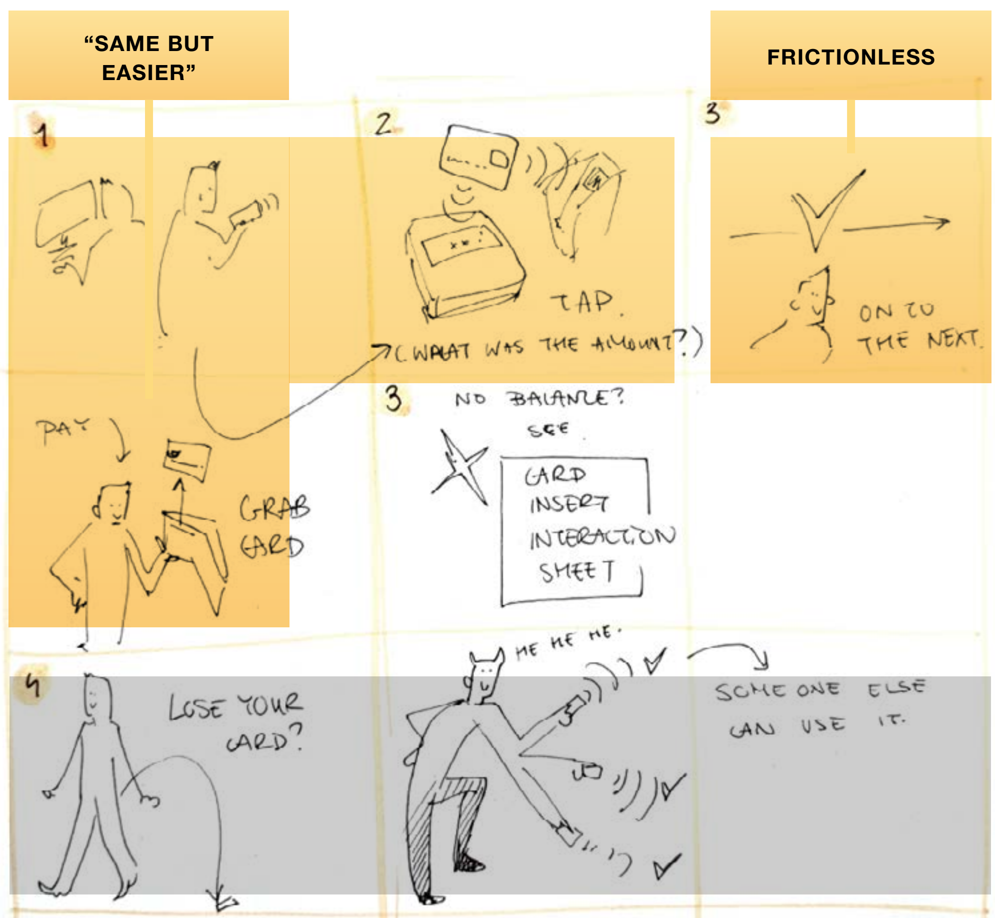


Figure 7: exploration of steps in the interaction with card by insertion for in-store purchases

2.2.3 CARD CONTACTLESS

The interaction of contactless payments using a card can be defined as **frictionless**, offering a **"same but easier"** experience compared to traditional card payments. While maintaining the fundamental mechanics of card transactions, they remove the PIN requirement for small value payments (€50), making the process quicker and smoother. This mechanism can be considered the gateway to frictionless payments, where convenience is prioritized over deliberate spending awareness.

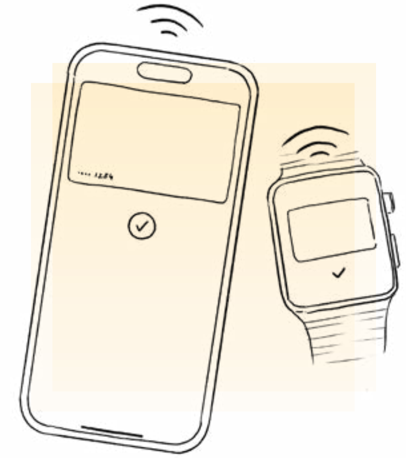
INTERACTION QUALITIES:



An interesting observation here, is that card by inserting is the most safe means of payment analysed, while contactless payment features make it less safe. Anyone can use your money when they find it and the user hasn't blocked the card yet.

Figure 8 exploration of steps in the interaction with card contactless for in-store purchases

2.2.4 MOBILE AND WEARABLE CONTACTLESS



The interaction for mobile contactless payments can be defined by their **frictionless** and **occluding** nature, making transactions nearly effortless and **painless.** With smartphones always within reach, users experience almost no transition between daily activities and the act of making a payment. NFC technology eliminates the need to open a payment app, enabling instant transactions. Unlike cash or cards, which are explicitly linked to spending money, phones serve multiple functions, further distancing the act of paying from the awareness of spending money. All this contributes to minimizing payment pain.

INTERACTION QUALITIES:

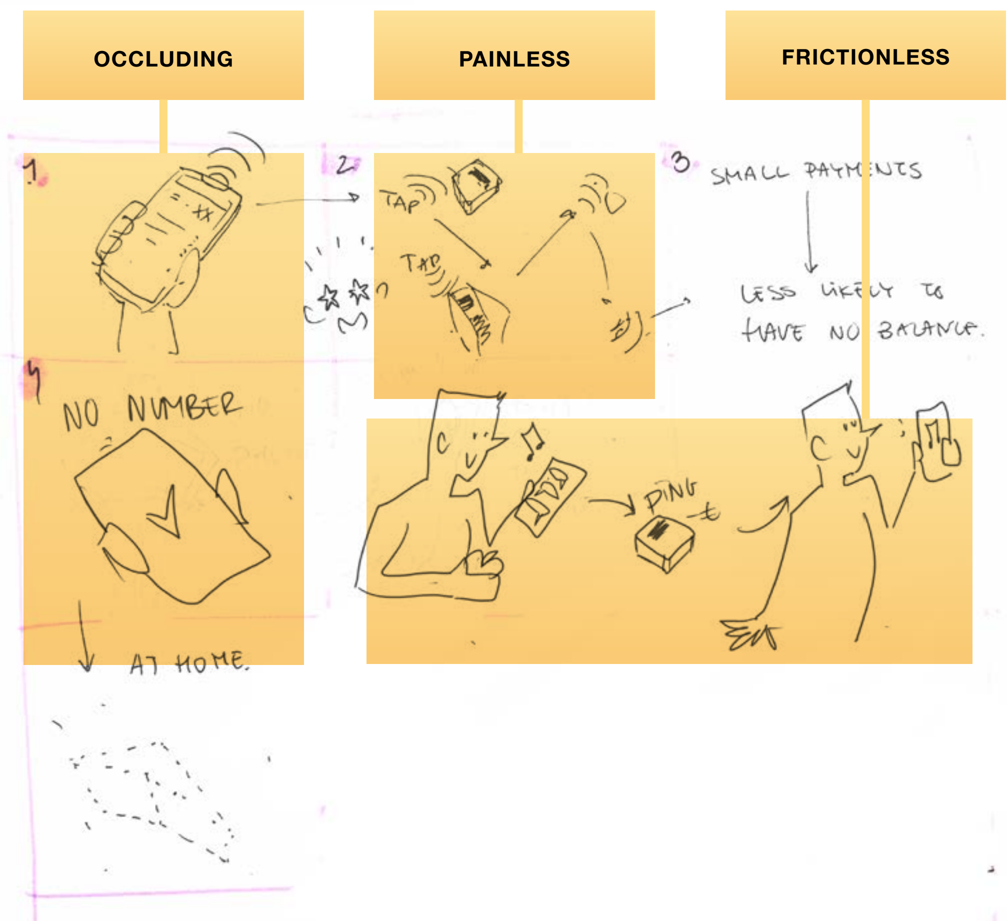


Figure 9 exploration of steps in the interaction with mobile contactless for in-store purchases

2.2.5 CONCLUSIONS INTERACTIONS WITH PAYMENTS

HOW DO PEOPLE INTERACT WITH PAYMENTS?

In figure 11, on the right, the previously analyzed means of payments have been placed in order of their age. Where cash is the oldest of these, mobile contactless payments are the newest.

While mobile payments are the youngest means of payment commonly used in the Netherlands, it will be the most used means of payments in store by 2024 if the trend of increased use continues (Betaalvereniging, 2024)(figure 10). This change in consumer behavior/choices can be justified from two opposing perspectives.

Consumers prefer contactless, frictionless payments because it is the most convenient and stops individuals from experiencing “payment pain”: the negative emotion felt when spending money (Van Vugt, 2025).

Businesses also stand to gain from supporting/encouraging frictionless payments and reducing as much payment pain as possible: companies that have less payment friction see faster growing revenue (Donald, 2024).

In conclusion, Dutch people are increasingly using frictionless payment methods such a contactless payments using card or mobile (Betaalvereniging, 2024). The payment interaction changes as a result of the movement towards frictionless payments, and we can see an exchange of tangibility and transparency for the sake of convenience. Where cash payment interactions are slower and informative due to the tangible exchange of money, contactless payments are at high speeds, sometimes completely without looking at the total amount of money being paid.

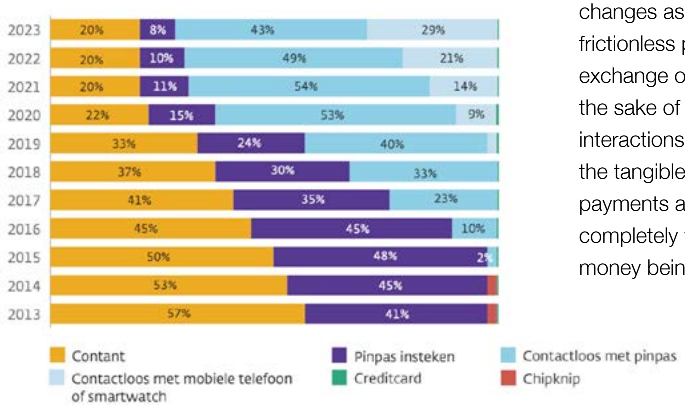


Figure 10 Distribution total payments by means of payment (Betaalvereniging, 2024).

UPCOMING MEANS OF PAYMENT DURING THE WRITING OF THIS THESIS

Buy now pay later was making its entrance into in-store payments while this thesis was being compiled (NOS, 2024). Since it was not among the most commonly used means of payment in store, it was not analyzed in this phase of the project. The interaction of buying something and paying later is however in line with the movement towards frictionless payments. BNPL is a more extreme version as this version of frictionless payment not only stimulates consumers to pay with less friction, but also to pay extra for the convenience of the payment delay. People are enabled to spend money they don’t have. Removing the only remaining friction in existing payment systems. Its effects on the relationship between society and payments will be considered in the *discover* and *define* sections of this thesis.

CASH
20% of payments in the Netherlands 2023

Interaction qualities
DELIBERATE
REFLECTIVE
PAINFUL

CARD BY INSERTING
8% of payments in the Netherlands 2023

Interaction qualities
SECURE
FOCUSED

CARD CONTACTLESS
43% of payments in the Netherlands 2023

Interaction qualities
FRICTIONLESS
“SAME BUT EASIER”

MOBILE AND WEARABLE CONTACTLESS
29% of payments in the Netherlands 2023

Interaction qualities
FRICTIONLESS
OCCLUDING
PAINLESS

Figure 11 Distribution total payments by means of payment (Betaalvereniging, 2024).

2.3 ACTORS IN PAYMENTS

Previously it was argued that the relationship between society and payments is not solely dictated by the consumer but is also significantly influenced by market players. The payments infrastructure in the Netherlands has become increasingly fragmented (De Nederlandsche Bank, 2022a), making it challenging for laypersons to understand and navigate in a conscious way. To address this complexity, sketching an overview of the actors in the digital payments infrastructure is valuable for understanding the current context. This understanding will provide a foundation for designing interventions that respond effectively to the current state of the payment infrastructure.

WHO ARE THE ACTORS SHAPING PAYMENTS?

POLICYMAKERS AND OVERSIGHT
De Nederlandsche Bank (DNB) is a key policymaker focusing on the safety, accessibility, and resilience of the payment infrastructure. Their role differs for public and private money:

- **CENTRAL BANK MONEY:** DNB collaborates closely with Geldmaat to ensure that cash remains accessible to most individuals, emphasizing the importance of central bank money as a public good.
- **PRIVATE MONEY:** As part of their oversight mandate, DNB instructs payment providers to improve their services when issues arise concerning their key priorities—safety, accessibility, and resilience. However, their involvement goes via commercial parties and they are therefore more removed from direct user interactions. This means that if there are concerns with digital payments, their intervening actions are always indirect as all digital payments in the Netherlands are currently private. This is a valuable opportunity for the digital euro, as the central banks will have more direct influence about the way this means of payment is shaped.

CARD ISSUERS
People access digital payments through cards and accounts provided by commercial banks. These banks act as intermediaries between consumers and the broader payment infrastructure, connecting users to digital financial systems.

INFRASTRUCTURE PROVIDERS
The cards provided by commercial banks typically operate through global networks such as Visa and MasterCard. These companies play a crucial role in enabling digital payments, but their involvement comes with financial implications: For every payment made using a Visa or MasterCard card, these companies receive a fee.

MERCHANTS
Merchants facilitate the payment interactions between consumers and themselves. They shoulder the costs of digital payments, including the fees charged by card networks. This dynamic influences pricing strategies and may indirectly affect consumers through higher prices. Merchants also play a pivotal role in adopting and promoting innovative payment solutions, which can shape consumer behavior and expectations.

CONSUMERS
Consumers are central to the payment ecosystem. Consumers rely on the accessibility and reliability of digital payment systems to conduct their daily transactions. However, the complexity of the payment infrastructure often leaves them unaware of the underlying costs and processes. This is exacerbated by the fact that it is illegal for consumers to bear the direct costs of digital payments in Europe (Your Europe, 2022), and retailers must absorb these fees.

This cost structure highlights an important dynamic within the private payment system: for individuals payments seem like a public good, and a right, because they are seemingly free.

Figure 12 visualizes the way these stakeholders are connected in the money flows of digital payments according to a simplified version of the 4 party system: a commonly used graphic visualizing data flows in digital payments. In reality there are more than 4 parties involved in all steps of the process, but the ones identified here are the most relevant for understanding the context shaping payments today.

In conclusion, payments have become increasingly convenient and painless because their design is shaped by commercial banks and infrastructure providers, with limited influence from merchants and consumers. Regulations make payments seem free to consumers, while merchants absorb the costs, driving up prices for consumers. Visa and MasterCard's duopoly keeps fees high, as a result of limited competition. DNB oversees payment accessibility, safety, and resilience but has limited direct control over digital payments. This market-driven system has prioritized convenience, benefiting consumers who prefer seamless transactions and private entities that profit from increased payment volumes.

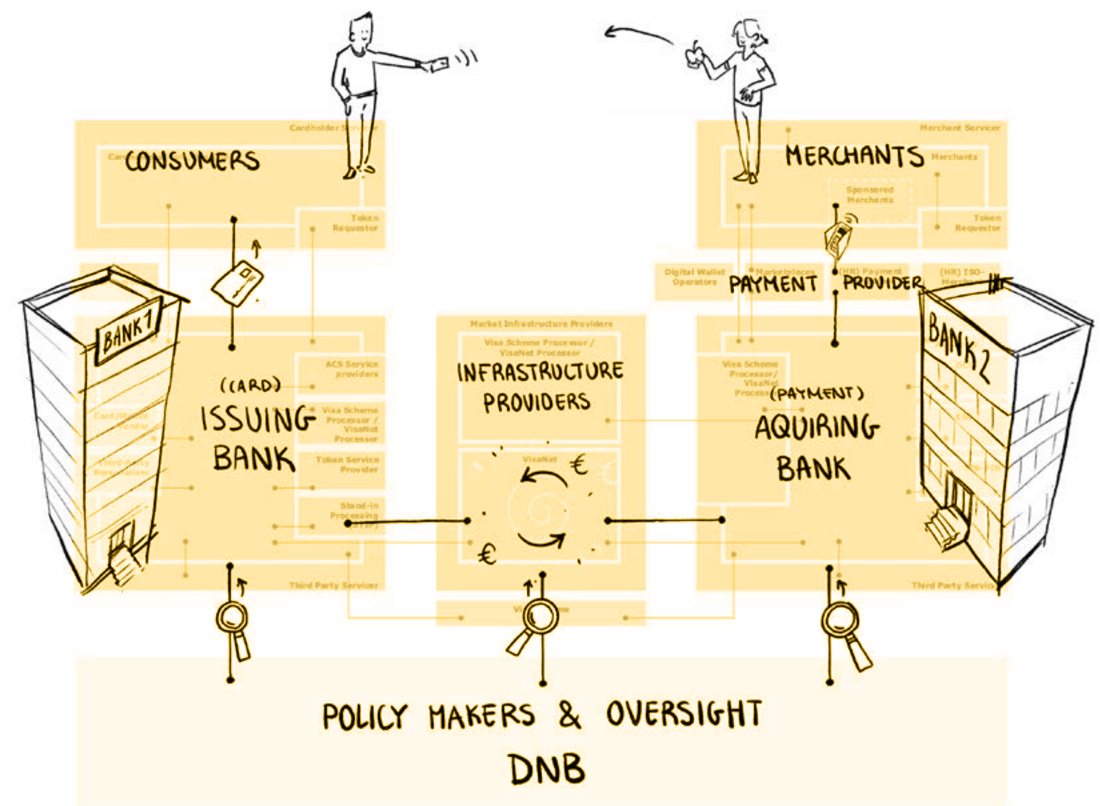


Figure 12. Overview of primary stakeholders for payments in the Netherlands. For details refer to appendix C

2.4 CHALLENGES IN PAYMENTS

In this chapter we explore how the current means of payment impact the stakeholders of payments, and which challenges can be identified for the design of payments today. To answer this, I attended two events centered around discussions on the design of the current payment infrastructure. Rather than discussing the challenges on policy level, these events discussed how payments provide value to society at user level. Insights from these events were synthesized to identify the pain points in the relationship between society and payment today.

The first event I attended was "Een D€ voor Iedereen," organized by De Nederlandsche Bank. During this symposium they invited a wide range of stakeholders for the digital euro. E.g. advocacy organizations for general consumers, disabled people, children, merchants, as well as representatives from several commercial banks and other actors in the providing side of the payment infrastructure.

The second event was "Een geldsysteem voor iedereen", hosted by Pakhuis de Zwijger. It was centered around discussions with the panel and the audiences addressing the inclusivity of the monetary system as a whole.

Analyzing my notes from these two sessions I distilled 3 challenges, which were primary conclusions from either session, or discussed in both. While it cannot be said with objective certainty that these are the 3 most pressing challenges at this time, identifying these helps us to better understand how the context of payments has lead to the current design of payments. The three challenges identified are market limitations for accessibility/inclusivity, (digital) financial literacy, and trust:

MARKET LIMITATIONS FOR ACCESSIBILITY
DNB recognizes inclusivity as a challenge for payments and considers it one of it's 3 focus points in their vision on payments (De Nederlandsche Bank, 2022a). While digital payments have become the most popular means of payment in the Netherlands (Betaalvereniging, 2024), they are not universally accessible. Especially low financial literacy and the complexity of digital interfaces exclude certain groups from fully participating in the financial ecosystem.

At the "Een geldsysteem voor iedereen" event, hosted by Pakhuis de Zwijger, discussions expanded to address the inclusivity of the monetary system as a whole. It was argued that the payment system must cater to the diverse needs of the population, ensuring equitable participation regardless of socioeconomic status. Participants raised the question: should the payment infrastructure, and payments in general, be considered a public good? While the Dutch payment infrastructure exhibits characteristics of a public good (Stellinga et al., 2021), it is argued that payments today are primarily market-driven, favoring profitability over accessibility.

(DIGITAL) FINANCIAL LITERACY
Commercial payment providers have developed "user friendly" and "frictionless" digital payment products, but these often focus on the majority of the digital savvy population and therefore may exclude individuals who cannot (adequately) navigate the technological side. This issue was raised at both events, where participants pointed out that leaving accessibility to market forces undermines the principle of equitable participation. A payment system reliant on private interests risks sidelining public values such as resilience, inclusivity, and fairness.

During the event "D€ voor Iedereen," organized by De Nederlandsche Bank (visualized in figure 6), stakeholders discussed the importance of designing a Digital Euro (D€) that goes beyond basic access. The insights revealed that "inclusivity" should not only ensure access but also address diverse user needs and preferences, ensuring that everyone feels motivated to adopt and use the Digital Euro. Features like anonymity and mandatory acceptance (not typically associated with accessibility) were highlighted as critical to fostering trust and engagement among all user groups.

TRUST
From the events it was argued that trust remains central to the functionality of any payment system. Without widespread trust in the reliability and existence of money, the entire monetary system risks collapse, as seen historically in instances of bank runs. However, the increasing privatization of payment systems has raised concerns about transparency and accountability.

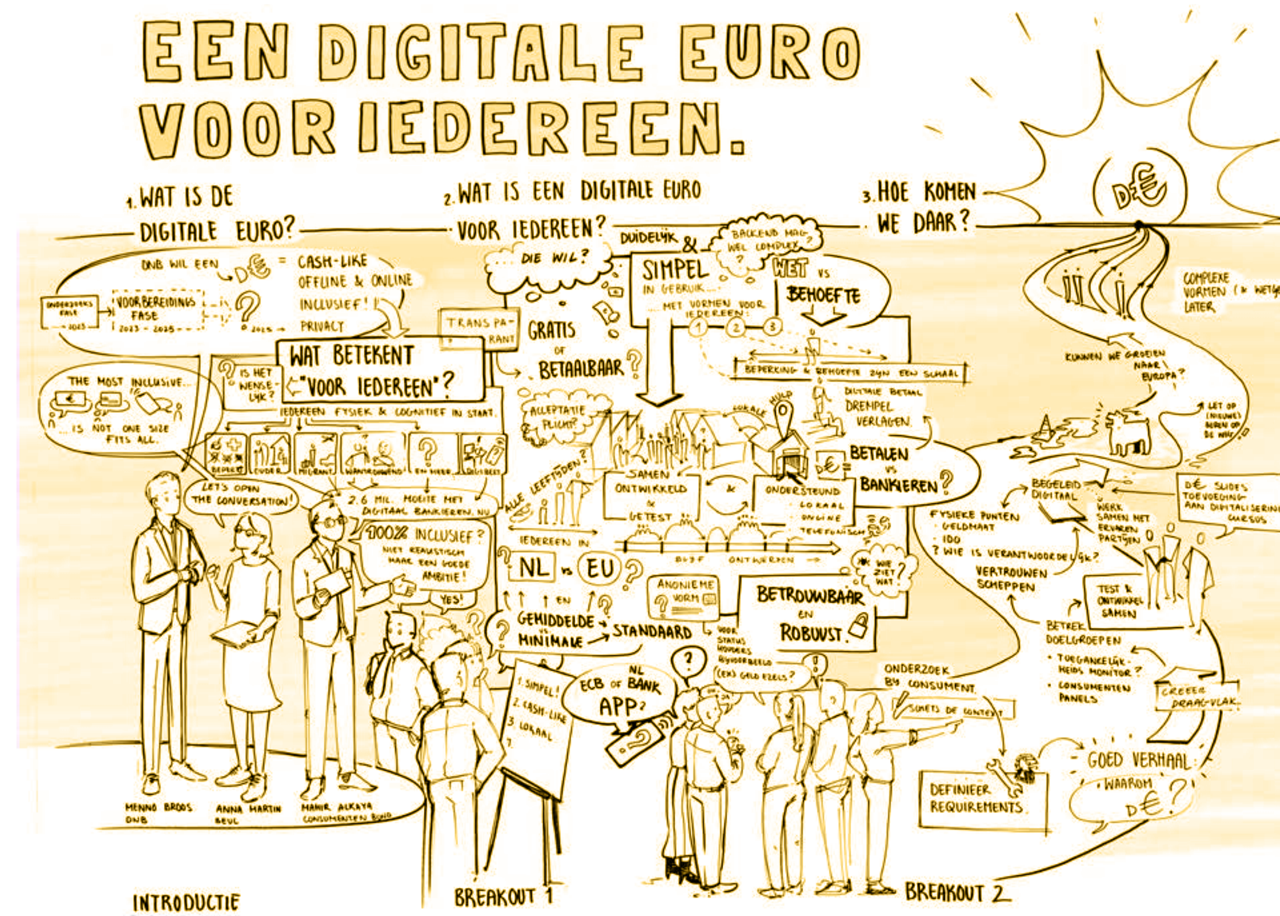


Figure 13: Visual summary Digital Euro symposium, organized by De Nederlandsche Bank

2.5 DECONSTRUCTING CONCLUSIONS: 3 CHALLENGES FOR PAYMENTS TODAY

Through deconstructing the concept of payments at three levels: product, interaction, and context level, we have attempted to answer the question “How can we describe the current relationship between society and payments?”. This analysis has shed light on the complex nature of payments, and some challenges identified for payments, considering the current context.

PRODUCT LEVEL

At its core, payments are a mechanism for value exchange, and the product associated with this is the “means of payment” (NL: betaalmiddel). Over time, these means have evolved, prioritizing efficiency and convenience. However, this evolution has led to a detachment from intrinsic value, making value exchange less tangible and harder for individuals to comprehend. From coins and banknotes to digital transactions, the abstraction of money has significantly impacted how people understand and engage with the concept of money.

INTERACTION LEVEL

As a result, the way we interact with payments has undergone a significant transformation. Modern payment systems are designed to be frictionless, enabling rapid and seamless transactions. While this efficiency has value for payment providers and merchants, and is appreciated in general by consumers, it has also reduced conscious engagement with financial decisions from the user perspective. Payments have become integrated into devices and platforms that are central to our social and entertainment lives, often resulting in impulsive or mindless spending behaviors.

CONTEXT LEVEL

The broader context of payments reveals a tension between public and private interests. While payments play a central role in societal functioning, the infrastructure supporting them is predominantly market-driven. As a result, the product of payments exists in a gray area between being a public good and a commercial product. This dual nature creates challenges in ensuring inclusivity, as market-driven solutions may not prioritize accessibility for all groups. Discussions at events like “D€ voor iedereen” and “Een geldsysteem voor iedereen” have highlighted the evolving definition of inclusivity. Beyond ensuring access, inclusivity might need to encompass addressing specific user needs, such as privacy and transparency, to foster trust and participation.

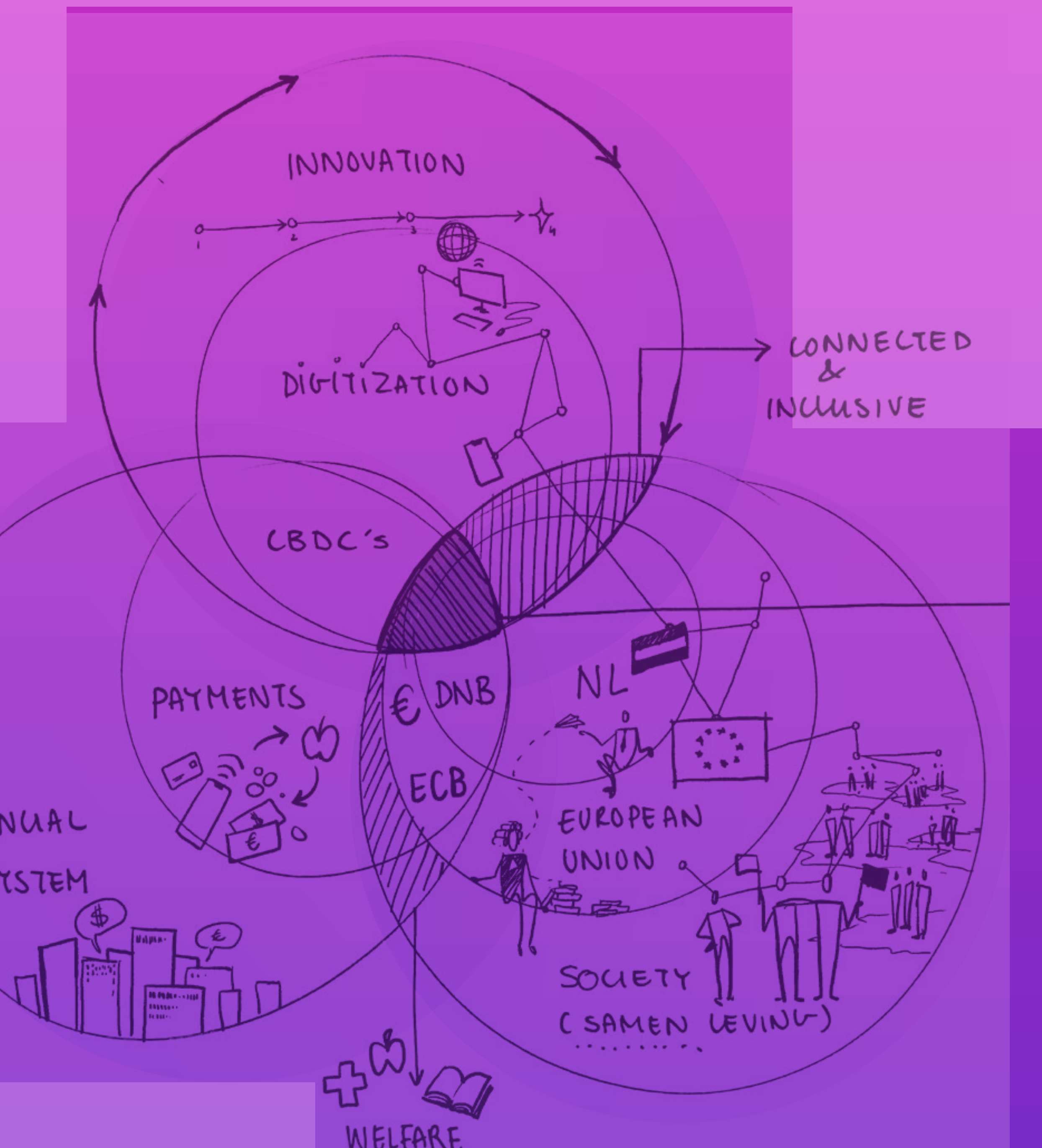
Based on the insights from the deconstruction on 3 levels and the insights from the events incorporating stakeholders, 3 challenges impairing the current relationship between society and payments have been identified.

1. MARKET LIMITATIONS FOR ACCESSIBILITY
2. (DIGITAL) FINANCIAL LITERACY
3. TRUST

Looking forward, these challenges can help us determine how the relationship between society and payments has changed. In the following chapter we will investigate how the relationship between society and payments is likely to change. To conclude this following chapter we can compare the current challenges, 2025, with the challenges emerging in likely future, 2035. Will these challenges overlap with the challenges for the future relationship between society and payments?

Figure 14. Impression of “Een Geldsysteem voor iedereen” at Pakhuis de Zwijger. Body language of engaged attendants

3. DISCOVER



This chapter marks the transition into the design phase of ViP (the second half of the curve) and lays the foundation for addressing the second research question: "What driving forces are likely to shape the relationship between society and payments in the Netherlands by 2035?"

Here, the research process focuses on diverging: the generation of insights (Design Council, 2005). Following the ViP methodology, a relevant research domain is identified, key context factors are gathered. and clustered.

To structure this exploration, the following subquestions are addressed:

1. What research domain is most relevant for investigating the future relationship between society and payments (2035)?
2. Which context factors are likely to influence this changing relationship?
3. What overarching themes connect these context factors?

By the end of this chapter, 14 key themes shaping the future of payments are identified. In the next chapter, these themes serve as the basis for uncovering the societal driving forces that will define the evolving relationship between people and payments.

DISCOVER CONTENTS **P**

3.1 RESEARCH DOMAIN

In this phase of the ViP methodology, we aim to identify the key themes expected to shape the relationship between society and payments in the future. By gathering insights on trends, developments, states and principles we can better understand the driving forces behind the evolution of payments. To ensure that these insights are relevant and contribute meaningfully to the research, a distinct research domain is established: *A description of the area in which we aim to make a contribution* (Hekkert & Van Dijk, 2011).

The research domain acts as a lens through which we analyze the world, ensuring that the collected context factors are both relevant and diverse. This serves two key purposes: (1) guiding the selection of insights that directly contribute to answering the research question, and (2) stimulating a broad perspective by considering influences that may not seem directly related to payments but still likely to affect their evolution. For example, while technological advancements are an obvious factor shaping digital payments, broader societal attitudes toward privacy also play a role in influencing consumer behavior and trust in payment systems.

To address the research question posed in this chapter the research domain for this thesis was defined as:

PAYMENTS IN A DIGITAL NETHERLANDS (2035)

In figure 15, the three lenses in this domain are represented.

This domain encompasses three subdomains expected to have a strong influence. Together, they allow for a comprehensive examination of both the changing dynamics of payments and the stable foundations within financial systems and societal norms

LENS 1: INNOVATION - DIGITIZATION: Captures the evolving aspects of the future, where innovation and improvements are drivers of rapid change and digitization.

LENS 2: FINANCIAL SYSTEM - PAYMENTS: Focuses on stable principles within monetary structures and the way society interacts with value exchange.

LENS 3: SOCIETY - THE NETHERLANDS: Examines the largely stable cultural and behavioral norms influencing payments and the monetary system at large.

For a more in-depth explanation of how this domain was determined please refer to appendix D,

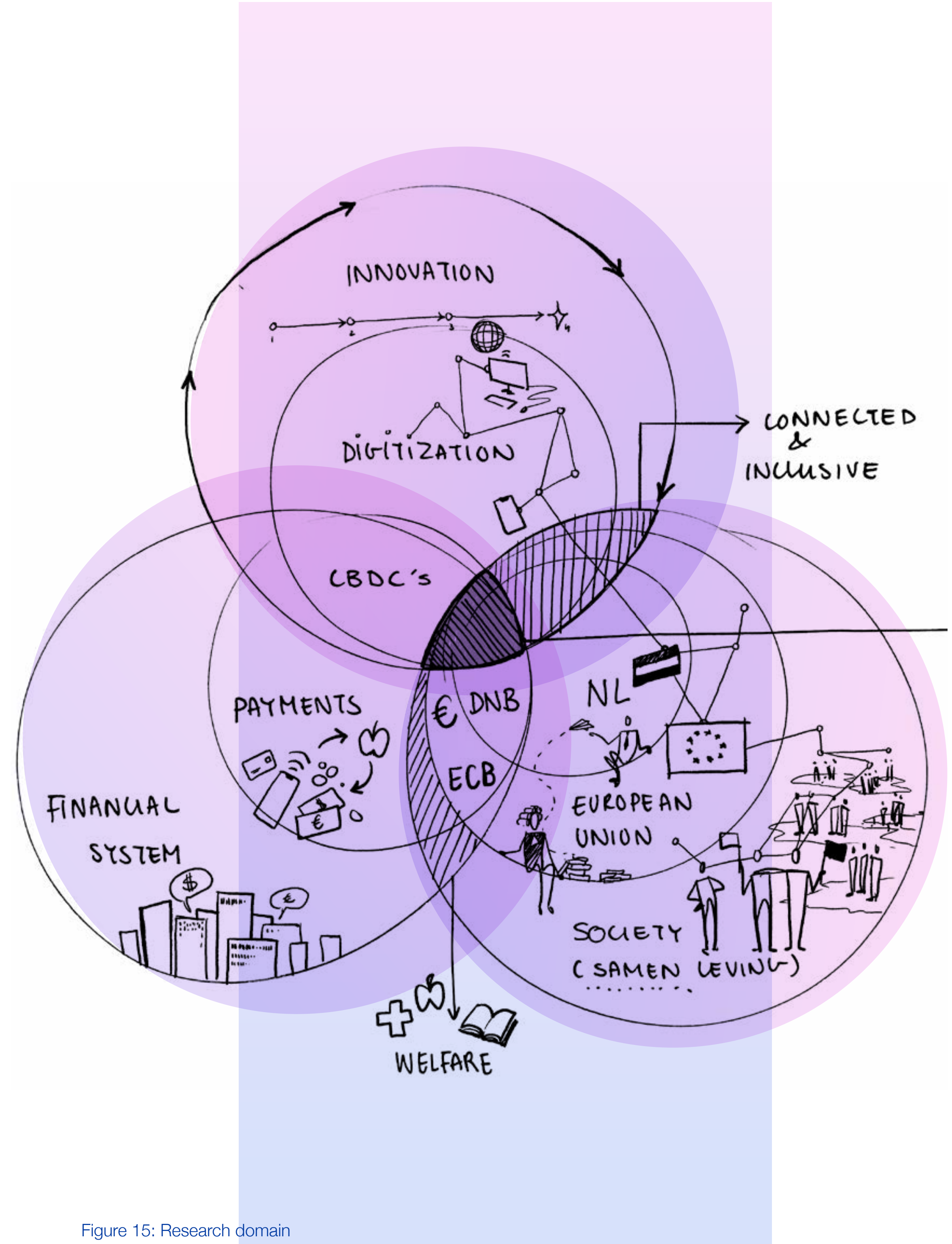


Figure 15: Research domain

3.2 GENERATION OF CONTEXT FACTORS

Based on this research domain, *Payments in a digital Netherlands,* a total of 149 insights, referred to as context factors, were collected. *"Factors are value-free descriptions of world phenomena as they appear"* (Hekkert & Van Dijk, 2011). They serve as building blocks for the likely future: While individually limited, these factors gain meaning when clustered, providing a deeper understanding of changes in the relationship between society and payments. These factors do not include moral judgments or indicate what the design should be, but the selection does reflect the (subconscious) values of the designer and tries to capture the values of DNB as described in the publications: DNB strategy 2025-2028 (De Nederlandsche Bank, 2024a) and Vision on Payments 2022-2025 (De Nederlandsche Bank, 2022a). The thesis supervisors were involved in the evaluation and discussion of context factors included and the directions of exploration.

In this study, most insights are sourced from academic papers, news articles or publications from DNB. In addition to this I have performed 3 interviews with persons of interest to understand their perspectives on the changing relationship with payments: Sociology, psychology, philosophy and economy. These fields of knowledge are each interesting in the way they perceive and shape payments. They are summarized on the next page. The insights were synthesized into additional context factors and analyzed alongside the broader dataset.

To maintain variety and depth in the dataset, a structured log was kept to track the distribution of trends, developments, states, and principles (figure 16). This ensured a balance between stable and dynamic factors—capturing both predictable constants and emerging uncertainties in the future of payments. While economic and financial perspectives were readily available, integrating cultural and sociological viewpoints required additional effort but was essential for a holistic understanding. Within the time constraints of the research, an attempt was made to balance these perspectives as much as possible.

	Cultural	Psychological	Political	Demographic	Sociological	Economic	Biological	Theology	Climate	Technological		Totaal	%	
Trends	3		12	3	7	5			1	4		35	23%	**Total changes until 2035**
Developments	1		0	3	1	11			2	3		21	14%	56
States	6	12	9	2	7	9		1	1	9		56	38%	**Total constants until 2035**
Principles		20	2			2	9	4				37	25%	93
Totaal	10	32	23	8	15	27	9	5	4	16	**Totaal:**	149		
% of total	7%	21%	15%	5%	10%	18%	6%	3%	3%	11%				

Figure 16 Overview of distribution context factors

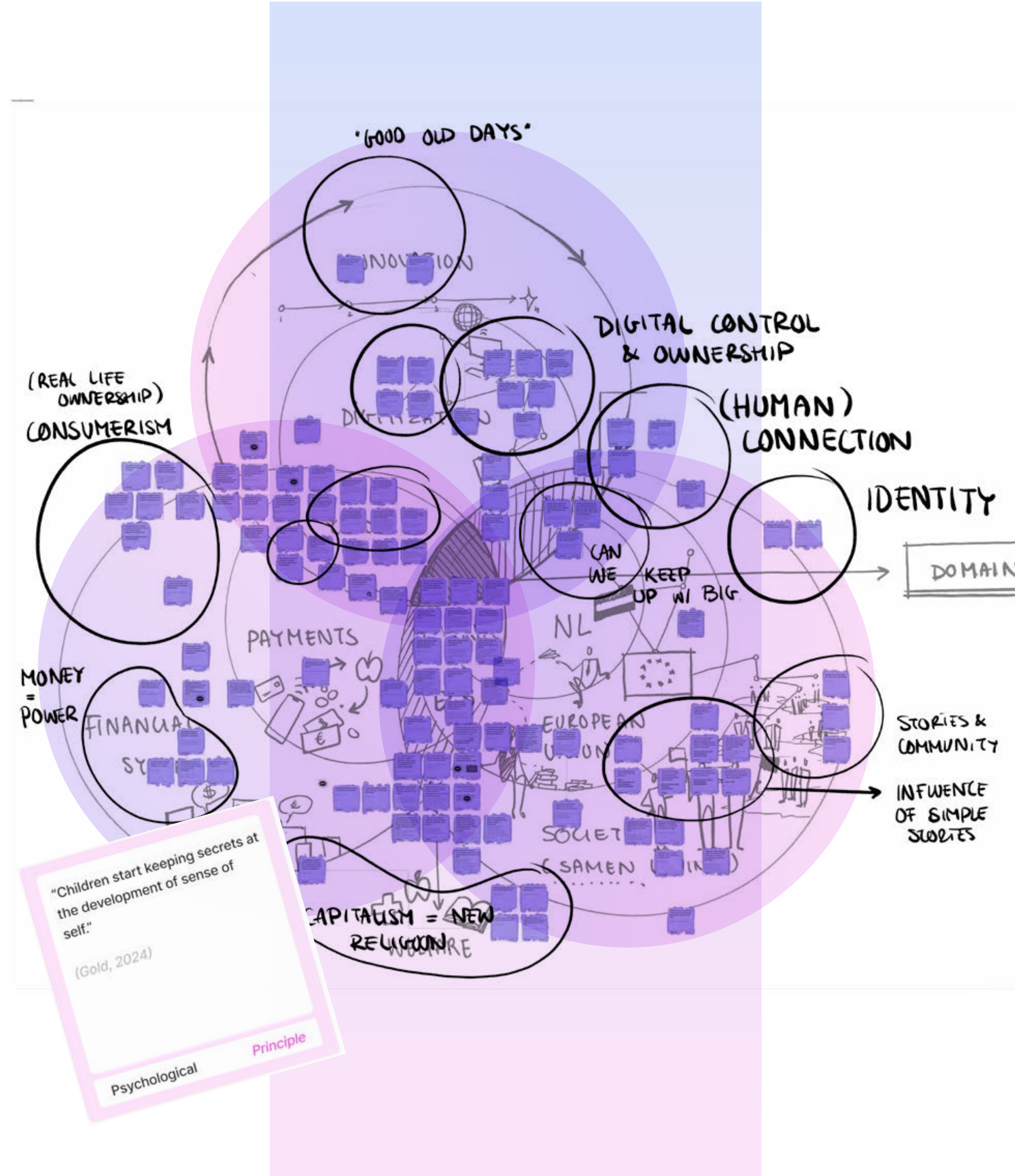


Figure 17 context factors distributed over domain

3.3 EXPERT INTERVIEWS

To ensure a diverse range of perspectives, outside the knowledge within DNB, three experts from different domains were interviewed. These each contribute insights into the evolving relationship between society and payments. Instead of conventional interviews, these were open discussions, exploring the philosophical and systemic implications of payments within their respective fields.

On the right, some quotes characterising these conversations are highlighted. For a more detailed breakdown of each discussion, refer to appendix E.

The most valuable insights from these interviews were translated into context factors and integrated into the broader selection.

“THE COMPLEXITY OF THE FINANCIAL SYSTEM CONTRIBUTES TO THE CONTINUED EXISTANCE OF IT.”

“PRIVATE MONEY AND PAYMENT SYSTEMS ARE INHERENTLY UNSTABLE, WHILE PUBLIC PAYMENTS ARE TYPICALLY STABLE.”

1. MARTIJN JEROEN VAN DER LINDEN

Economist, PhD author of *Design Guidelines for the Monetary and Financial System in the Digital Age*, co-author of *The Waterworks of Money*

“BANKS DON’T SELL MOST OF THE DATA THEY AQUIRE FROM THEIR PAYMENTS, BECAUSE THEIR CUSTOMERS VALUE THEIR PRIVACY.”

2. MARKUS UNTERNAHRER

Sociologist, co-author of *Unlocking the Payment Experience: Future Imaginaries in the Case of Digital Payments*

“PRIVACY IS A FORM OF SECRET KEEPING”

“CONFIDENTLY PROCLAIMING SOMETHING AS THE TRUTH, PLACES THE BURDEN OF PROOF ON YOUR OPPONENT. TRUE UNTIL PROVEN WRONG.”

3. ANDREAS WISMEIJER

Psychologist, researcher at Tilburg University, specializing in the psychology of secrets

3.4 CLUSTERING CONTEXT FACTORS

Clustering the context factors is the first step towards creating a structure in which they are all connected (Hekkert & Van Dijk, 2011). The collected context factors can be combined into clusters describing larger themes influencing the relationship between society and payments. These clusters are either combinations of factors pointing to the same underlying direction, or emergent quality clusters that bring together factors, where they together indicate/imply a new direction all together. The combinations of clusters show us themes describing the developments for the relationship between society and payments.

The clustering was initially done individually to get a comprehensive overview of the complete set of context factors. A second iteration was done in collaboration with Joost van Baar, a fellow design intern at DNB, and Huib Klarenbeek and Anneloes van Gent, my regular supervisors from DNB. Through this process, 149 context factors were synthesized into 14 clusters: A manageable number for further analysis and design. The clusters are presented on the following pages as research outcomes of this phase.

LIST OF CLUSTERS:

1 Consumers as Products
2 Seeking Digital autonomy
3 Building barriers of independence
4 New rules in payments
5 Overconfidence in a Digital age
6 Influential fairy-tales: Heroes and villains of modern society
7 The abstraction of money
8 The Search for Lightness in a Serious Society
9 The illusion of trust in digital authenticity
10 Moral boundaries of Capitalism
11 The Dilemma of Growth vs. Sustainability
12 Unequitable burdens
13 Power of broken Promises in a Digital Democracy
14 Challenges of a shared money

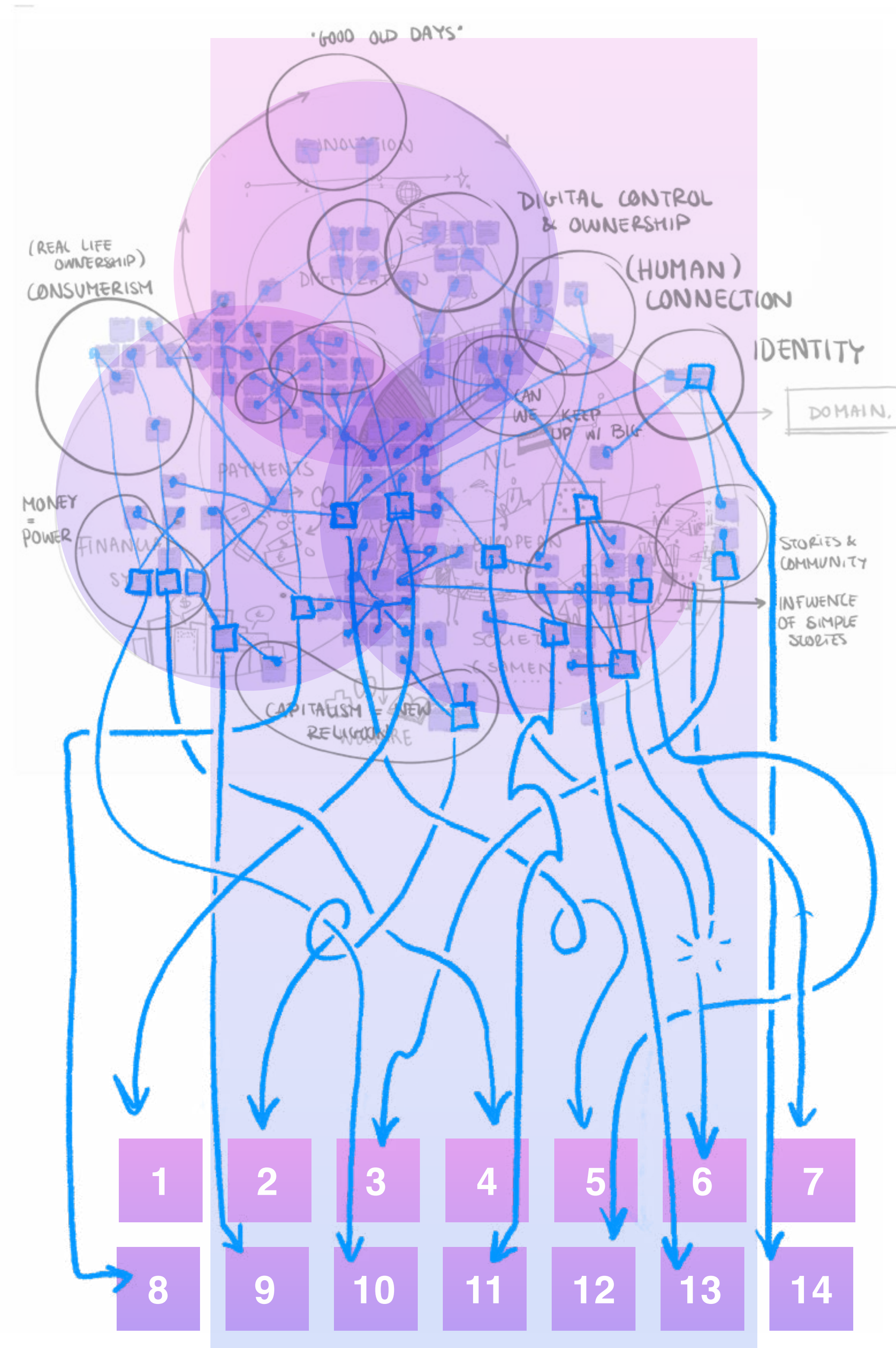
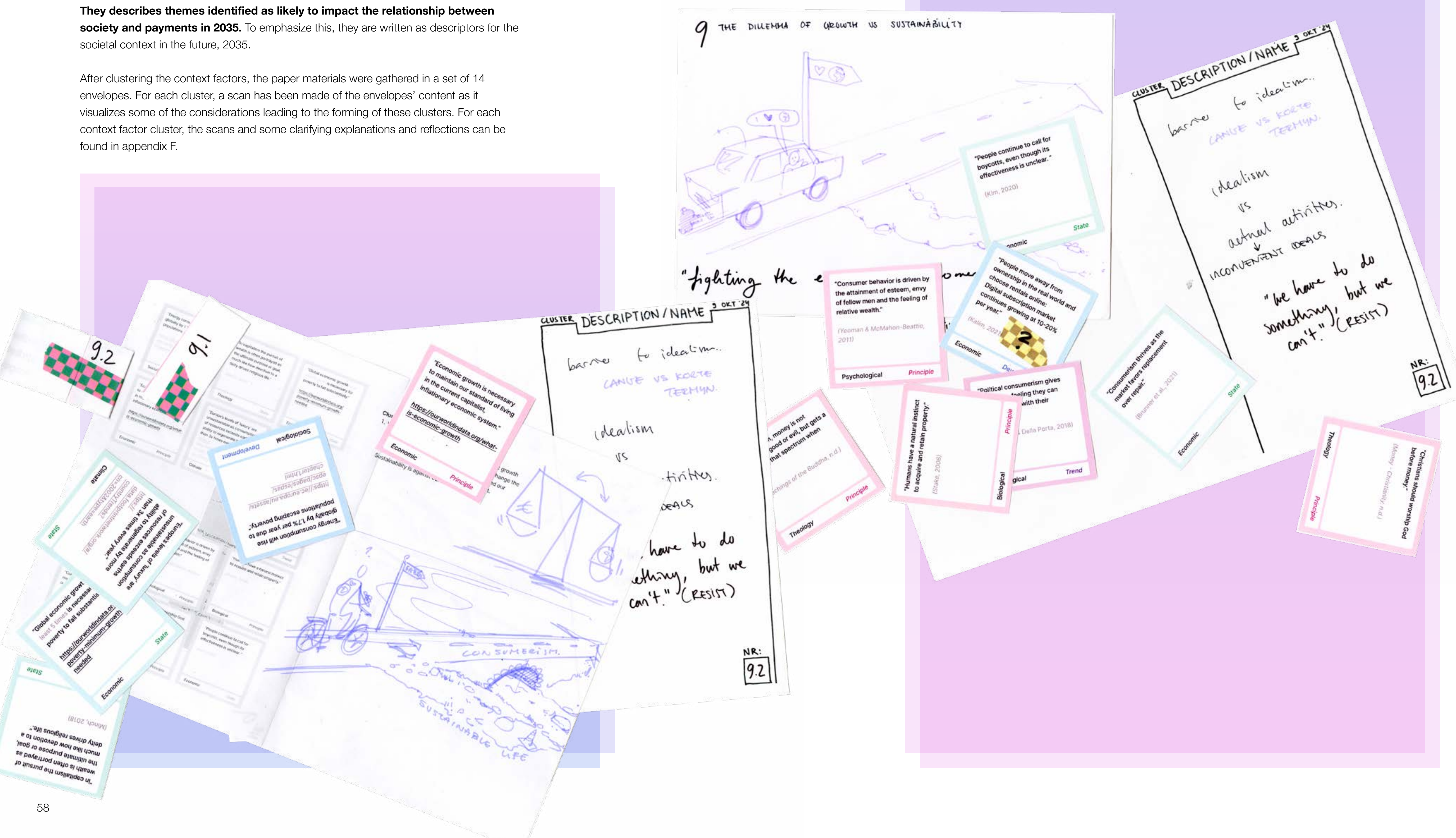


Figure 18 Visual representation of clustering

3.5 CLUSTERS OF CONTEXT FACTORS

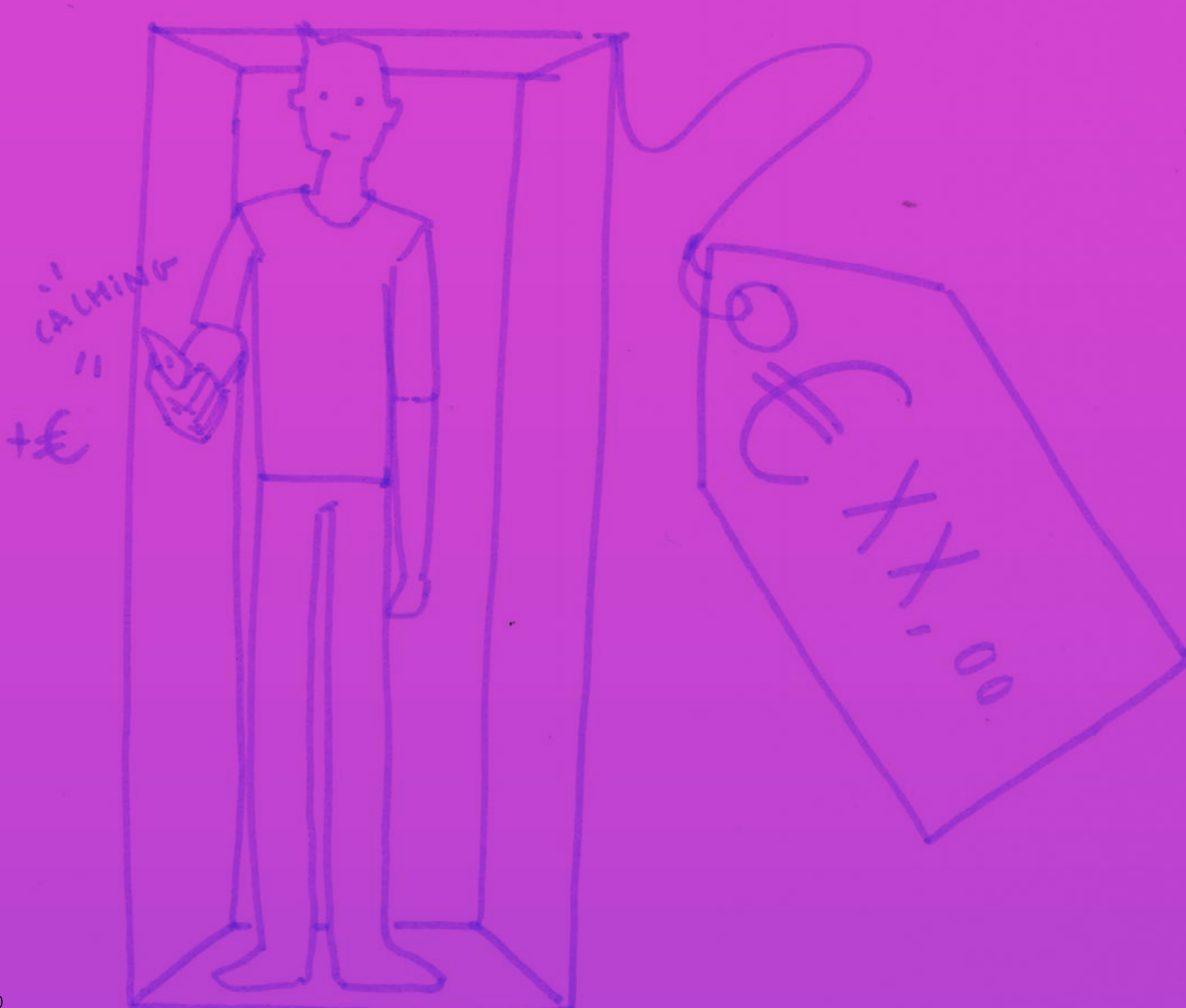
The clusters are presented on the following pages as research outcomes of this phase. **They describes themes identified as likely to impact the relationship between society and payments in 2035.** To emphasize this, they are written as descriptors for the societal context in the future, 2035.

After clustering the context factors, the paper materials were gathered in a set of 14 envelopes. For each cluster, a scan has been made of the envelopes' content as it visualizes some of the considerations leading to the forming of these clusters. For each context factor cluster, the scans and some clarifying explanations and reflections can be found in appendix F.



3.5.1 CONSUMERS AS PRODUCTS

As people increasingly prioritize sustainability and convenience, we are moving away from traditional product ownership in favor of digital subscriptions. What we once owned is now provided through recurring services, with the business model focused on keeping customers subscribed for long-term profit. Even with free digital products, data and attention are sold to advertisers. By 2035, most products and services are likely designed to maximize user engagement through addictive features and by lowering payment barriers, ensuring consumers stay hooked.



SUPPORTING CONTEXT FACTORS:

When (digital) products are free to use, the consumer (data) is typically the product (Mützel, 2021)

Addictions cause people to lose control over their actions, even when they know it is harming them (Biology of Addiction, 2024)

New technologies are often difficult to comprehend, but easy to use (FD, 2024)

Teens are especially vulnerable to develop (digital) addictions (Biology of Addiction, 2024)

Private companies are increasingly involved in payments (Research Nester, 2024)

The bombardment of advertisements and brand exposures have caused customer loyalty to decline (CBS, 2024)

To avoid losing customers, businesses are forced to offer new, more convenient payment methods (DNB)

Buy-now-pay-later' schemes are marketed to make young people think buying on credit a is not acquiring debt (Doelman, 2024)

Technologic developments (NFC's, wearables, software) are making digital payments easier to use and more secure (Mützel, 2021)

People move away from ownership in the real world and choose for rental products (Kalim, 2021)

More people become exposed to unmonitored debt as "Buy now, pay later" market grows 11% annually (Research and Markets Ltd, 2024)

3.5.2 SEEKING DIGITAL AUTONOMY

Humans have an inherent need to feel in control of their lives. The ability to keep secrets is crucial to maintaining a sense of autonomy and safeguarding a personal identity. In the vast digital world, individuals struggle to control what is shared, what others can see, and what they wish to keep private. As digital products and on-line organizations play an increasingly dominant role in society, many long for a simpler, more private time, favoring cash and "dumb phones" as artifacts of a time where privacy was easier to protect.

Decreased privacy and security on-line pushes people to desire technological regression (Frattari, 2024)

A 'dumb phone' can protect your mental well being from overexposure to digital media (Frattari, 2024)

Highly personal advertisements feel like a breach of your private thoughts and feelings (Andreas Wismeijer)

Secrets improve autonomy over personal identity (Gold, 2024)

Having secrets without cognitive preoccupation, is beneficial for quality of life (Andreas Wismeijer)

Children start keeping secrets at the development of sense of self (Gold, 2024)

Feeling like your privacy is violated leads to anxiety, stress, and a loss of control (Priyanshu, 2024)

Mishandling private data is the most influential reason for decline in trust of their bank (Van Der Cruijsen et al., 2021)

News about increasing amount of "sovereign" people in NL is a symbol of decreasing (trust in) authority of the Dutch Government (Spraakmakers, KRO NCRV, 2023)

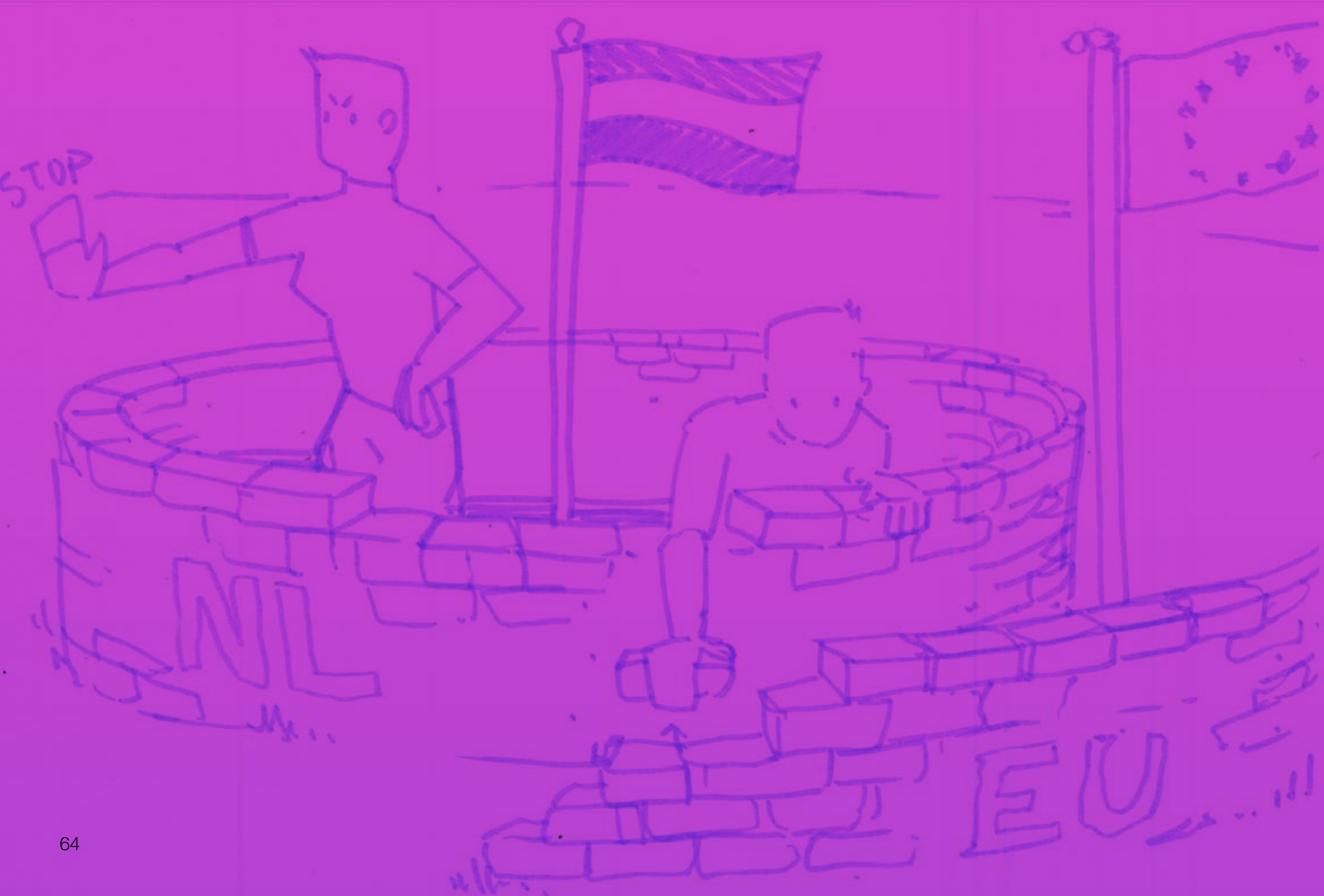
Trust in value of cash stays high while use of cash continues decreasing with 1% per year (ECB, 2021)

On-line platforms are providing more options for taking control over your digital privacy (Andreas Wismeijer)

Without the leverage of the European Union, individual countries can't resist the (bad) influence of big tech. (FD, 2024)

3.5.3 BUILDING BARRIERS OF INDEPENDENCE

Global and local collaboration has played a key role in achieving widespread welfare across Europe. Now that it has become wealthy, and has much to protect, the rest of the world is often perceived as a threat to this hard-earned prosperity. Feeling increasingly disconnected from others in the global economy, people fear that outsiders will drag them down. To safeguard the welfare of their own communities, they begin building barriers around themselves, even if this risks weakening the very alliances that helped them achieve their prosperity in the first place.



SUPPORTING CONTEXT FACTORS:

Feeling wealthier makes us act more selfish (Piff & Robinson, 2024)

Uncertainty makes it more difficult to implement policies fostering long term improvement (International Monetary Fund, 2024)

In fear of a next financial crisis, first world countries are adopting more nation-centric policies (Schirm, 2022)

Accusing people of keeping secrets contributes to widespread distrust and manipulation (Gold, 2024)

Rising global tensions limit economic growth especially for Low Income Developing Countries (International Monetary Fund, 2024)

European payments are highly dependent on private, non European companies such as MasterCard and Visa (Atlantic Council, 2024)

Most countries are exploring, piloting or using CBDC's (Atlantic Council, 2024)

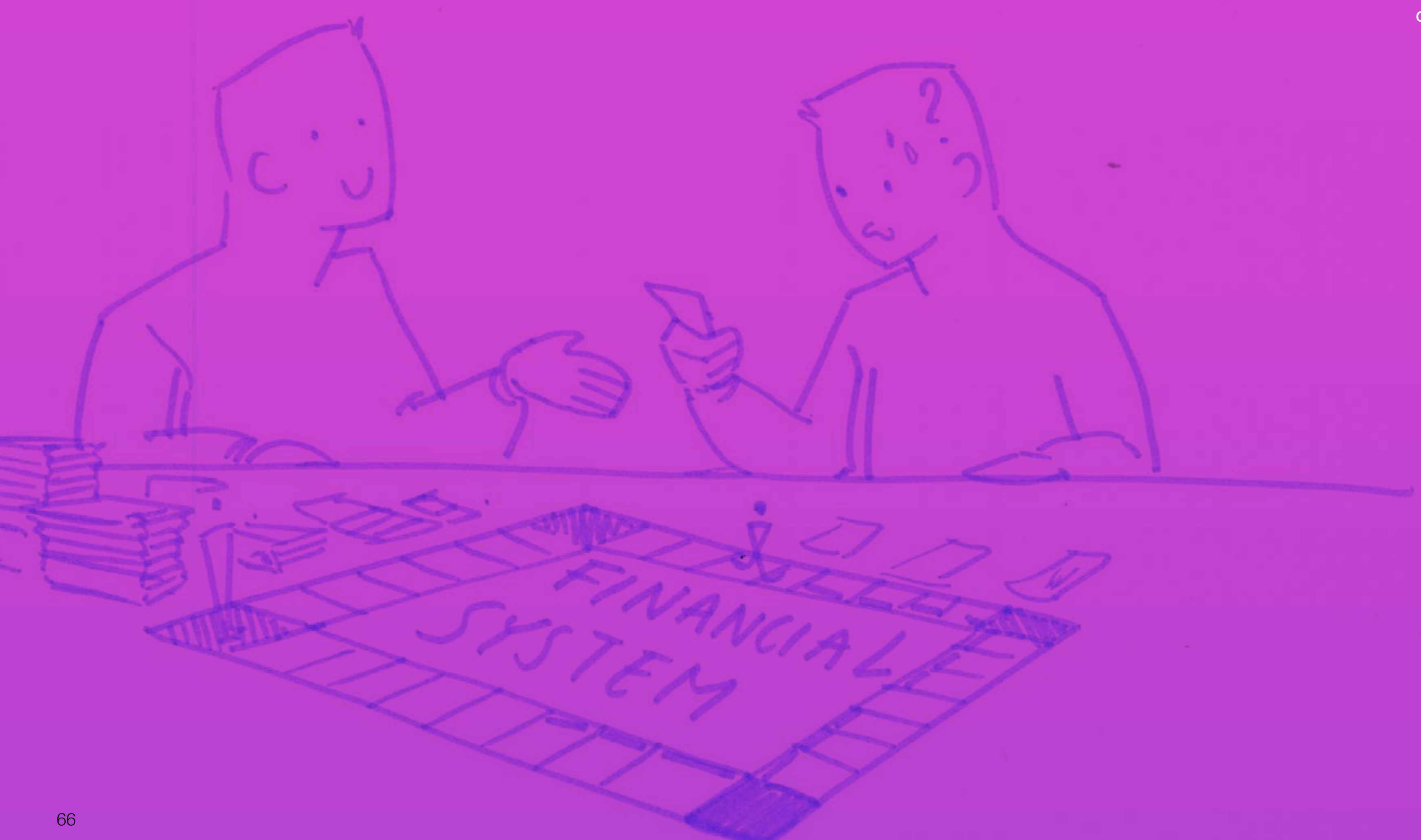
Central bank money is used as a tool for maintaining financial stability (ECB)

Europe doesn't keep up with global digital developments as they structurally invest less in R&D than Japan, USA and China (ESPAS - Global Trends to 2030)

Countries are creating trade barriers and domestic subsidies to bring back local industry at a high cost (Antras, 2024)

3.5.4 NEW RULES IN PAYMENTS

The financial system operates with a clear set of rules that can be both simple and complex to understand and navigate. While participating in this system has never been easier in the digital world of 2035, understanding the rules has become increasingly elusive. The constantly evolving digital landscape means that the most accurate and current information is found on-line. However, this poses significant challenges for those unable to discern truth from misinformation on-line. For the digitally illiterate, this creates a situation where they are forced to play the financial game without fully understanding the rules, often resulting in losses on their part.



SUPPORTING CONTEXT FACTORS:

More people are seeking on-line tools like StemWijzer as it becomes extremely time consuming to understand the viewpoints of all political parties (De Leeuw & Muselaers, 2022)

Non-specialists have trouble distinguishing truths from falsehoods on the internet (Eurostat, 2022)

Stock-trading-training's are especially successful when targeting beginner/ inexperienced investors (Business Research Insights, 2024)

Confidently proclaiming something as the truth, places the burden of proof on your opponent (Andreas Wismeijer)

Digital financial services are more accessible to financially literate/smart people (Van Rooij et al., 2012)

Especially lower educated groups source news from untrustworthy sources (Geers, 2020)

Unmonitored, Fin-techs are able to innovate at a speed unattainable by commercial banks (Mützel, 2021)

As investing becomes more like gaming/ gambling, 'investment app' market experiences significant growth (Global Market Insights Inc., 2023)

3.5.5 OVERCONFIDENCE IN A DIGITAL AGE

By 2035, people are becoming more determined to take control of their personal and financial well-being. As the governing structure grows more complex, there is increasing doubt about whether those in authority can effectively manage their responsibilities in such a rapidly changing society. The rise of digital tools like crypto-currencies, on-line health resources, and the flood of both accurate and misleading information has empowered individuals to believe they can manage things on their own. However, this confidence often leads to over-reliance on unreliable sources. Unrealistic promises of a better future are prioritized over fact-checking and consulting credible experts, organizations, or the government.

SUPPORTING CONTEXT FACTORS:

For digital currencies trust is not dependent on the system, but rather on the trust people have in their own digital proficiency (Schraten, 2019)

Misunderstandings of DNB's tasks and responsibilities reduce trust (De Nederlandsche Bank, 2022)

Individuals are increasingly asked to take responsibility for their retirement preparation (Van Rooij et al., 2012)

Dutch people increasingly place savings in other European countries (De Nederlandsche Bank, 2024b)

Trust in science is dependent on political affiliation (left vs right) and overall trust in institutions (Rathenau Instituut, 2024)

WebMD searching behavior negatively impacts satisfaction and trust in general practitioner (Rivetz, 2014)

Finfluencers' are increasing the amount of unknowledgeable investors on the market (Autoriteit Financiële Markten, 2021)

Distrust of financial institutions and government interference allow Crypto market to grow to 13B in 2034 (Fact.Mr, 2024)

Crypto currencies are more successful in individualistic cultures (Deleanu et al., 2019)

Most young adults (18-35, 51%) don't have the administrative skills or knowledge needed to manage their finances (Nibud, 2022)

Young people (18-34) are twice as likely to invest in crypto than the older generation (35-54) (Michael, 2024)

Increasing transparency helps improve trust in the government (Alessandro et al., 2021)

Humans have the tendency to remember the past as better than it actually was (Krank, 2019)

Population of atheistic and agnostic people grows as Christians let go of their affiliations with the church (Wormald, 2024)

3.5.6 INFLUENTIAL FAIRY-TALES: HEROES AND VILLAINS OF MODERN SOCIETY

Increased access to information in the digital age makes us more aware of global problems, but the complexity of our political landscape makes it harder to fully understand these issues and form balanced opinions and priorities. Our democratic system tends to favor opinions shared by large groups, particularly the majority. To gain influence, it's often more effective to craft a simplified narrative about our complex society by framing it in terms of heroes and villains. Whether these oversimplified "fairy-tales" actually address the complexities of the world is less important than how convincing they appear compared to opposing viewpoints

SUPPORTING CONTEXT FACTORS:

Shared stories create a sense of community and belonging (Prompt, 2023)

Our brains are hardwired to seek, understand, and resonate with narratives (Prompt, 2023)

People trust PayPal's platform, not because it is safe, but because it's simple (Schraten, 2019)

Sharing a currency makes Europeans feel more connected to the European identity. (Negri et al., 2020)

The Netherlands has a longstanding history of national pride and collaboration for the benefit of our nation (Pleij, 2019)

In religion, people have to trust that their beliefs are the truth (Semen, 2010)

Populism takes advantage of the complexity of politics, which is hard to understand (ESPAS, 2019)

Politicians with extreme views are more successful through attacking their opponents character than their arguments (Bail et al., 2018)

Democracy takes into account all voters, even when voters may lack the necessary information to make informed choices (Meyer, 2016)

Populism is a political style, relying on emotional and offensive language to stress the urgency of its demands, and their proximity to the people (ESPAS, 2019)

The increasingly harsh nature and tone of political arguments makes people feel that polarization is growing (Oostveen, 2024)

Exposure to opposing views on social media is more likely to cause polarization than to change someones mind (Bail et al., 2018)

Financial stability is a global public good requiring collaboration between nations (Kaul, 2003)

People from lower and middle class feel betrayed by the 'elite, highly educated' as a result of their radical, climate stances (Cuperus, 2024)

3.5.7 THE ABSTRACTION OF MONEY

Throughout history, the concept of payments has evolved in the journey towards creating a more efficient monetary system. To streamline transactions, society has gradually moved away from tangible assets with intrinsic value, making money increasingly abstract. By 2035, the digital age has further blurred the collective understanding of financial health, with money reduced to a balance that can be seen but never physically held. As slang shifts the narrative from “purchasing” to “getting,” and cash becomes less central to our financial balance, spending money no longer carries the same weight it once did.

SUPPORTING CONTEXT FACTORS:

The difference between intrinsic and monetary value of our money keeps increasing as we move towards a more convenient monetary system (DNB)

Money can be used without understanding the basic economic and legal mechanisms (Schraten, 2019)

Digitization of banking communication and payments causes more than 20% of Dutch people to struggle with their financial administration (Nibud, 2022)

Reduced insight into digital financial administration as 44% of people regularly pay for subscriptions they don’t want or use (Nibud, 2022)

Spending money on necessities hurts more than spending on luxuries (De Nederlandsche Bank, 2024a)

For teenagers, paying with cash hurts less than paying with card since the balance in their banking app doesn’t go down (De Nederlandsche Bank, 2024a)

New “street language” terms for money or purchasing are making the spending of money feel even more abstract (e.g. “Nieuwe patta’s halen ipv kopen) (Van Dongen, 2021)

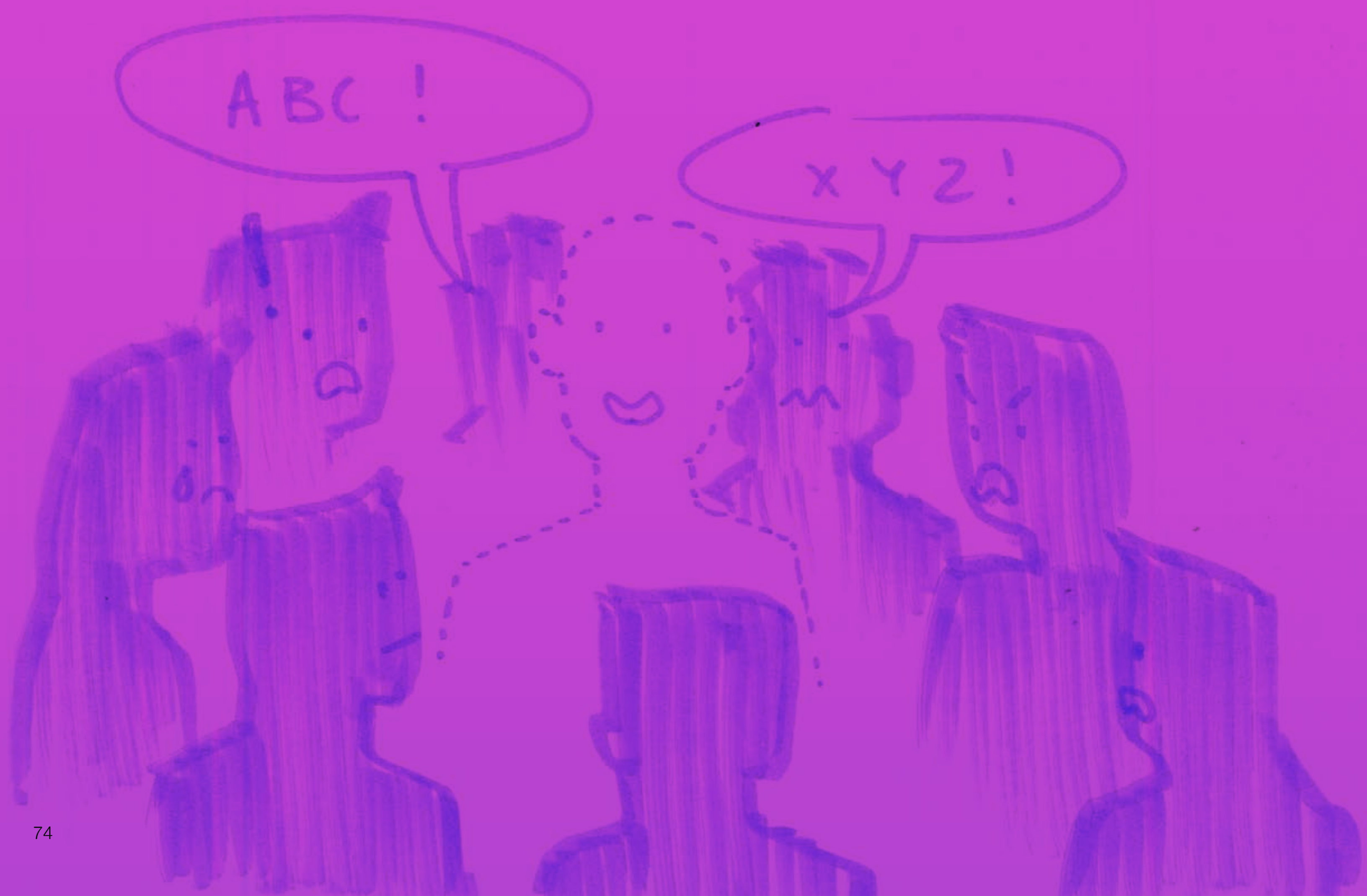
The younger the person, the more regularly they check their bank balance on-line (De Nederlandsche Bank, 2024a)

Getting paid more frequently causes people to feel wealthier and increases spending, while the additional spending causes them to actually be less wealthy (Giesler, 2022)

The use of central bank money is declining as people choose the more convenient payment methods with digital, private money (DNB)

3.5.8 THE SEARCH FOR LIGHTNESS IN A SERIOUS SOCIETY

As more of people's lives shift into the digital realm, individuals increasingly feel tracked, recorded, and remembered. The ability to escape past mistakes is a luxury only those who lived before the internet era truly experienced. Faced with the overwhelming complexity of modern life, people seek ways to escape its seriousness. Trends like "girl math," sensational fake news, and faceless troublemakers on social media reflect society's desire for lightness and enjoyment without the burden of being taken too seriously and remembered forever.



SUPPORTING CONTEXT FACTORS:

People like freely sharing their opinions on-line when their actual identity is kept secret (Andreas Wismeijer)

Secrets (and lying) are an useful tool for maintaining/improving your position in social situations as long as you aren't found out (Andreas Wismeijer)

Young people use mental workarounds like 'girl math' to escape the unpleasant feeling/reality of spending money on things they don't need (De Nederlandsche Bank, 2024a)

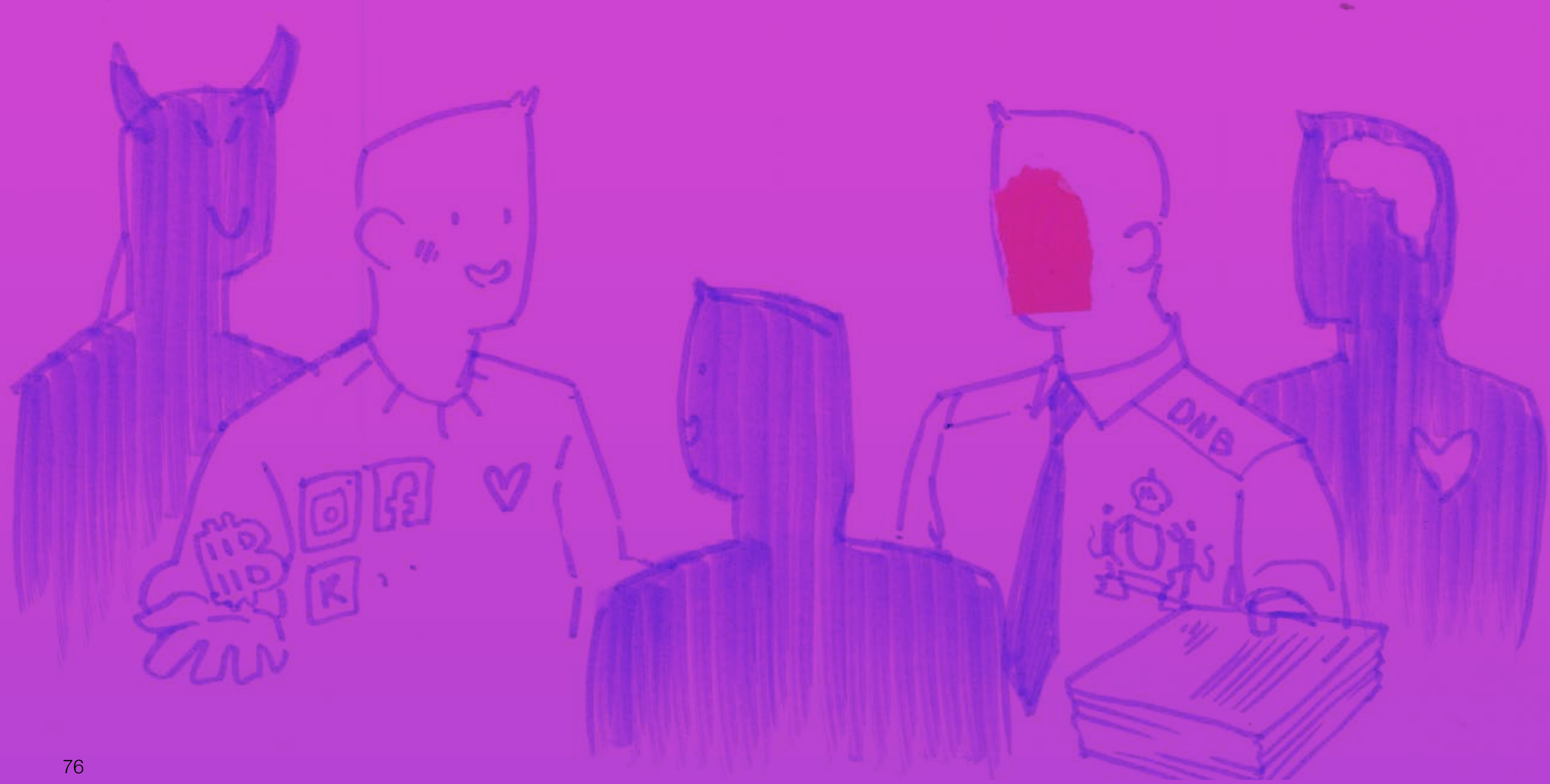
On social media, fake news travels faster and further than the truth (Bail et al., 2018)

Increasing complexity of government policies in a digital world force more people to seek comfort in the simple, comforting words of populists (ESPAS, 2019)

People increasingly seek a presence on social media to escape their presence in reality (Kırcaburun & Griffiths, 2018)

3.5.9 THE ILLUSION OF TRUST IN DIGITAL AUTHENTICITY

By 2035, the solitary human seeks to regain the human connection lost in the shift to a digital society. People are growing increasingly distrustful of large, impersonal organizations, and instead feel more connected to individuals who display their humanity on social media. Social media personas build trust and loyalty by sharing authentic glimpses of their lives, presenting themselves as relatable, independent voices in a world dominated by distant, corporate entities. This perceived trust and personal connection often outweigh the actual credibility of these individuals, which may not be backed by education or accountability. While influential figures may show their flaws to appear more human, they frequently conceal the full extent of their wrongdoings or hidden agendas.



SUPPORTING CONTEXT FACTORS:

Humans have evolved the basic need for social connection (Braren, 2023)

Companies and persons are perceived as having more integrity if they are more familiar (Alarcon et al., 2016)

Time spent with fellow humans decreases as people increasingly live in single person households (CBS, 2024)

Young voters increasingly find and trust political information found on social media (Wat Vinden Jonge Mensen Van De Politiek?, 2023)

Nowadays, more people are investing in risky investment products (such as crypto's) based on advice from unlicensed 'finfluencers' (Autoriteit Financiële Markten, 2021)

Sharing secrets forms loyalty, trust and a sense of connection (Gold, 2024)

Ambiguity and mystery feed the human ability to create imaginary stories (Grant, 1983)

Increased awareness of digital security causes large growth of the VPN market (CAGR 22%) (Precedence Research, 2023)

3.5.10 MORAL BOUNDARIES OF CAPITALISM

In capitalism, people can experience moral boundaries that define what they see as fair wealth distribution: within these limits, the market is perceived as functioning properly. However, when wealth distribution exceeds these boundaries, such as the stark contrast between the wealthiest 1% and the poorest 50%, capitalism is often viewed as unjust. The moral boundaries of capitalism are subjective to the group observing it. In the society of 2035, people are increasingly becoming entrenched in echo chambers that reinforce their beliefs, creating isolated groups with shared perspectives. As society fragments, what one group considers fair, just, or right can differ dramatically from the views of others.

SUPPORTING CONTEXT FACTORS:

Society imposes moral boundaries around the use of money (Zelizer, 1994)

Thinking about money is not purely rational, but deeply influenced by social values and relationships (Zelizer, 1994)

Humans are capable of making long term plans for the benefit of their children (Stake, 2006)

Egalitarian instinct: What we think is fair, trumps what is actually equal (Corning, 2015)(Charlton, 1997)

Rather than polarization (which is experienced by people) fragmentation is growing as people are seeking groups that confirm their own opinions (Oostveen, 2024)

Children are often inherently cooperative, but selfish behaviors are often taught/ rewarded more (Jiang, 2021)

People process information by looking for, or interpreting, information that is consistent with their existing beliefs (Casad & Luebering, 2024)

Especially in countries (communities) where many people suffer from poverty (>60%), most people (84%) would get personally involved to help someone who is struggling (Mercier et al., 2023)

Humans have a limited capacity to feel social connection. (up to 150 people) (Lafont, 2022)

3.5.11 THE DILEMMA OF GROWTH VS. SUSTAINABILITY

In Europe, there is a widespread consensus that welfare should be fairly distributed and poverty significantly reduced. Over the past few centuries, technological advancements have driven substantial economic growth, lifting the average standard of living well above the poverty line. However, human nature compels people to constantly seek more, trapping them in the pursuit of continuous economic growth: both to maintain their own standards and to raise the poorest out of poverty. By 2035, this pursuit is increasingly at odds with another urgent goal: sustainability. Achieving sustainability may require sacrificing some economic growth, presenting a difficult dilemma in a world still driven by the need for constant expansion.

SUPPORTING CONTEXT FACTORS:

Energy consumption will rise globally by 1.7% per year due to populations escaping poverty (ESPAS, 2019)

In capitalism the pursuit of wealth is often portrayed as the ultimate purpose or goal, much like devotion to a deity (Minch, 2018)

Global economic growth of at least 5 times is necessary for poverty to fall substantially (Roser, 2024a)

Economic growth is necessary to maintain our standard of living in the current capitalist, inflationary economic system (Roser, 2024b)

Europe's levels of 'luxury' are unsustainable as consumption of resources exceeds earths ability to regenerate by more than 3x times every year (Global Footprint Network, 2022)

Political consumerism gives people the feeling they can change the world with their money (Monticelli & Della Porta, 2018)

In Buddhism, money is not inherently good or evil, but gets a place on that spectrum when used (Teachings of the Buddha)

Consumer behavior is driven by the attainment of esteem, envy of fellow men (Yeoman & McMahon-Beattie, 2011)

Humans have a natural instinct to acquire property (Stake, 2006)

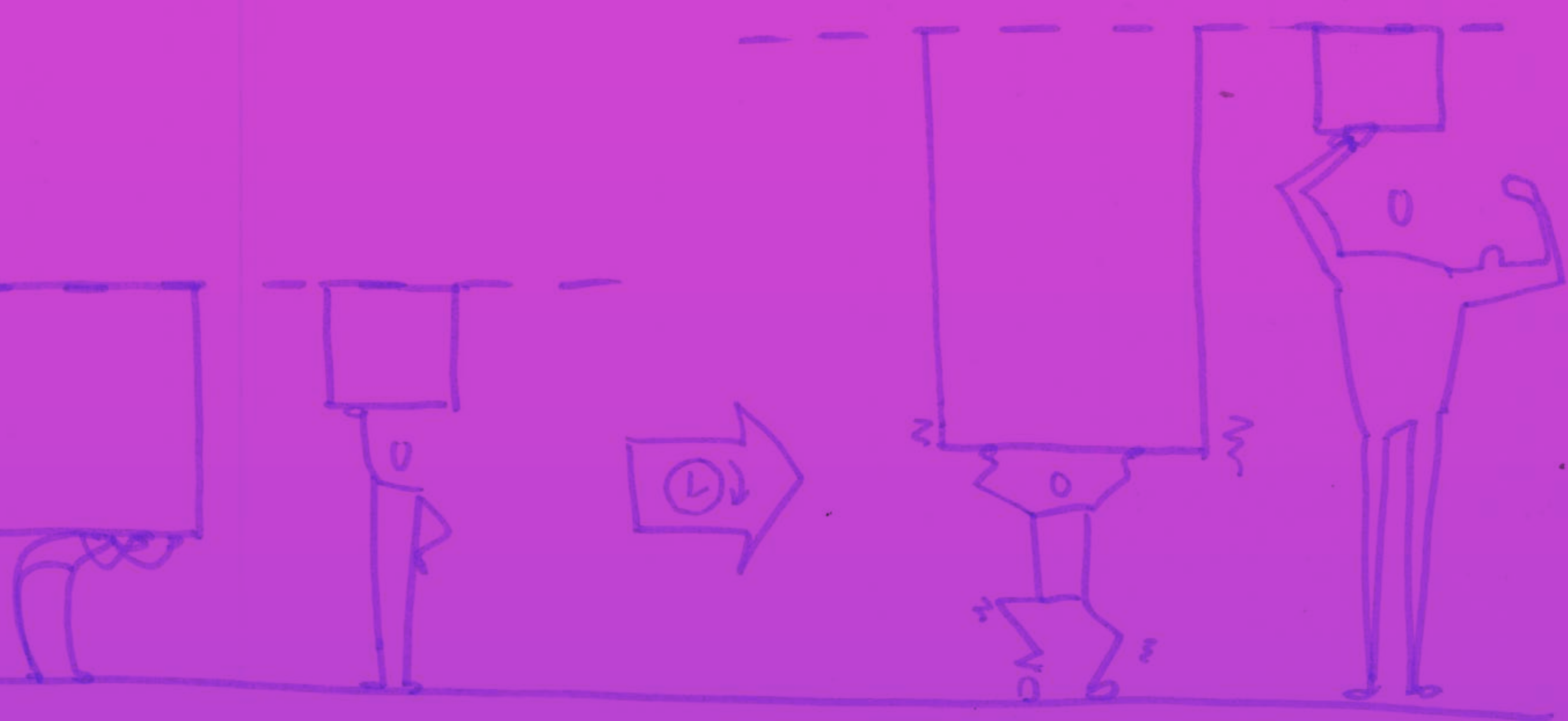
Consumerism thrives as the market favors replacement over repair (Brunner et al., 2021)

Christians should worship God before money (Money - Christianity)

People continue to call for boycotts, even though its effectiveness is unclear. (Kim, 2020)

3.5.12 UNEQUITABLE BURDENS

The basic principle of investment, where money generates more money, naturally leads to growing wealth inequality over time. By 2035, this dynamic could result in the rich becoming richer and the poor falling further behind. To address this imbalance, policies like taxes and stipends are introduced to create a more level playing field. However, this raises a key dilemma: what is truly fair? The subjective nature of fairness makes it difficult for society to agree on a solution. Should fairness be limited to our own population, extend to countries we've historically profited from, or include all those facing poverty worldwide? Since there is no objective standard for fairness, this question will likely continue to challenge in the years to come.



SUPPORTING CONTEXT FACTORS:

Inequality in the EU increases as southern countries bear higher healthcare and food costs (Menga, 2024)

Hyperinflation more common globally as political instability, wars and economic mismanagement are increasing in developing countries (World Bank Group, 2024)

Young groups struggle to enter the housing market as increasing older house owners vote for right wing parties that don't prioritize affordable housing policies (Brännlund & Szulkin, 2023)

Gender wage gap (NL) continues decreasing slowly as awareness grows (Centraal Bureau voor de Statistiek, 2023)

Money can generate money through investment (Waterworks of Money)

Financial inequality increases as increased expenditure on healthcare and food will impact poorer households more than wealthy households (Menga, 2024)

Inequality between education levels and correlation to parents income is increasing (ESB, 2023)

Secrets cannot be ranked from good to bad as the weight of a secret is highly subjective (Andreas Wismeijer)

People prefer earning only slightly more than others in their social circle to avoid jealousy (Andreas Wismeijer)

The mental load of potential climate change damage weighs heavily on the minds of people already in financial distress (Hornsey & Pearson, 2024)

3.5.13 POWER OF BROKEN PROMISES IN A DIGITAL DEMOCRACY

In the digital age, where nothing is forgotten, the unfulfilled promises of our democracy continue to shape our dissatisfaction with the system. Dutch citizens, paying 38% of their income in taxes (CBS, 2022), have high expectations of the services their government should provide. However, the collaborative nature of our democratic system often prevents politicians from fully delivering on their promises, even when they “win” the elections. By 2035, this dissatisfaction has only grown as the government struggles to meet expectations in an increasingly unstable political climate and resource-constrained world where nothing is forgotten.

SUPPORTING CONTEXT FACTORS:

As economic welfare levels don’t continue increasing, newer generations feel worse off than their parents (ESPAS - Global Trends to 2030, 2019)

It is human nature to not only to register negative stimuli more readily but also to dwell on these events longer than positive stimuli (Cherry, 2023)

49% of Europeans blame inflation rather than lagging wages for their decrease in purchasing power (Mercier et al., 2023)

The willingness to pay taxes (tax morale) is higher when people feel the government is spending their money well (Kemme et al., 2019)

Shrinking working age population will limits European prosperity (European Commission, 2023b) (Center for Global Development, 2024)

High inflation causes distrust of central banks and government (De Nederlandsche Bank, 2023)

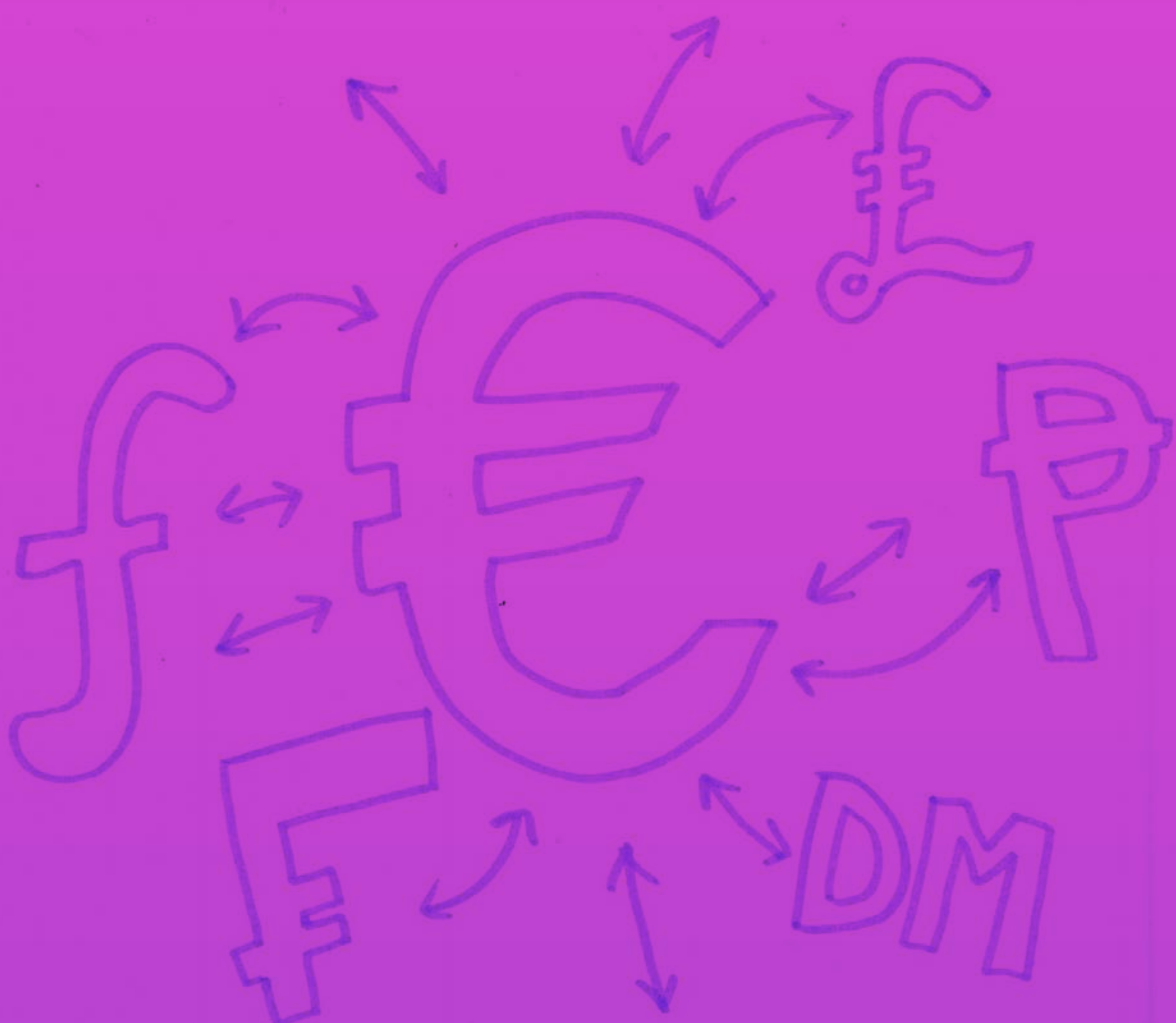
Children don’t learn how to solve their own problems as parents are increasingly involved in the smooth progression of their child’s life (Richards, 2019)

People have high(er) expectations of the government while trust and respect for authority continues decreasing (Ministerie van Volksgezondheid, Welzijn en Sport, 2022)

Political fragmentation in NL continues increasing as a result of reduced support for long standing political parties (De Leeuw & Muselaers, 2022)

3.5.14 CHALLENGES OF A SHARED MONEY

By 2035, Europe's increasing cultural and ethnic diversity introduces a broader range of needs and expectations for monetary products. Policy and innovation often conflict with the deeply rooted cultural values and traditions of native and migrating groups. The significance of family, national, and cultural customs in this diverse landscape makes it challenging to develop "one-size-fits-all" solutions within a shared currency system.



SUPPORTING CONTEXT FACTORS:

Europe becomes increasingly multi-ethnic and culturally diverse to maintain size of working age population (Springford, 2024)

Cash becomes increasingly used for saving (ECB, 2021)

Beliefs about money are often passed down from generation to generation (Abbenes, n.d.)

The replacement of familiar (payment methods and) routines has made people feel distrust towards the managers of our monetary system. (Schraten, 2019)

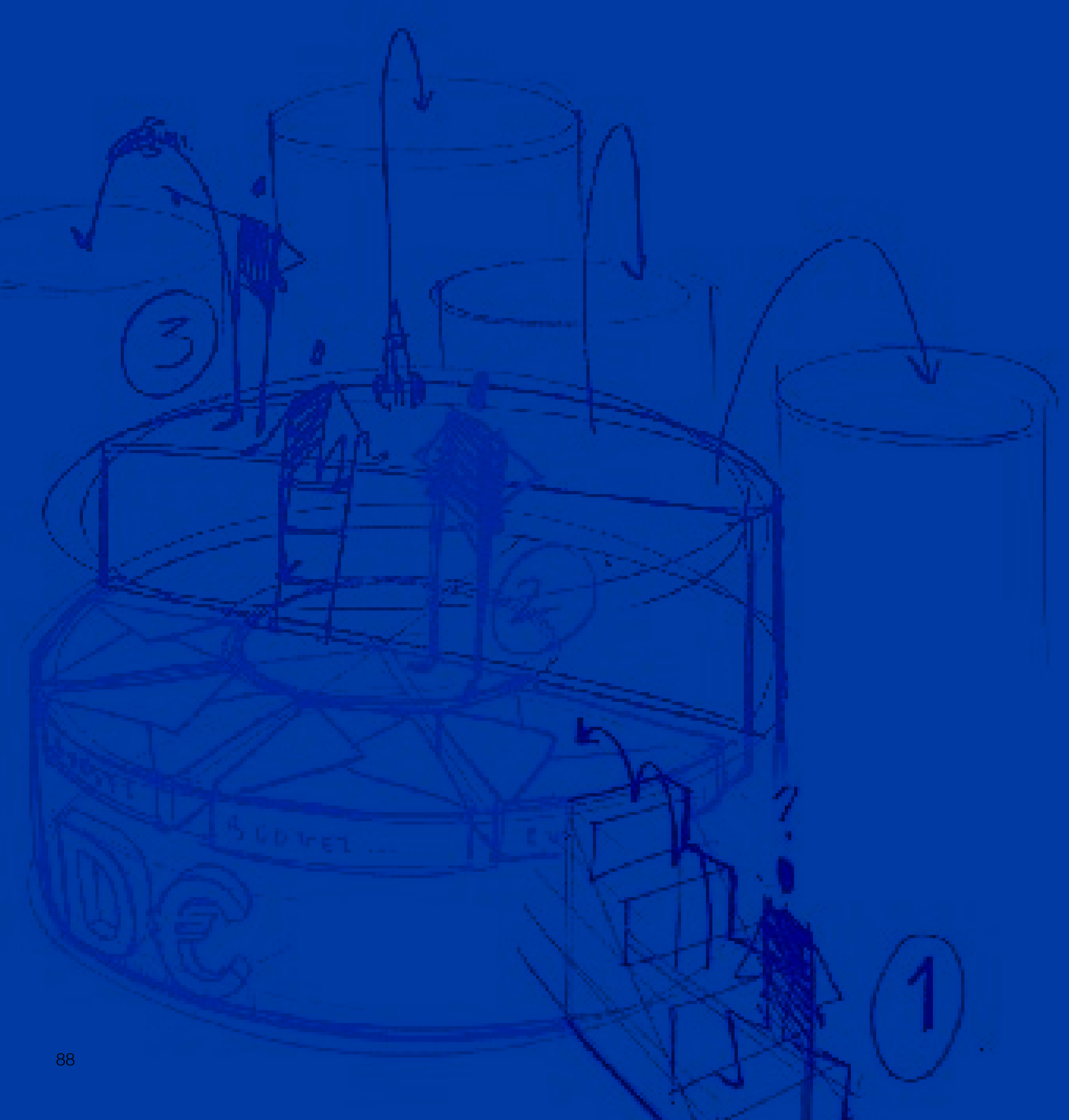
Charging or paying interest on loans is not allowed in Islam (Hayes, 2024)

While health and sickness are universal across the human kind, cultural differences affect the type of healthcare preferred by the patient (Putsch & Joyce, 1990)

'Tikkie Cultuur' increasingly causes frustration as people regularly receive tikkies for as little as 50 cents. (Fellinger, 2023)

As people choose to work more part-time: Wealth is increasingly measured in freedom rather than material property (Andreas Wismeijer)

4. DEFINE



This chapter marks the transition to the re-framing phase, where we re-define the problems emerging from the gathered insights in the discover chapter. This is done by addressing the second research question: *“What driving forces are likely to shape the relationship between society and payments in the Netherlands by 2035?”*

Based on the themes identified in the discover chapter, we can restructure the context and identify some underlying driving forces in the changing relationship between society and payments. By learning how the relationship will change, and why, we can anticipate the likely future and(re)design payments in a goal oriented way, based on an envisioned desirable future vision.

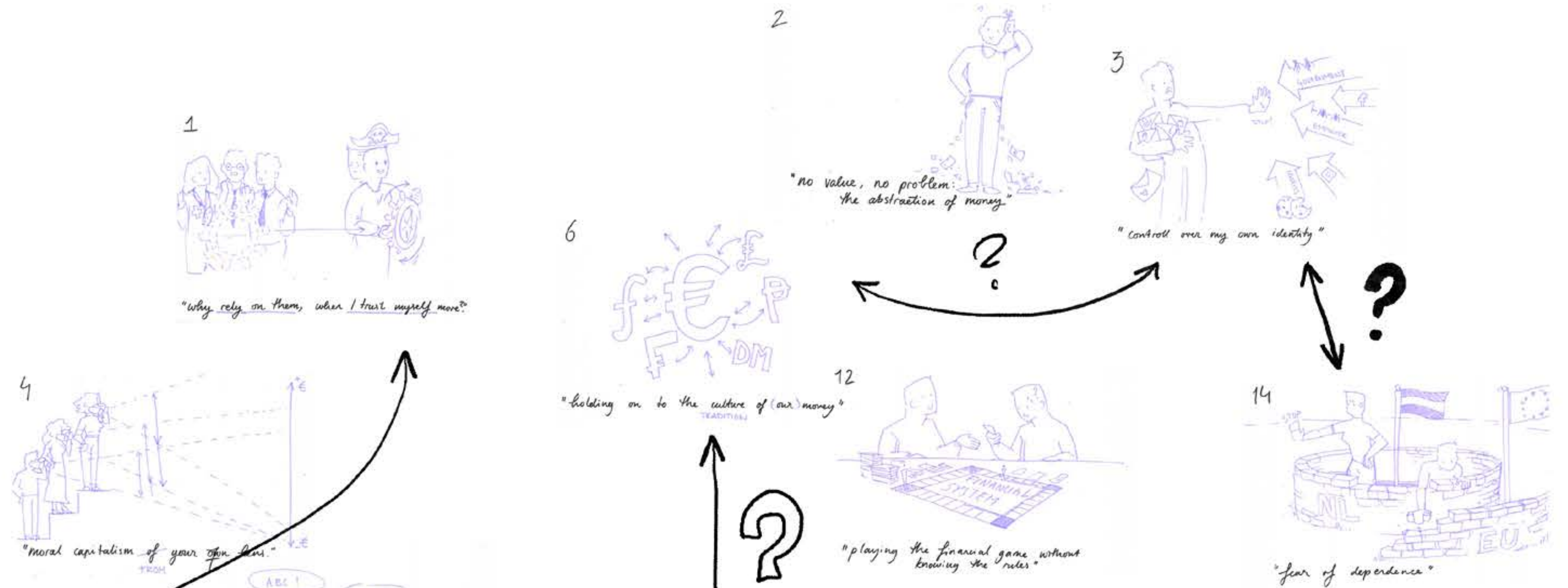
In the following chapter, the emergence of these drivers is substantiated from the contextual analysis. The interplay of these “driving forces” leads us to frame three emerging challenges for the changing relationship between society and payments. For each challenge a vision is written explaining how we should intervene in try to achieve an envisioned desirable future.

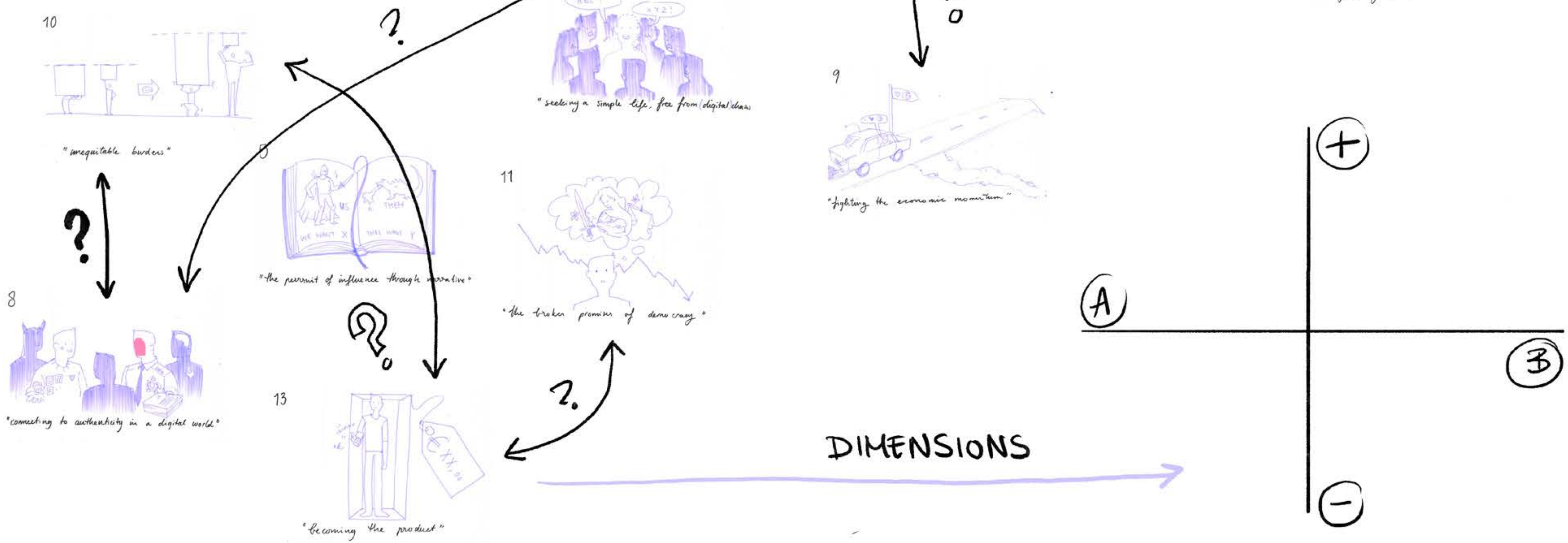
DEFINE CONTENTS **P**

4.1 STRUCTURING THE CONTEXT

With the 149 context factors synthesized into 14 clusters, we can now move towards identifying the main patterns shaping the future of digital payments. According to the ViP methodology, this is achieved by defining dimensions: *axes of tension where clusters conflict, contrast, or represent opposing forces in the evolving relationship between society and payments (Hekkert & Van Dijk, 2011).*

By mapping out these dimensions, we can uncover the primary drivers of change, offering a structured way to analyze the dynamics influencing digital payments. This process not only clarifies the tensions at play but also provides a foundation for designing within this future context.





4.2 EXPLORATION CONTEXT DIMENSIONS

To determine the most meaningful context dimensions for the gathered context factors, multiple dimensions were explored. The final selection was made based on their ability to tell a compelling and relevant story about the future of payments. However, in the complex world of payments, many different narratives could be constructed.

All of these dimensions highlight interesting themes and tensions within the identified context clusters. While not all explored dimensions were selected, each provides insight into how the relationship between people and payments could evolve. The ones left out are not irrelevant; they simply do not represent the most critical driving forces shaping the future landscape.

A: SYSTEM PARTICIPATION IS...

Payments are a central piece in the financial system as we know it. If you want to be a functioning member of society participation is inevitable, but the way people perceive their role in this system varies greatly.

Forced | Unknowing | On your initiative

B: SELF SUFFICIENCY:

The Netherlands is often referred to as a welfare state, but freedom and autonomy is also highly valued. Tensions arrive between institutions expecting people to save themselves, and individuals expectations that they will be taken care of.

Individuals have to save themselves | Individuals (can) expect to be saved

C: THE PERCEPTION OF FAIRNESS OF OUR FINANCIAL SYSTEM

In the Netherlands, the financial system is based on capitalism, but not in it’s purest form. Subsidies and taxes try to make it more fair, but tensions arise in the discussion about what is fair.

Capitalism is fair to me | Capitalism is unfair to me | Capitalism is unfair for everyone

D: PERCEPTION OF THE TOP PRIORITY

Building upon “fairness in our financial system”, tensions arise in the way people see our collective priorities. Who is the center of the universe of payment systems?

The system | Us, the people | The individual

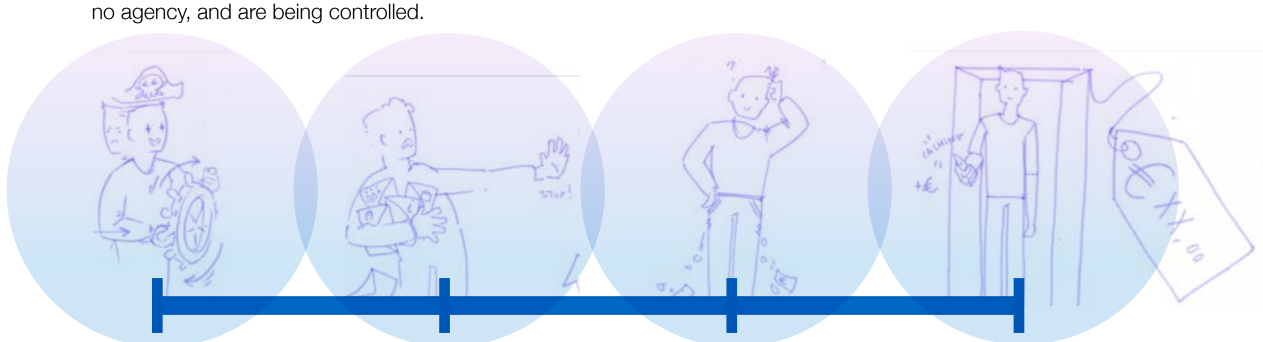
E: INDIVIDUAL VS LEARNING

The digitization of our world is changing the way people receive information and learn. Tensions arise between those who are able to empower themselves through the internet, in contrast to those who fall victim to the complexities.

Understanding seems easy | Unclear where to start | Is difficult

F: AGENCY

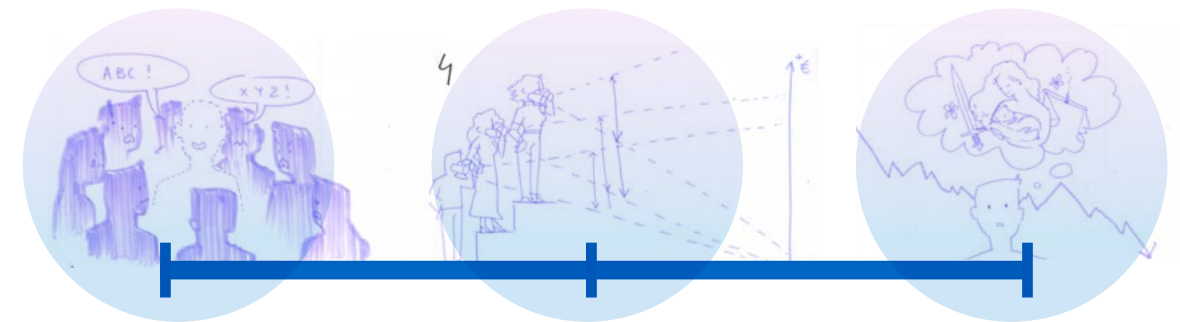
In capitalism, payments are one of the strongest ways for institutions or individuals to exercise power. This creates tensions between those who feel high levels of agency, and who are in control, and those who feel no agency, and are being controlled.



In control | Trying to have control | Out of control | Controlled

G: TRUST ATTITUDE

As we receive information differently than we are used to, determining who to trust becomes increasingly difficult: choosing uniform trust or distrust makes it easier for the user. Tensions arise between those who naively have blind trust in everything, and those who cynically distrust all.



Naive | Pragmatic | Cynic

In order to evaluate the usefulness of these dimensions, they were combined in a variety of frameworks (where two dimensions form the X and the Y axis). These frameworks were tested to see whether the combination of dimensions would generate interesting results. A complete overview of the tested frameworks can be found in appendix G.

Ultimately it was decided, together with DNB, that “Agency” and “Trust attitude” are the most relevant and inspiring dimensions. Payments are central to how individuals exercise agency, allowing us to act and influence the world around us. This also applies to a system level, as political parties use budgets to reflect their priorities—money is the medium through which society wields power.

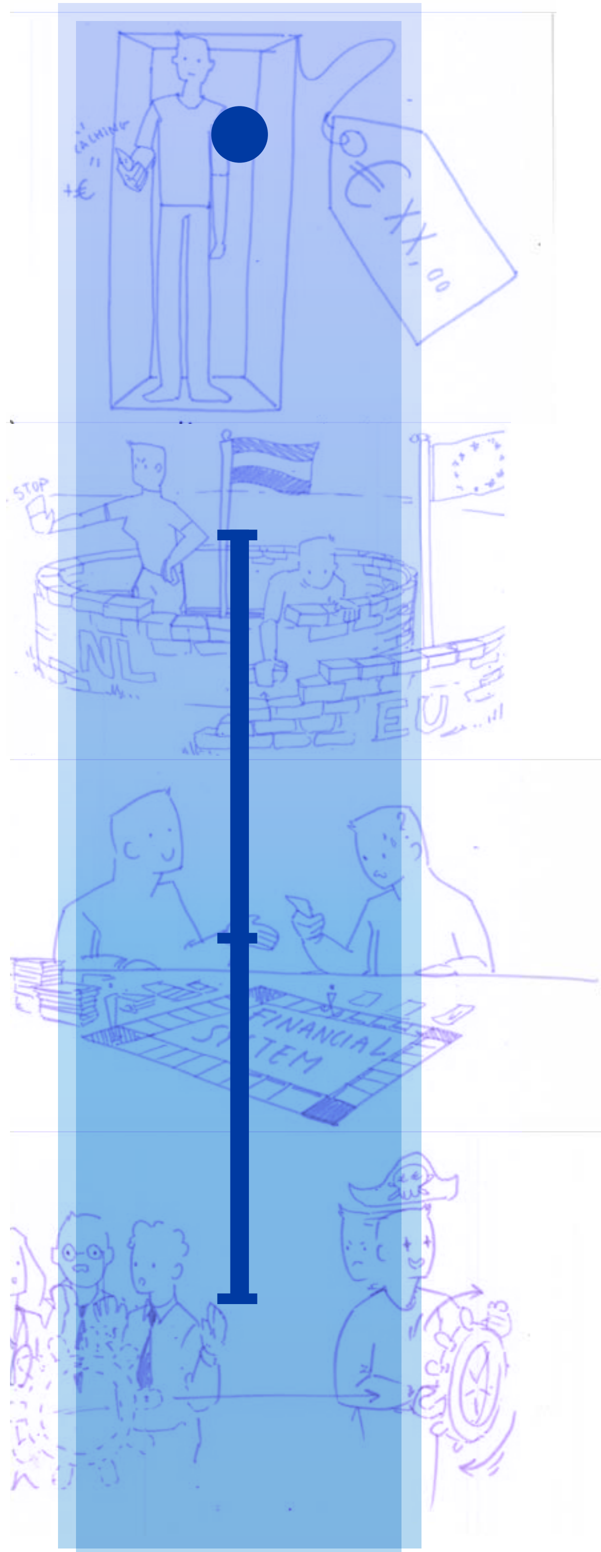
With the digitization of money and payments, traditional power dynamics are shifting. In these new payment situations, people’s actions are influenced by the level of agency and autonomy they feel.

To exercise agency effectively, we must carefully navigate trust and distrust according to our experiences and what we know. As the payment infrastructure becomes increasingly fragmented (De Nederlandsche Bank, 2022a) and complex payment situations become increasingly unfamiliar and predatory. Deciding what to trust becomes a challenge in many situations.

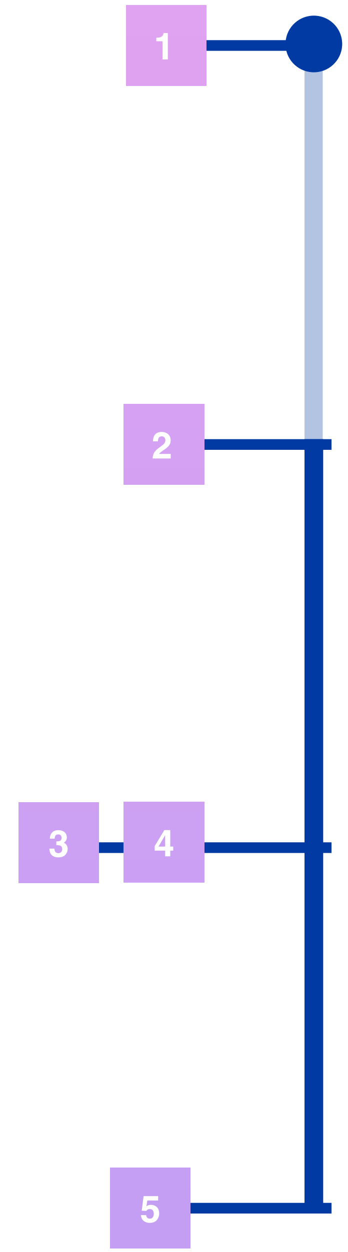
4.3 DIMENSION 1: AGENCY

The growing complexity of digital payments and the shifting power dynamics that accompany them are reshaping how individuals experience agency in financial transactions. As payment systems evolve, people must continuously adapt to new rules, and the way they navigate these changes has a profound impact on their sense of control. Are individuals consumers in the digital economy, or are they the product of it? This question highlights the range of experiences people have in relation to digital payments, from feelings of detachment and helplessness to resistance, manipulation, and, in some cases, over-empowerment. The varied experiences of agency within the digital payment landscape are critical to understanding how these systems affect individuals and society as a whole.

This dimension describes 4 steps within the experience of agency, based on 5 context factor clusters - themes for the changing relationship between society and payments.



DIMENSION 1: AGENCY



DETACHED FROM INFLUENCE

Products and services are increasingly designed to retain consumers, turning users into the product rather than merely selling to them. This susceptibility to addiction and the inability to be autonomous in the digital world can leave people feeling helpless, with the sense that there's little they can do to change this.

RESISTING HELPLESSNESS

Consumers feel increasingly threatened by on-line entities and fight for the right to maintain digital autonomy. In some cases, this resistance leads to rejecting the "digital world" entirely. On a broader scale, countries are also striving to protect themselves. Despite unprecedented prosperity, there is a growing fear of losing—of others taking advantage of the wealth that has been built.

CHASING EMPOWERMENT

The digital world has introduced a new set of rules that people must learn to navigate. While the internet provides a wealth of information, using it effectively requires skill. Some groups of consumers try to benefit from the advantages the digital work introduced, this quest for empowerments involves trial and error.

OVERLY EMPOWERED

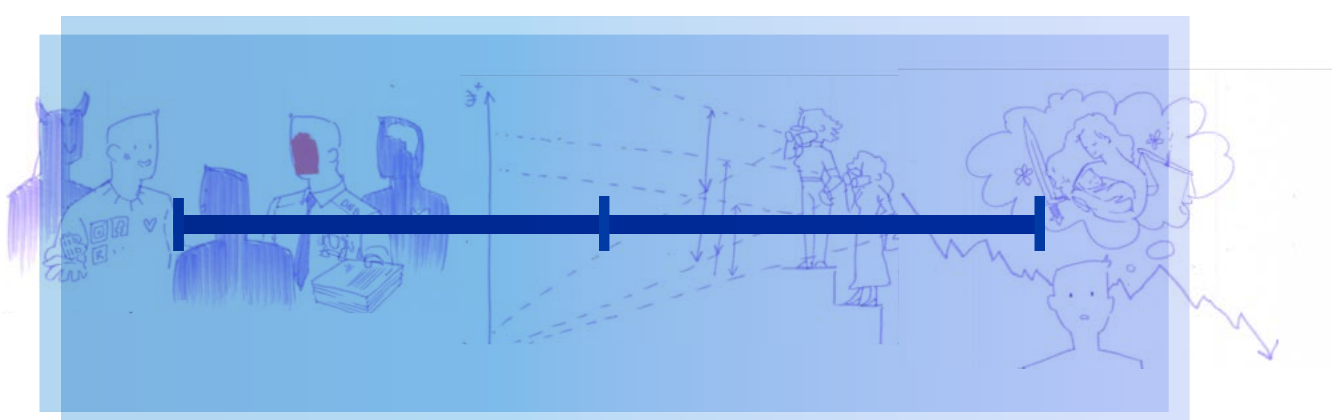
While some people attempt but fail to gain control in digital spaces, others boldly, even recklessly, seize control over their lives. They place little value on the authority of established institutions and take matters into their own hands, guided by personal experience and intuition. Their rejection of support and advice, heightens the potential to make mistakes and undermines the social securities set in place.

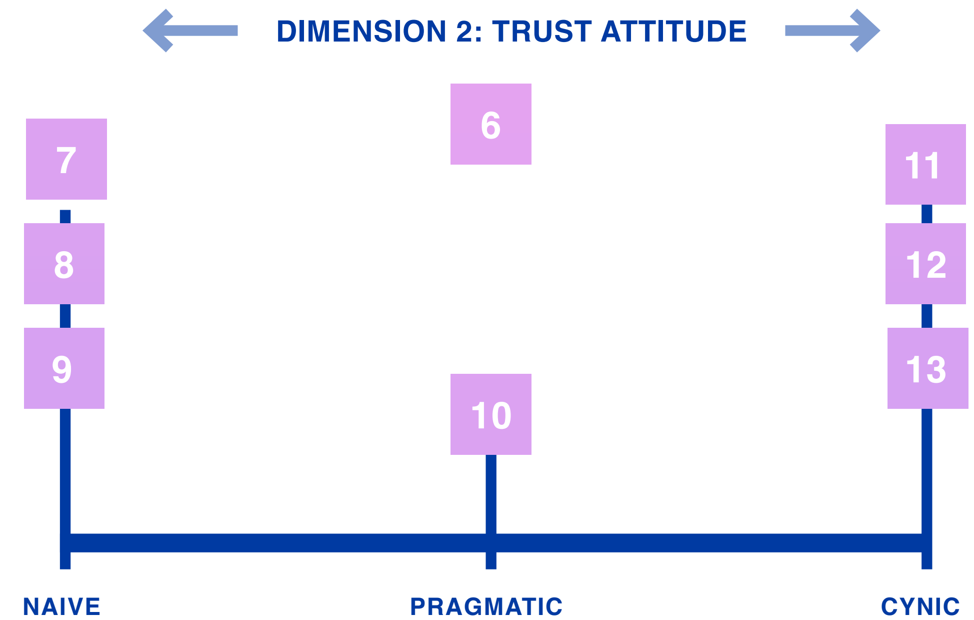
4.4 DIMENSION 2: TRUST

People increasingly encounter complexity in daily life: from convoluted tax and benefits systems to distinguishing between fake and real news on a day-to-day basis. As social media exposes individuals to global issues such as sustainability and conflict, the overwhelming nature of these topics often leads people to simplify their understanding, framing the world in black-and-white terms. This simplification is reflected in the range of worldviews people hold, from those who maintain a pragmatic, dynamic perspective to others who lean toward cynical or naive interpretations of reality. These varying trust attitudes, shaped by personal experiences and broader societal influences, play a critical role in how individuals engage with digital payment systems and the broader digital economy.

Understanding these worldviews is essential to addressing the trust challenges that arise in the evolving payment landscape.

This dimension describes 3 steps within trust attitudes based on worldview, using 8 context factor clusters - themes for the changing relationship between society and payments.





The naive worldview is primarily driven by the abstraction of money, the escape from serious life through the internet, and the shift in trust toward on-line personas that appear authentic. As digital money is less tangible than physical cash, people increasingly fail to perceive the impact of spending. Frictionless payment systems make it harder to grasp what it means to make a purchase and how it affects us. However, by thinking less about it, we also worry less about money in the short term.

It's not just money that feels less real in the digital world—our existence there also feels less real and serious. The idea of hiding behind a digital profile gives people the sense that they can live on-line without consequences, offering a temporary escape from the negative and serious aspects of life in the physical world. Additionally, the reduction in human contact drives people to seek authentic connections through other means. This reflects a simple, blind trust, even though digital authenticity is not always what it seems.

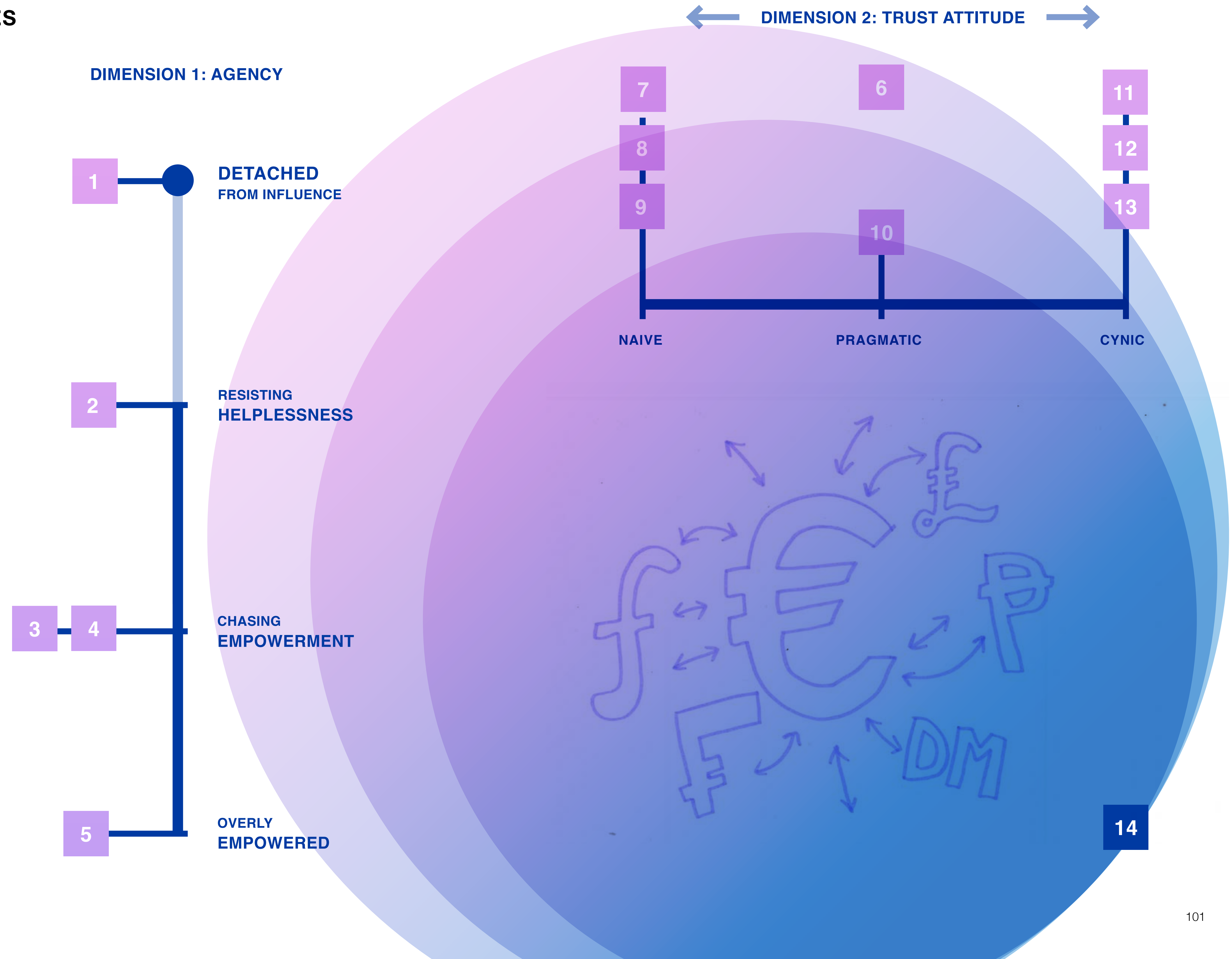
A nuanced, pragmatic worldview acknowledges that capitalism functions well within certain boundaries but also contributes to inequality when payments disproportionately favor one side. To maintain a fair and functional system, we must continually assess what benefits society as a whole and what does not. This calls for an ongoing understanding of the complexities of the world and society and the impact our collective payment behaviors have on it.

The cynical side of the spectrum is characterized by "blind distrust," driven by a sense that payments are to change oneself or the world as (the perception of) ever-growing inequality continues increasing. Lingering memories of broken promises within the democratic system foster feelings of abandonment and betrayal when protection seems lacking. Cynical distrust stems from the belief that the world is deteriorating and that the system is inherently incapable of functioning as a fair and just framework, undermining trust in the very foundations of a functioning payment infrastructure.

4.5 OVERARCHING VALUES

Almost all of the context factor clusters could be distributed on the two dimensions of trust and agency. The last cluster of insights is too general, but should absolutely be considered in the design process as an overarching "force".

The growing cultural and ethnic diversity in Europe highlights the increasing variety of opinions and values that our money must accommodate. This is an important consideration for the design process, as central bank money is inherently a product that exists for everyone.



4.6 THE INTERPLAY OF AGENCY AND TRUST IN DIGITAL PAYMENTS

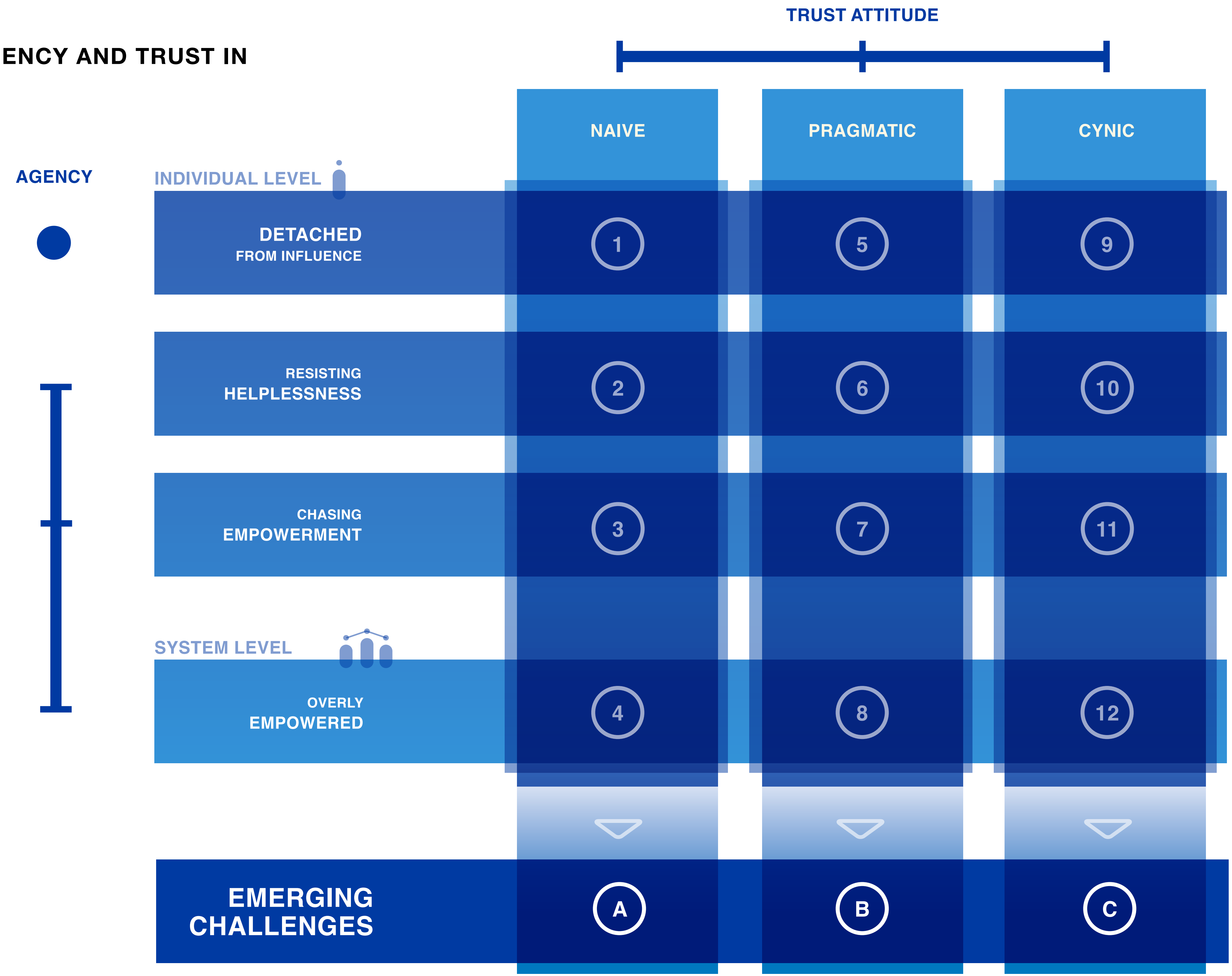
Based on the interplay of the two driving forces in the changing relationship between society and payments, we can create a framework: the interplay of these “forces” introduces 12 potential payment situations for the likely future. Every column contains 4 unique payment situations based on the different combinations of trust attitude and agency felt by individuals.

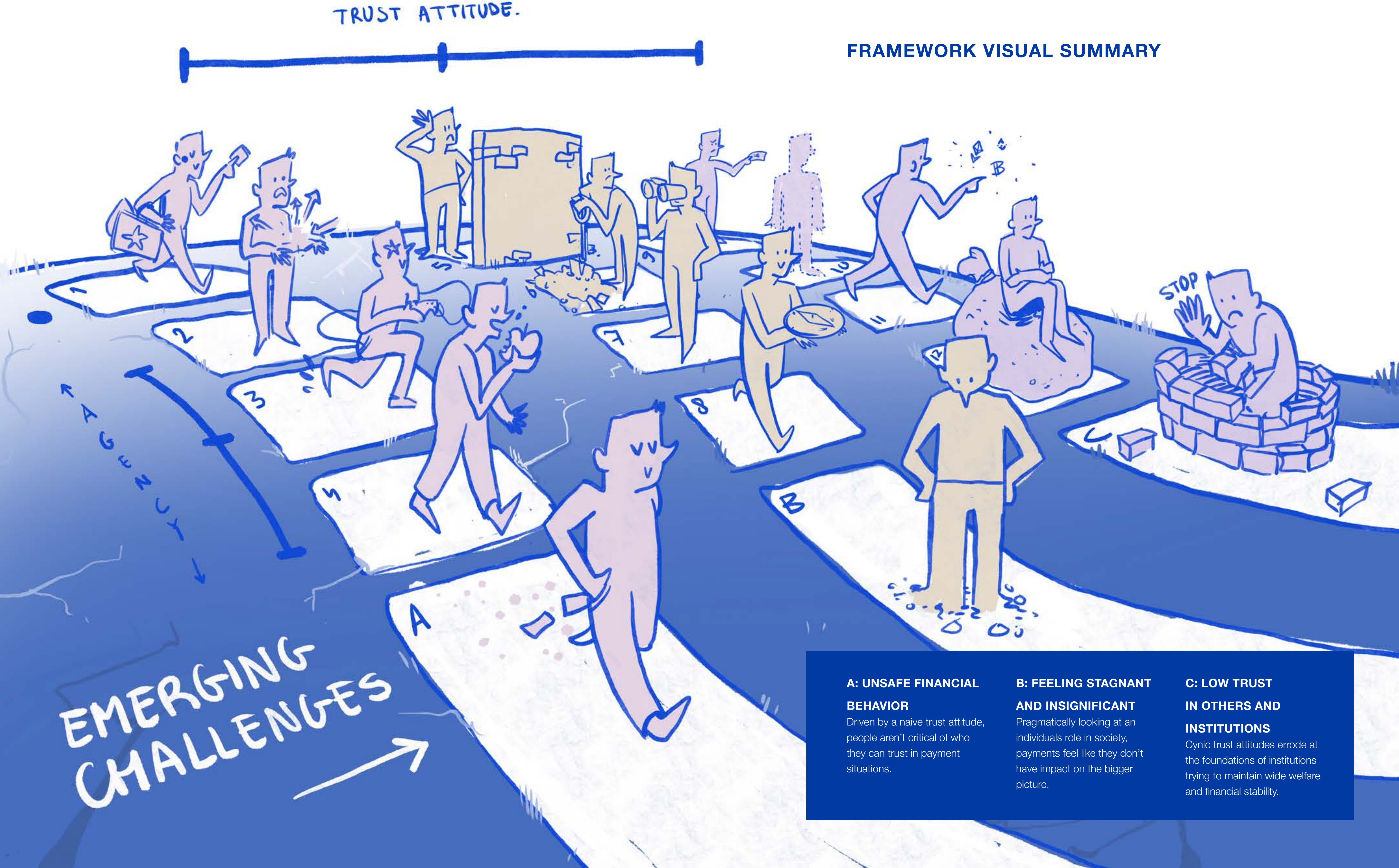
An interesting observation at this point is that the “overly empowered” situations reflect how individuals experience agency above the system, whereas the top three situations are more relevant to personal agency as an active part of the system. This distinction highlights an important dynamic: over-empowered individuals, by becoming complacent, often lose sight of the broader social systems that have enabled their sense of empowerment in the first place. In other words, their focus on personal control can lead them to overlook the collective structures that contribute to their autonomy. This shift in perspective is valuable for understanding the evolving relationship between society and payments, as it underscores the tension between individual agency and the larger systemic forces at play.

According to the ViP methodology, *designing is never neutral: it requires the designer to take an explicit stance* (Hekkert & Van Dijk, 2011). A purely objective approach is impossible, as every design decision reflects underlying values and priorities.

To make this position explicit, the next step involves formulating vision statements. These statements, grounded in the insights from agency-trust interplay, will guide the direction of design interventions. By doing so, we ensure that the design process is anchored in clear values, setting a trajectory toward a responsible, inclusive, and user-centered payment ecosystem.

In the following chapter, we will explore each column of the framework in greater depth, defining the risks, opportunities, and based on the designer values, vision statements are formulated which can be used as a starting point for design, where the ultimate goal is clear.





FRAMEWORK VISUAL SUMMARY

A: UNSAFE FINANCIAL BEHAVIOR
Driven by a naive trust attitude, people aren't critical of who they can trust in payment situations.

B: FEELING STAGNANT AND INSIGNIFICANT
Pragmatically looking at an individuals role in society, payments feel like they don't have impact on the bigger picture.

C: LOW TRUST IN OTHERS AND INSTITUTIONS
Cynic trust attitudes errode at the foundations of institutions trying to maintain wide welfare and financial stability.

4.6.1 CHALLENGE A: NAIVE

A naive worldview fosters blind trust in systems and others, encouraging risky financial behaviors, particularly in digital payments. The rising popularity of Buy Now Pay Later (BNPL) schemes and gambling apps exemplifies this trend. Individuals often fail to grasp the long-term implications of their actions, leaving them vulnerable to financial consequences. Over-empowerment further leads to naivety about the societal role of payments and the resilience or costs associated with the payment decisions we make.

NAIVE

VISION STATEMENT

INDIVIDUAL LEVEL

1 DETACHED FROM INFLUENCE

I want people to feel capable of impact through their payment behavior

2 RESISTING HELPLESSNESS

I want people to feel secure during payments

3 CHASING EMPOWERMENT

I want to protect people from addictive mechanisms in payments

SYSTEM LEVEL

4 OVERLY EMPOWERED

I want people to recognize how public payments can contribute to systemic financial health

RISKS

Naivety about digital payments exposes individuals to significant risks. Due to the sensitive nature of financial problems, a single negative experience with severe long-term consequences (such as falling into debt due to scams) can fundamentally alter an individual's perspective on financial systems (Van der Cruijsen et al., 2020).

Such experiences often push individuals toward a more cynical worldview (as supported by insight cluster 11, appendix F). High expectations and trust in the government or institutions can lead to feelings of betrayal and disappointment when those expectations are not met. This gap between what was promised and what is delivered fosters disillusionment, making individuals more likely to distrust the systems they once relied on. This shift towards cynicism can have a cascading effect, eroding societal trust and further destabilizing the financial ecosystem.

OPPORTUNITIES

In sight of this risk, there are significant opportunities to guide individuals towards safer financial behaviors within the digital payments. The 4 identified payment situations present ways to address these challenges by embedding protective measures at both personal and systemic levels. On a personal level, individuals should be guided to:

1. Avoid mindless payments by fostering awareness of their payments.
2. Mitigate uncertainty in payments through transparent systems and reflection.
3. Learn to act responsibly with payments by offering educational tools that build financial literacy from youth.

On a systemic level, payment infrastructures protected by emphasizing the public value of our payment infrastructure.

DESIGNER VISION

Financial inclusion was one of the starting points of this thesis, discussed during the kick-off meeting. Now, it becomes clear that financial accessibility may contributes to the risks we see in these situations. Here, access to digital payments is provided without the necessary skills to navigate them effectively.

Digital financial inclusion is a priority for DNB and one of the three pillars in their 2022-2025 vision on payments (De Nederlandsche Bank, 2022a).

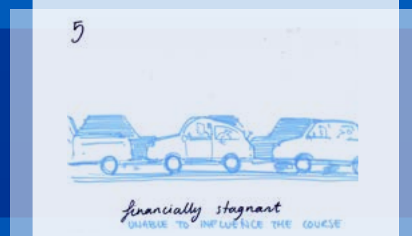
It is my vision that the focus should not solely be on digital financial inclusion but on ***responsible*** digital financial inclusion: Not just providing access to digital payments via the Digital Euro but also equipping individuals with the tools to protect themselves from the risks associated with digital payments.

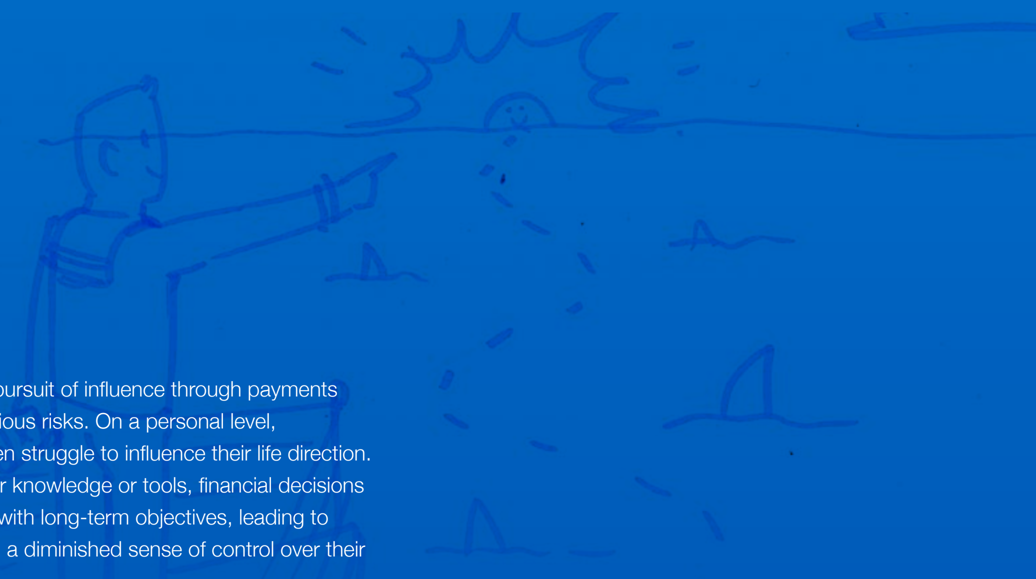
VISION STATEMENT

I want to enable responsible digital financial inclusion by protecting individuals and the payment infrastructure from risks as a result of naive behavior.

4.6.2 CHALLENGE B: PRAGMATIC

This challenge is characterized by the understanding that money is one of the most effective tools for exerting influence and achieving tangible impact. Strategic use of payments can shape systems and outcomes at various levels: from lobbying efforts that shape public policy to influencing the course of an individuals life. For the average individual, the power to influence the world around them is often perceived as limited. Beyond the ability to vote, people seek to use their payments to make a difference in their daily lives. This emerging challenge explores how payments can empower individuals and systems to achieve influence/impact.

	PRAGMATIC	VISION STATEMENT
INDIVIDUAL LEVEL		
5 **DETACHED** FROM INFLUENCE		**I want people to feel capable of impact through financial services**
6 RESISTING **HELPLESSNESS**		**I want people to feel secure during payments**
7 CHASING **EMPOWERMENT**		**I want to help people explore digital means of payment responsibly**
SYSTEM LEVEL		
8 OVERLY **EMPOWERED**		**I want to empower people to have collective impact through payments**



RISKS

The practical pursuit of influence through payments introduces various risks. On a personal level, individuals often struggle to influence their life direction. Without proper knowledge or tools, financial decisions may not align with long-term objectives, leading to frustration and a diminished sense of control over their future.

As the digital payment landscape grows more intricate, it becomes harder to ensure that individuals make free and informed choices, often resulting in unintended outcomes. The lack of resources to navigate and optimize new payment methods can leave individuals at a disadvantage, unable to maximize their benefits.

At a broader systemic level, risks arise from individuals' lack of awareness regarding the political power embedded in payments. Many underestimate how their spending habits and financial decisions contribute to wider societal and political dynamics. This lack of awareness can perpetuate inequitable and unsustainable systems. Although political consumerism holds potential, achieving collective action across diverse groups is a substantial challenge. Without systemic support, individual efforts may struggle to create meaningful change.

OPPORTUNITIES

Payments offer significant opportunities to empower individuals. At the personal level, payments should be designed to:

1. Providing tools and resources that align financial decisions with personal aspirations.
2. Designing transparent payment systems to maintain control and clarity over payment decisions.
3. Educating about emerging payment methods and how to benefit from them.

On a systemic level, payment infrastructure should highlight how consumer choices influence societal outcomes to empower individuals to engage in political consumerism, consuming based on political views, more effectively.

Additionally, building platforms and networks facilitating coordinated financial actions among individuals can amplify their influence at a system level.

DESIGNER VISION

To unlock the potential of payments as a tool for influence, we must address both individual and systemic needs. On a personal level, individuals should be equipped to make proactive, informed payment decisions that are aligned with their goals and values. At a systemic level, raising awareness of the broader political and societal implications of payments can encourage collective action and foster meaningful change.

VISION STATEMENT

I want to support proactive payment decision-making by making payment decisions more conscious and goal oriented, to align with pragmatic objectives.

4.6.3 CHALLENGE C: CYNIC

On the cynical side, we observe some of the most undesirable behaviors from a societal perspective. There's a profound blind distrust in institutions, coupled with a strong desire to distance oneself from the collective functioning of both the financial and social systems. These situations are driven by the feeling of betrayal of trust for the system in it's entirety. This cynicism, while born from legitimate experiences, fosters isolation and hinders collective progress.

CYNIC

VISION STATEMENT

INDIVIDUAL LEVEL

9 **DETACHED FROM INFLUENCE**

I want people to gain insight in the effect of their payments

10 **RESISTING HELPLESSNESS**

I want people to feel their privacy is protected in payments

11 **CHASING EMPOWERMENT**

I want people to feel supported in payments within DNB oversight.

SYSTEM LEVEL

12 **OVERLY EMPOWERED**

I want people to recognise the value of paying taxes.

RISKS

Cynicism in payments carries significant risks at both personal and systemic levels. On a personal level, a lack of transparency can lead to frustration and disengagement. People often feel powerless when they are unable to see the results of their payments, such as how profits and costs are distributed. This absence of clarity can foster a sense of exclusion and deepen their distrust in the system.

Additionally, as individuals reject means of payment within the oversight of central banks, they may struggle to balance the risks associated with new, unmonitored payment methods. Without proper guidance, they risk exposure to financial instability and further erosion of trust.

On a systemic level, failure to address transparency and accountability can exacerbate societal distrust, weakening the shared understanding necessary for a functioning financial system.

OPPORTUNITIES

The desire/need for transparency in the payment situations driven by a cynic trust attitude, offer opportunities to rebuild trust and empower individuals through this method.

For interactions acting on an individual level, payments should be designed such that they:

1. Provide transparent insights into payment information, such as the actual costs of digital payments.
2. Protect the right to private payments.
3. Educate individuals on balancing risks and navigating new payment methods effectively.

On a systemic level awareness should be raised about the societal importance of the payment system and the role individuals play in maintaining it.

DESIGNER VISION

Navigating these situations requires a commitment to transparency at both the individual and systemic levels. By illuminating the inner workings of payments and the surrounding system we can begin to address the root causes of distrust and foster a more engaged and responsible society. Transparency is a crucial first step toward bridging the gap between cynicism conditional trust and participation.

VISION STATEMENT

I want to improve trust in payments by providing transparency about the exchanges of value and data in payments.

4.7 OVERVIEW VISION STATEMENTS

For each situation identified in the framework a statement is written. Every situation addresses a specific problem that should be addressed in order to achieve overarching visions A, B & C.

NAIVE

A: I want to enable responsible digital financial inclusion by protecting individuals and the payment infrastructure from risks as a result of naive behavior.

PRAGMATIC

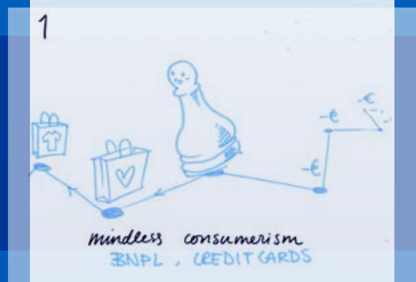
B: I want to support proactive payment decision-making by making payment decisions more conscious and goal oriented, to align with pragmatic objectives.

CYNIC

C: I want to improve trust in payments by providing transparency about the exchanges of value and data in payments.

INDIVIDUAL LEVEL

DETACHED FROM INFLUENCE



1: I want people to feel capable of impact through their payment behavior

5. I want people to feel capable of impact through financial services

9. I want people to gain insight in the effect of their payments

RESISTING HELPLESSNESS

2: I want people to feel secure during payments

6. I want people to feel secure during payments

10. I want people to feel their privacy is protected in payments

CHASING EMPOWERMENT

3: I want to protect people from addictive mechanisms in payments

7. I want to help people explore digital means of payment responsibly

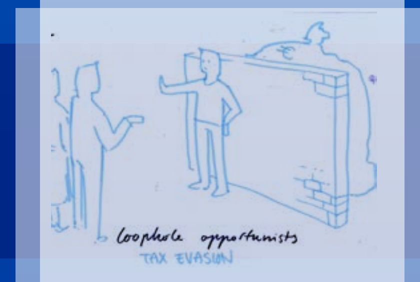
11. I want people to feel supported in payments within DNB oversight.

SYSTEM LEVEL

OVERLY EMPOWERED

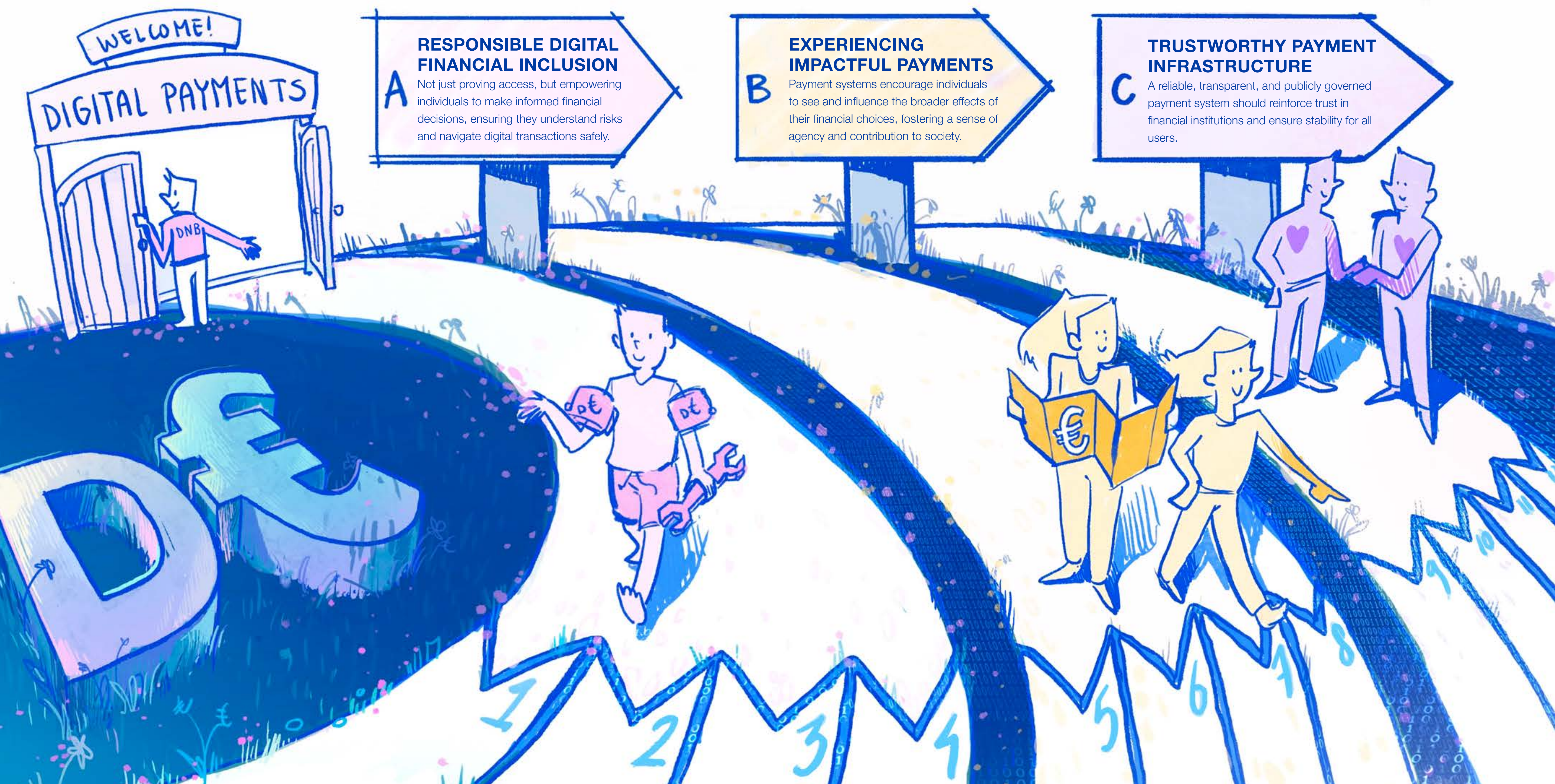
4: I want people to recognize how public payments can contribute to financial health

8. I want to empower people to have collective impact through payments

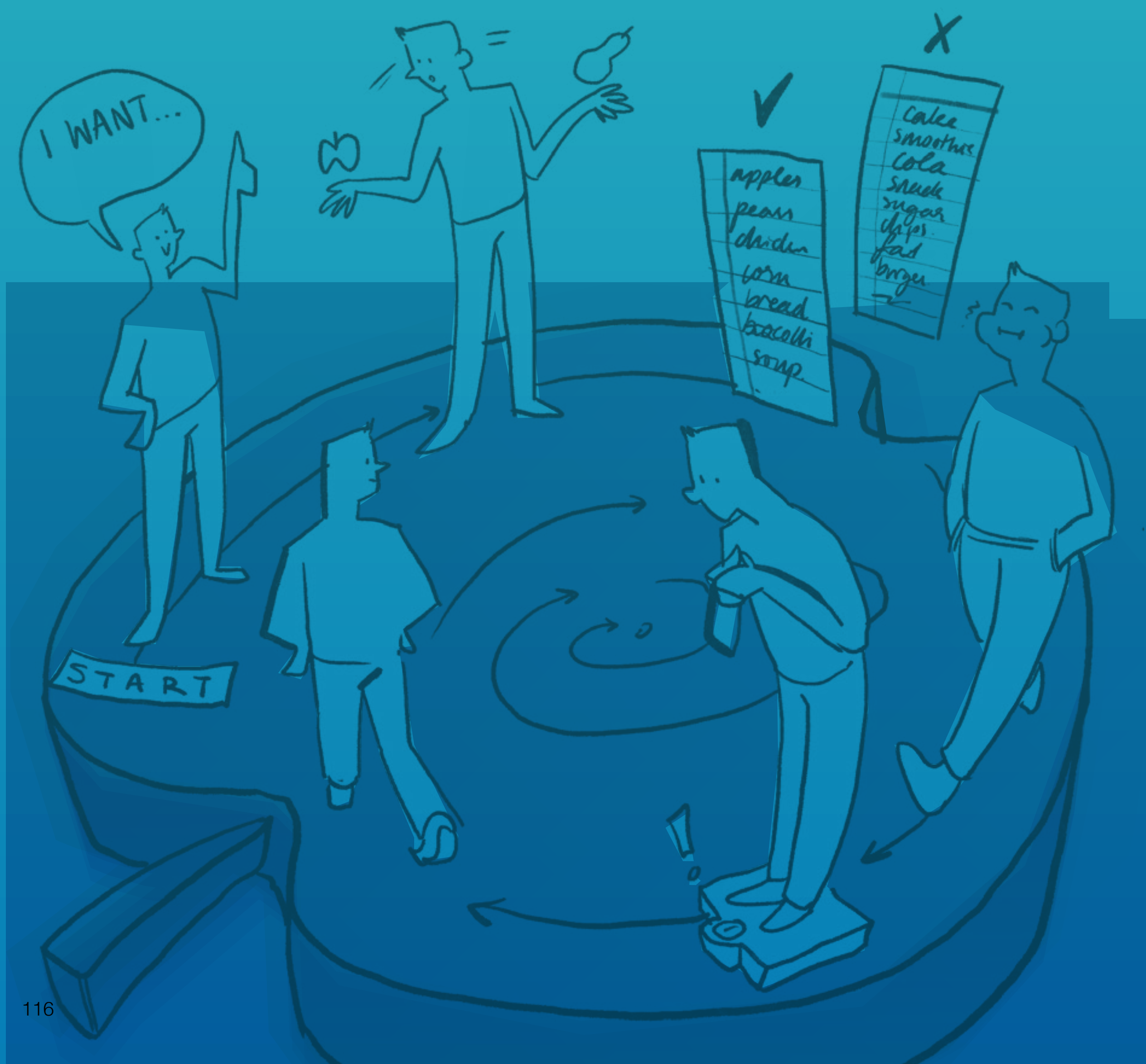


12. I want people to recognise the value of paying taxes.

FUTURE VISIONS VISUAL SUMMARY



5. DEVELOP



This chapter focuses on the designing phase, addressing the third and final research question: *"How can DNB intervene on the challenges emerging from this changing relationship through the design of the digital euro?"*. Building on insights from the deconstruct, discover and define phases, this stage explores potential design interventions to ensure that the digital euro aligns with the identified societal needs.

From the three challenges identified in the re-framing phase, one has been selected for deeper exploration: *responsible digital financial inclusion.* To not only provide access to digital payments but also empower individuals to use these systems safely and effectively within a rapidly evolving digital society.

The conceptual interventions developed in this phase aim to illustrate how the situations identified in the framework can be translated into design interventions for payments. This phase is structured around the following subquestions:

1. Which challenge is most relevant for DNB to focus on for further development?
2. How can we define *"responsible digital financial inclusion"*?
3. How can we intervene to enable *responsible digital financial inclusion*?

DESIGNING CONTENTS **P**

5.1 COMPARISON CHALLENGES 2025 - 2035

The *develop* chapter focuses on transforming one of the emerging challenges into a series of concept interventions to achieve the written vision. Given that this thesis investigates the evolution of digital payments over the next 10 years, it is valuable to analyze which of the three emerging challenges is likely to arise first within this period, as this should probably be addressed most urgently.

For this I looked at the three challenges identified previously in the *deconstruct* chapter:

1. MARKET LIMITATIONS IN PROVIDING ACCESS: The market-driven nature of payment systems often prioritizes profitability over accessibility.

2. (DIGITAL) FINANCIAL LITERACY: Many individuals lack the knowledge or skills to effectively use digital financial tools.

3. LOW (MUTUAL) TRUST: A lack of trust between users, institutions, and systems undermines the reliability and adoption of payment methods.

Chapter 3 and 4 - *discover and define* - explored the driving forces likely to shape the relationship between society and payments in the Netherlands by 2035. This led to the identification of three new challenges, which reflect an evolution of the issues identified earlier. Comparing these challenges provides insights into how the payment landscape may develop over the next 10 years.

In the following paragraphs the connection between current challenges and future challenges is described and reflected upon.

A: UNSAFE FINANCIAL BEHAVIOR
Accessibility and financial literacy are identified as challenges for 2025. Currently efforts are underway to improve access to digital payments, but there is insufficient emphasis on educating users about how to use these tools effectively. Looking towards 2035 we can expect that this leads to the emergence of challenge A: Enabling *responsible digital financial inclusion*. In an attempt to provide access and solve the problems of today, banks and payment providers risk including people too quickly, without giving them the skills and protections to be safe in the world of digital finance.

B: FEELING STAGNANT AND INSIGNIFICANT
The deconstruction phase did not identify a challenge connecting to this. This gap emphasizes the importance of fostering autonomy in financial decision-making when redesigning payments looking towards the future. This gap also indicates that this may not be the most urgent challenge to tackle.

C: LOW TRUST IN OTHERS AND INSTITUTIONS
Trust remains a challenge in payments between 2025 and 2035. The lack of trust between consumers, institutions, and payment systems continues to erode without targeted interventions to build transparency and trustworthyness. The persistence of this problem will potentially exacerbate societal divisions.

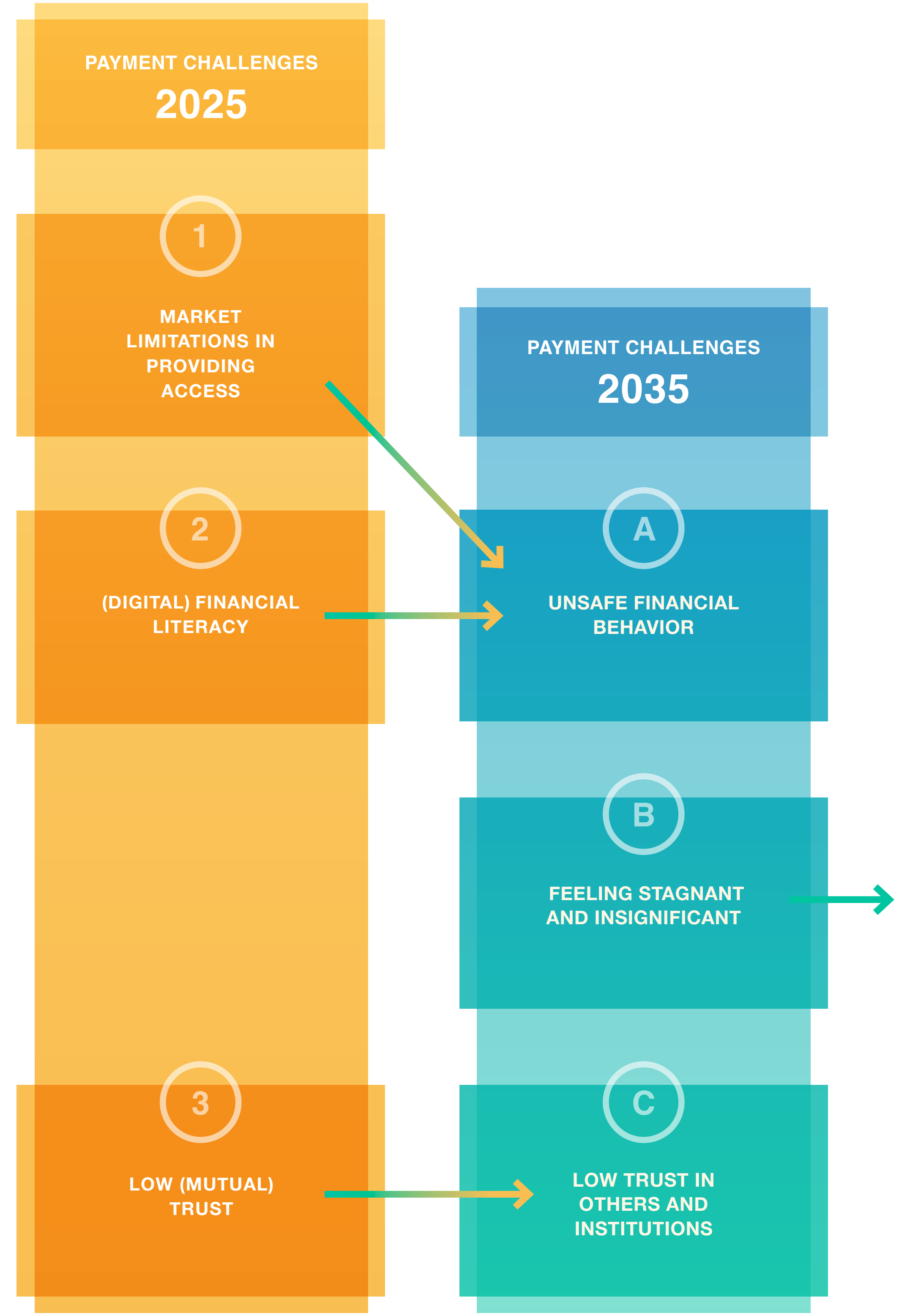


Figure 19: connections between challenges in the relationship between society and payments 2025-2035

5.2 CHOOSING DESIGN DIRECTION

Given the constraints of time and resources within this project, a decision was made to focus on one design direction identified in the earlier framework for further development. The selection was guided by the following criteria:

1. **Affinity with the Digital Euro:** The chosen direction must align closely with the objectives of the D€ to capitalise on this unique design opportunity of a new means of central bank money/payments.
2. **Affinity with DNB's Mandate:** As the central authority overseeing safe and accessible payment traffic (veilig & toegankelijk betalingsverkeer), the design focus preferably fits within DNB's scope of responsibility (De Nederlandsche Bank, n.d.-a).
3. **Design Opportunity:** The direction must promise high societal impact with minimal means, maximizing the potential value of the intervention. This criteria favors challenges that are expected to have an effect on payments sooner rather than later. As well as interventions focused around prevention rather than repairing.

From this, the focus was placed on addressing payment situations characterized by a "naive trust attitude", to achieve the vision of responsible digital financial inclusion:

1. **Affinity with the Digital Euro:** Many risks tied to naive trust arise from the private nature of current payment systems, where consumer behavior is often exploited for profit. Private payment providers encourage mindless consumption and addictive spending patterns, while trust among providers themselves is limited, hindering information sharing and collaboration. The D€, as a public form of money, offers a unique opportunity to shift this paradigm. Without a profit motive (winstoogmerk), the D€ can prioritize societal value over commercial gain, fostering safer and more equitable payment practices.
2. **Affinity with DNB's Mandate:** The issue of naive trust directly impacts the safety and accessibility of payment systems, key pillars of DNB's responsibilities. By tackling this challenge, DNB can ensure that individuals engage with payment systems more thoughtfully and securely.
3. **Design opportunity:** Research suggests that personal opinions and worldviews are shaped by lived experiences (Hartley, 2023). This means that setbacks in navigating digital payments may push individuals from a naive perspective to a cynical one. Thus it would be valuable to address this challenge before it becomes more difficult to help people.

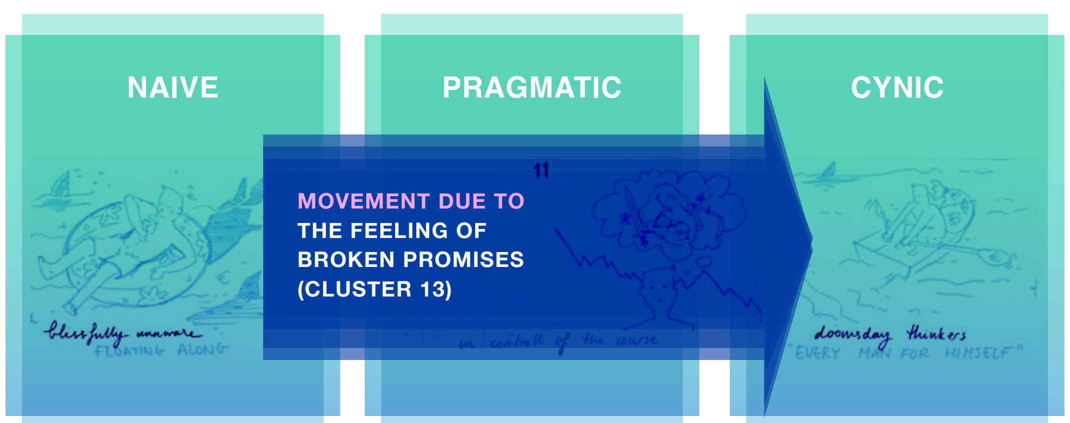


Figure 20 Bad experiences could drive people to adopt a cynic trust attitude more often.

Figure 21 Responsible digital financial inclusion is identified as the most relevant challenge for DNB at this time.

5.3 VISION STATEMENT

RESPONSIBLE DIGITAL FINANCIAL INCLUSION

In the previous chapter a decision was made to focus on the design for “responsible digital financial inclusion” by comparing the three emerging challenges. In the following chapter we explore this challenge further and translate it into a vision statement.

The identified payment situations for this vision reveal behaviors characterized by an “I’ll be alright” mentality, resulting in risky financial behavior due to a lack of reflection about what is trustworthy and what is not. Supported by the insights from the *discover* phase of this thesis, this is largely driven by the abstraction of money in the digital age and the growing inability to comprehend the complexities of digital means of payment and the wider impact of payments.

The digitization of payments has created a divide between individuals who are digitally literate and able to navigate this effectively, and those who struggle to keep up. In the identified situations, people fail to approach money with the seriousness it requires, overlooking the long-term consequences of their payment decisions. Research suggests that personal opinions and worldviews are shaped by lived experiences (Hartley, 2023). This means that setbacks in navigating digital payments may push individuals from a naive perspective to a cynical one - something DNB should want to avoid at all cost, as trust is a high priority for them (De Nederlandsche Bank, n.d.-a).

Helping individuals recognize their influence and societal roles can encourage long-term thinking and planning that supports both personal well-being and community strength. This requires going beyond providing basic access to financial tools and ensuring that people understand how to use these tools responsibly and critically.

FROM FINANCIAL INCLUSION TO RESPONSIBLE FINANCIAL INCLUSION

Digital financial inclusion is commonly defined as providing access to essential digital financial services. For DNB, this means facilitating access to basic payment functions such as opening a bank account, viewing balances, receiving and depositing funds, and making digital payments (De Nederlandsche Bank, 2022a). However, while this approach addresses basic accessibility, it does not account for the loss of financial control experienced by individuals who lack the knowledge to manage the long-term implications of their financial decisions.

In the “naive situations” identified in our framework, basic access to digital financial services has unintentionally increased exposure to financial risk. Market-driven innovations have prioritized making payments easier and more seamless but have not provided the necessary opportunities for individuals to learn and adapt to the new tools. This creates an environment of irresponsible digital financial inclusion, where individuals have access but lack the skills to use digital financial services safely and effectively.

To address this challenge, DNB should shift its focus from basic financial inclusion to responsible digital financial inclusion. Responsible digital financial inclusion is not just about ensuring access: it is about equipping individuals with the knowledge, skills, and protections required to navigate the complexities of the digital payment ecosystem safely.

Thus we come to the following vision statement:
“I want to enable responsible digital financial inclusion by protecting individuals and the payment infrastructure from risks as a result of a naive trust attitude.”

By prioritizing responsible digital financial inclusion, DNB can bridge the gap between access and capability, empowering people to regain control over their financial lives and participate confidently in the digital economy. This approach aligns with DNB’s mandate to foster safe and accessible payment systems while addressing the systemic risks posed by naive and uninformed financial behaviors. Additionally focused on giving ownership over the problem to the parties who are giving access. In the case of the Digital Euro, DNB is partially involved. In the case of payments in general, we would even attribute ownership to private payment providers.

PROBLEM DIGITAL FINANCIAL INCLUSION:
Giving people access without ensuring they don’t drown if something goes wrong.

RESPONSIBLE DIGITAL FINANCIAL INCLUSION:
Providing access while ensuring people are protected, or have the skills to protect themselves.

Figure 22 Visualisations made during the exploration of this vision statement

5.4 DEFINING

RESPONSIBLE DIGITAL FINANCIAL INCLUSION

DNB defines digital financial inclusion as ensuring that everyone can independently carry out basic payment functions. This includes opening a payment account, activating a payment card, depositing and withdrawing cash, viewing account balances and transactions, and issuing payment orders (De Nederlandsche Bank, 2022a). However, responsible digital financial inclusion goes beyond access; it emphasizes empowering individuals to engage with digital payment infrastructure safely, critically, and effectively. In the previous chapter we stated that responsible digital financial inclusion is "providing access while ensuring people are protected, or have the skills to protect themselves".

From the framework we identified 4 situations where there is risky financial behavior. By address these four situations provoking naive behavior, we aim to achieve responsible digital financial inclusion. Each situation reflects a distinct area of concern where naivety creates risks:

1. **NAIVE ABOUT THE IMPACT OF MINDLESS PAYMENTS**: Individuals often underestimate how small, daily financial decisions accumulate and impact their overall financial health.

2. **NAIVE ABOUT HELPLESSNESS IN PAYMENTS:** The increasing speed of rapid payments creates a sense of urgency and reduces the information available during transactions. This can lead individuals to feel powerless, despite the reality that control ultimately lies with the person holding the money.

3. **NAIVE ABOUT MANIPULATION FOR PAYMENTS:** Digital payments often mask manipulation techniques, such as behavioral nudges designed to encourage overspending or addiction to consumption patterns.

4. **NAIVE ABOUT THE PUBLIC FUNCTION OF PAYMENTS:** A lack of awareness about the societal role of public money and payments can lead to apathy or misguided trust in private entities, which prioritize profit over public interest.

In order to address these situations and the specific challenge identified in each situation, an additional vision statement is written. Through designing for these statements we aim to illustrate what responsible digital financial inclusion can look like:

PERSONAL LEVEL

1. **PROTECTION FROM MINDLESS PAYMENTS:** "In such situations that evoke naive behavior, I want people who feel detached from influence to feel capable of impact through their payment behavior, though making the influence of their spending explicit."
2. **PROTECTION FROM UNCERTAINTY IN PAYMENTS:** "In such situations that evoke naive behavior, I want people trying to avoid helplessness to feel secure during payments, through providing delays and time to make payments based on objective information"
3. **LEARNING TO PROTECT ONESELF IN PAYMENTS:** "In such situations that evoke naive behavior, I want people who are overly empowered to recognize how public payments can contribute to healthy local economies."

SYSTEM LEVEL

4. **PROTECTING THE PAYMENT INFRASTRUCTURE:** "In such situations that evoke naive behavior, I want people who are overly empowered to recognize how public payments can contribute to healthy local economies."

By addressing these statements, responsible digital financial inclusion ensures that individuals are not only enabled to participate in the digital payment infrastructure but are also empowered to navigate it responsibly. This approach aligns with DNB's mission to ensure safe and accessible payment systems while fostering financial literacy and trust among users.

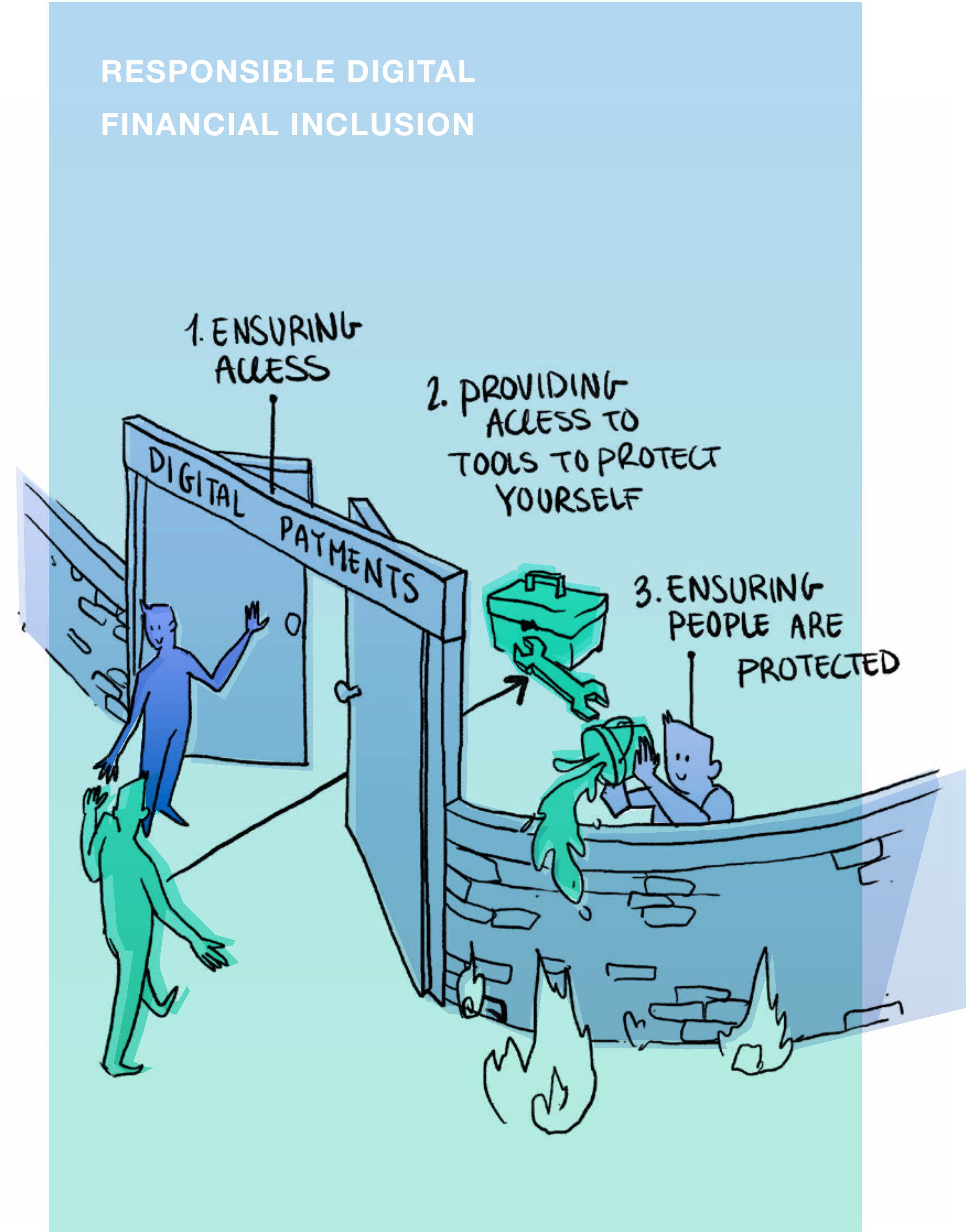


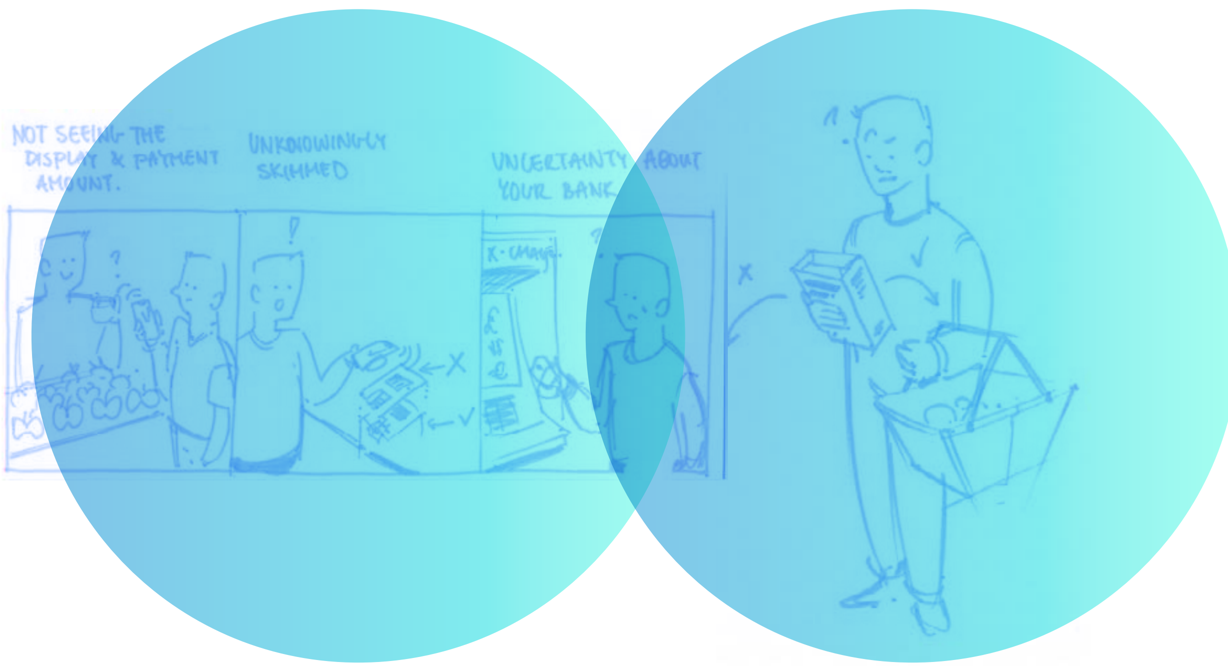
Figure 22 Illustration responsible digital financial inclusion

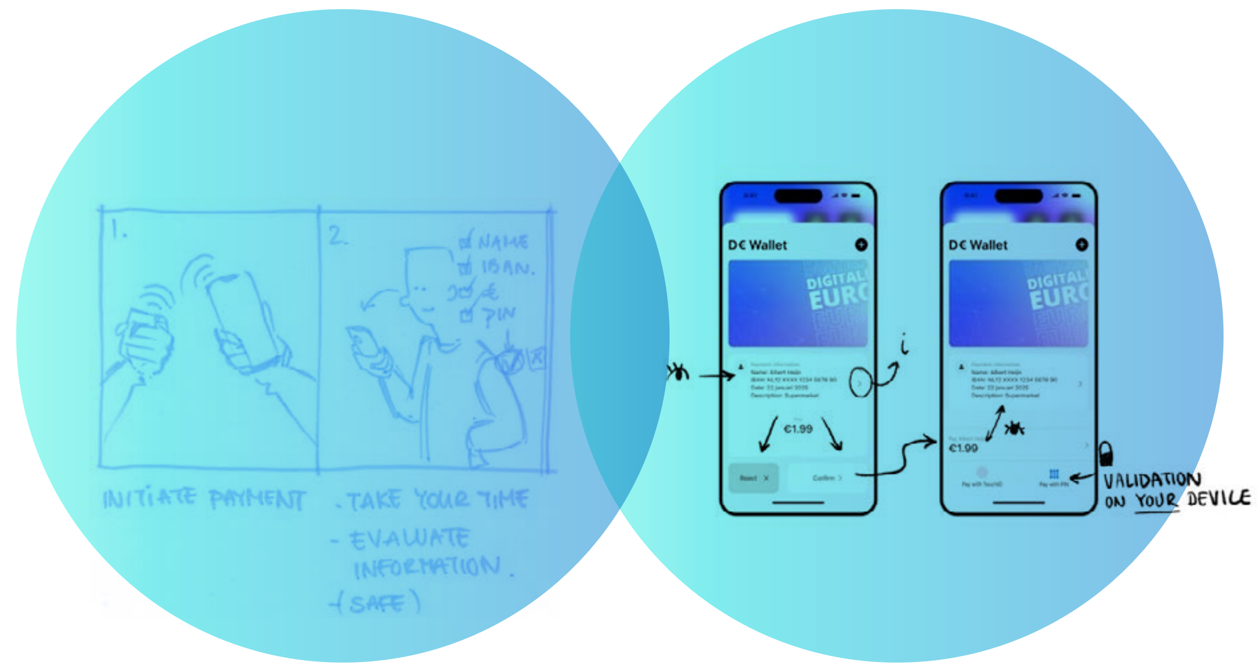
5.5 DESIGN APPROACH

In the *develop* chapter we aim to translate the design vision into interventions/designs for the digital euro. The ViP methodology provides a structured approach to this process, ensuring that interventions align with the overarching design vision.

The design process unfolds in four distinct steps:

By following these four steps, we aim to create meaningful interventions that redefine digital payment interactions, ensuring they align with the evolving trust-agency dynamics shaping the future of payments.





1. DEFINING THE UNDESIRABLE INTERACTION FURTHER
In the *define* chapter, we identified situations that illustrate problematic aspects of the payment experience. This step makes the problem explicit by analyzing how people currently interact with payments and identifies the underlying problem.

2. FORMULATING THE DESIRED INTERACTION ANALOGY
With a clear problem definition, we explore what kind of interaction might be desirable in each situation.
This is done using an interaction analogy, which helps translate abstract design goals into concrete interaction qualities.

3. DESIGNING THE INTERVENTION CONCEPT
Based on the desired interaction qualities, we develop design concepts (interventions) that bridge the gap between the current and desired interaction.
This involves exploring features that align with the vision statement to ensure a meaningful interaction with payments through our designed interventions.

4. VISUALIZING AND COMMUNICATING THE DESIGN
To bring the design to life, we detail and visualize the intervention. Through creating mock ups and other visualisations of the concept, we demonstrate how the intervention enhance the payment experience.

5.6 GENERAL DESIGN ANALOGY: HEALTHY EATING

The ViP methodology is an interaction centered design methodology: *Rather than just coming up with a product idea, the vision describes the relationship between the user and the product* (Hekkert & Van Dijk, 2011). In this case we aim to design a new relationship between society and digital payments. In ViP, this is typically done through using a design analogy: Analyzing an existing interaction in a different context to shape the desirable new interaction with the product being designed.

The 4 situations in the naive column reflect risky behaviors that may harm long-term financial health of consumers. For instance, individuals may accumulate small expenses without realizing their impact until it's too late or make poor financial decisions due to a lack of information in stressful situations. These behaviors are comparable to unhealthy eating habits, where poor choices stem from convenience, stress, or limited options. So, we could compare the situations from the framework as being "unhealthy payment behavior".

This issue is exacerbated by the privatization of payments, which to a certain extent fails to provide "healthy" digital payment options, leaving individuals to choose between means of payment ultimately designed to generate profit for others. As a public means of payment, the Digital Euro (D€) has the potential to serve as a healthy alternative: empowering individuals to make healthier payment decisions by adding it to the payment infrastructure.

This analogy of "healthy eating" serves as the foundation for developing interventions. By drawing specific parallels, the interactions with future payments can be re-imagined to promote healthier financial behaviors. I believe "healthy eating" is an especially useful analogy to design with as it is relatable for most people, so it will be straightforward in communicateing the desired effect.

Additionally, "eating healthy" is a process that has many seperate aspects, from "Setting goals to eat healthier" to "making the healthy choice in store" or "enjoying/eating in moderation". Some of the separate interactions contained in the analogy that served as inspiration are visualized on the right in figure 23.

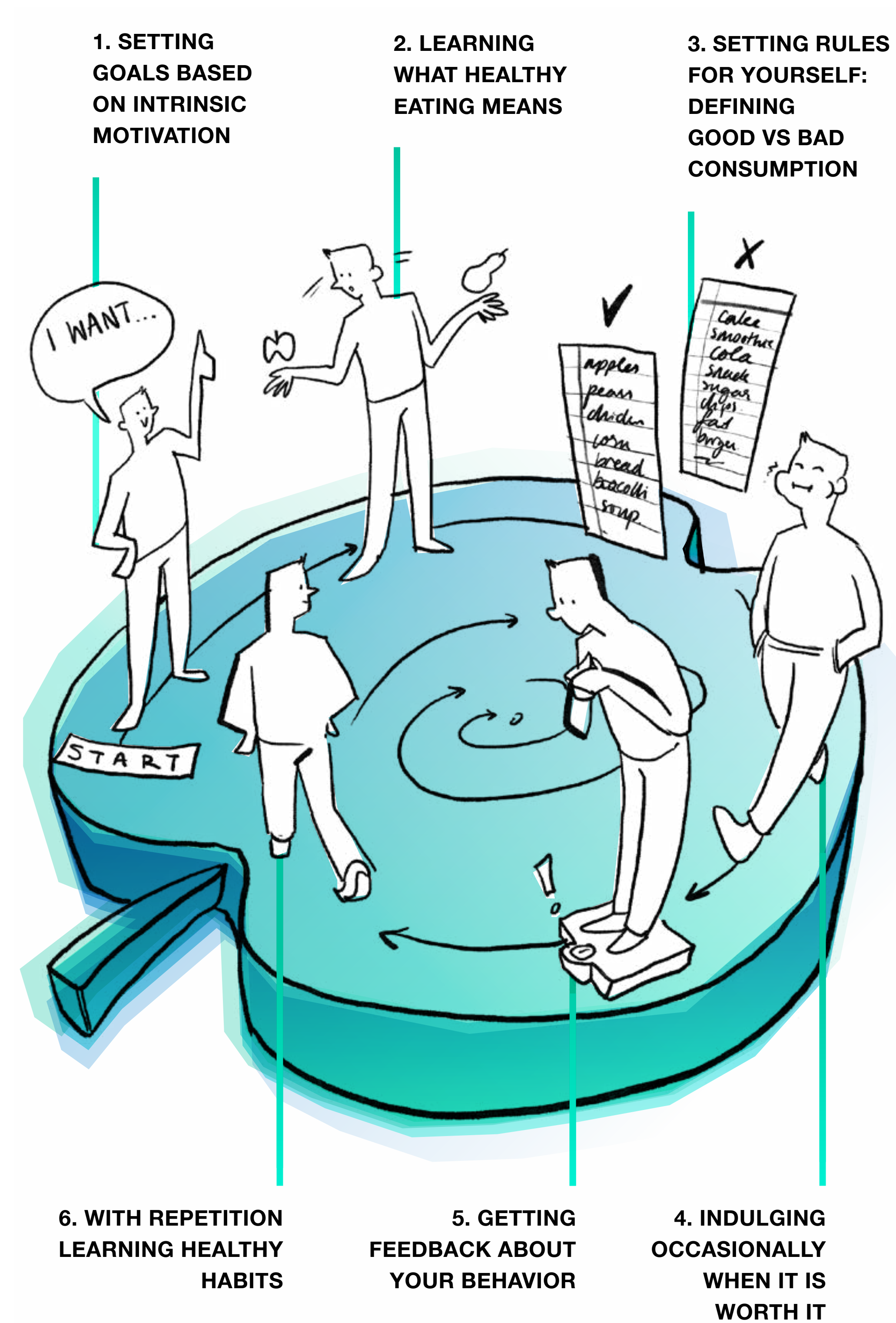


Figure 23 Visualization of some situations and interactions that could be used design analogies

5.7 OVERVIEW INTERVENTIONS 1, 2, 3, 4

Based on the previously outlined design approach and the interaction analogy of healthy eating, four interventions were developed to support responsible digital financial inclusion. These interventions illustrate how DNB could address the challenges identified in the define chapter and serve as conceptual explorations rather than finalized solutions.

Given the limited time for this project, it would be premature to claim that these interventions represent definitive or final versions. Instead, they should be viewed as starting points for further development and refinement.

The following chapters provide an overview of the design steps and outcomes for each intervention, demonstrating how the proposed methodology was applied in practice. Not all of the content produced for the design is included in order to streamline the story. Determining the exact formulation of the vision statements, choosing the design analogy and settling on an intervention was an iterative approach. Like with the clusters identified in the *discover* chapter, the content for each intervention was kept separate using envelopes, so they could be developed independently.

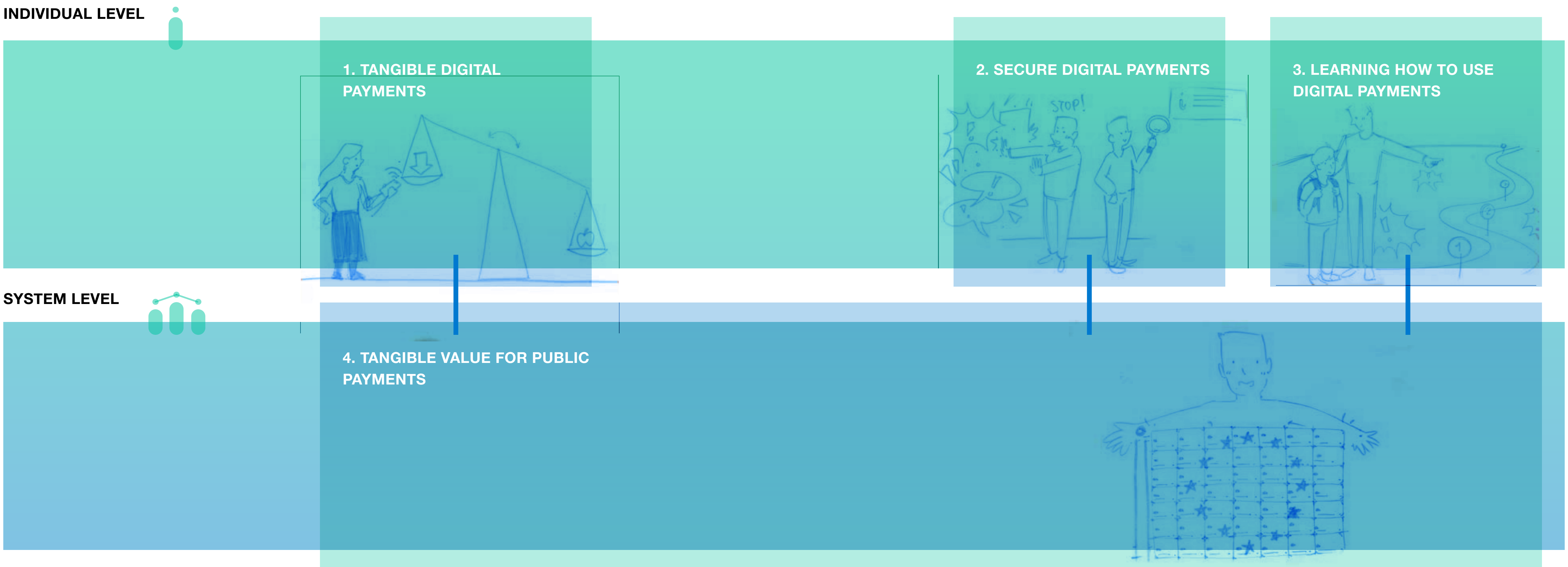
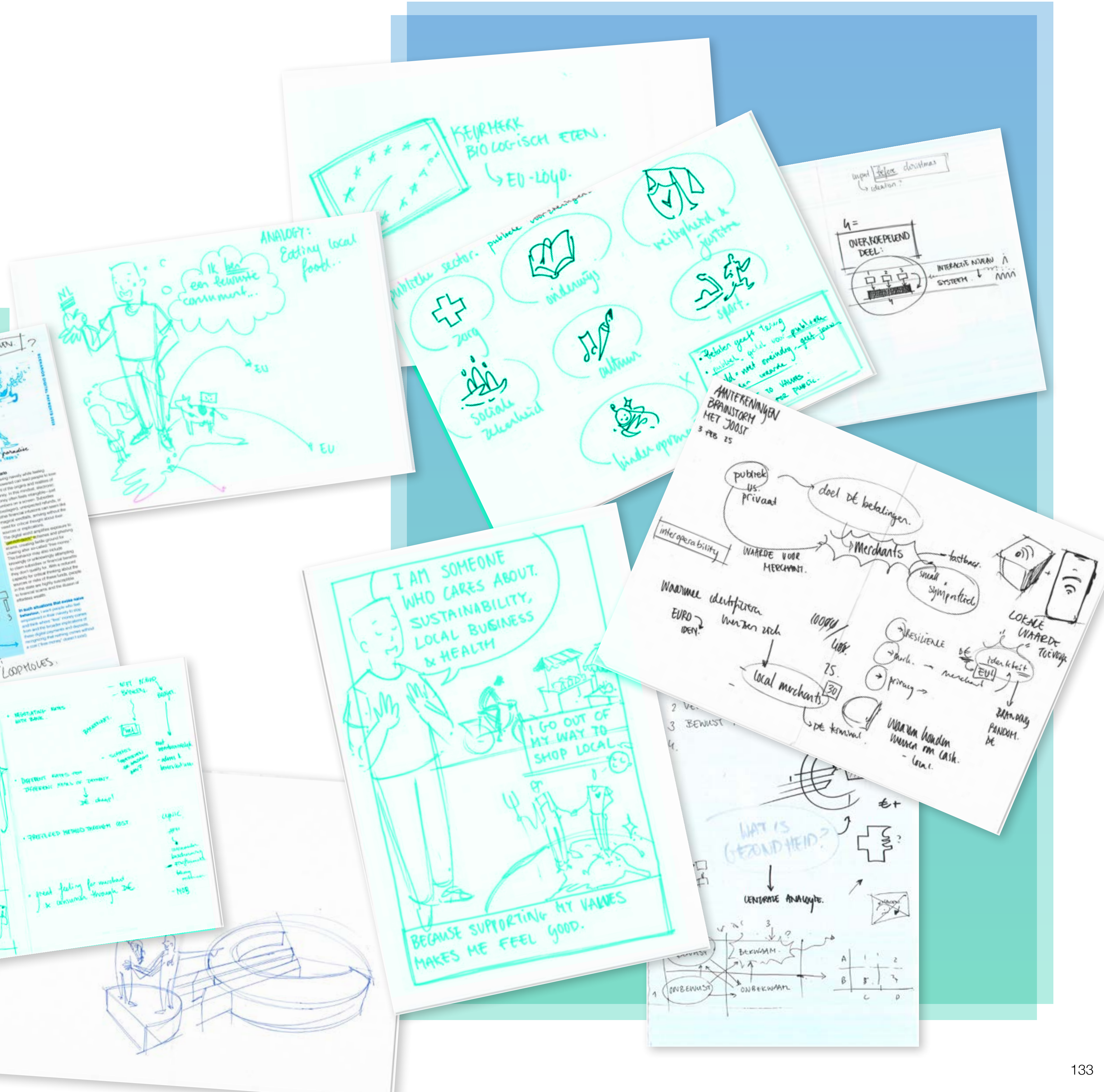


Figure 24 Visualisation of some situations and interactions that could be used design analogies

5.7 DESIGN APPROACH

As with the previous phases of this project, most ideation and development took place on paper. This approach allowed for greater flexibility in visual exploration, making it easier to sketch, annotate, and iterate on ideas. To maintain structure throughout the process, materials related to each intervention were collected in individual envelopes. These envelopes contain sketches, notes, and concept iterations, documenting the evolution of each idea.

This page provides an overview of the design approach taken for intervention 4. Scanned copies of each envelope are available. If you are interested in a more detailed look at these materials, please feel free to reach out.



5.7.1 INTERVENTION 1: UNDESIRABLE INTERACTION

SITUATION DESCRIPTION:
Trust attitude: Naive
Feeling of Agency: Detached from influence

Behaving naively while feeling detached from any ability to make meaningful change can lead people to situationally, disconnect from responsibility for their long-term financial well-being. In a world where consumers are increasingly the product, they're bombarded with constant messages to buy, buy, buy. This relentless pressure can make saving or planning for the future feel pointless, influencing people to believe that worrying about finances isn't necessary at this moment. With this attitude, people may focus on fleeting happiness from impulsive consumption rather than their long-term stability, something they remain ultimately responsible for. The more they spend on short-term dopamine boosts, the more depressing their financial situation becomes, as debts and unpaid bills pile up. This avoidance can spiral into a delay in dealing with problems, pushing them closer to the point where recovery feels impossible.

Figure 25 Illustration situation 1: Naive and detached from influence

TANGIBLE DIGITAL PAYMENTS

UNDESIRABLE INTERACTION:
This situation focuses on the payment interaction driven by contactless payments and mindless spending. Specific aspects of this interaction identified as being undesirable are:

- Not even thinking about payments
- No "payment pain"
- Lack of oversight in (small) payments
- Easy to lose yourself to impulses when there is no information/feedback to reflect on

To address these undesirable aspects of the identified situation, the impact of payments should become more tangible at the moment of spending, reinforcing users' awareness of their financial influence.

This leads us to the following vision statement:

VISION STATEMENT

"In such situations that evoke naive behavior, I want people who feel detached from influence to feel capable of impact through their payment behavior, though making the influence of their spending explicit."

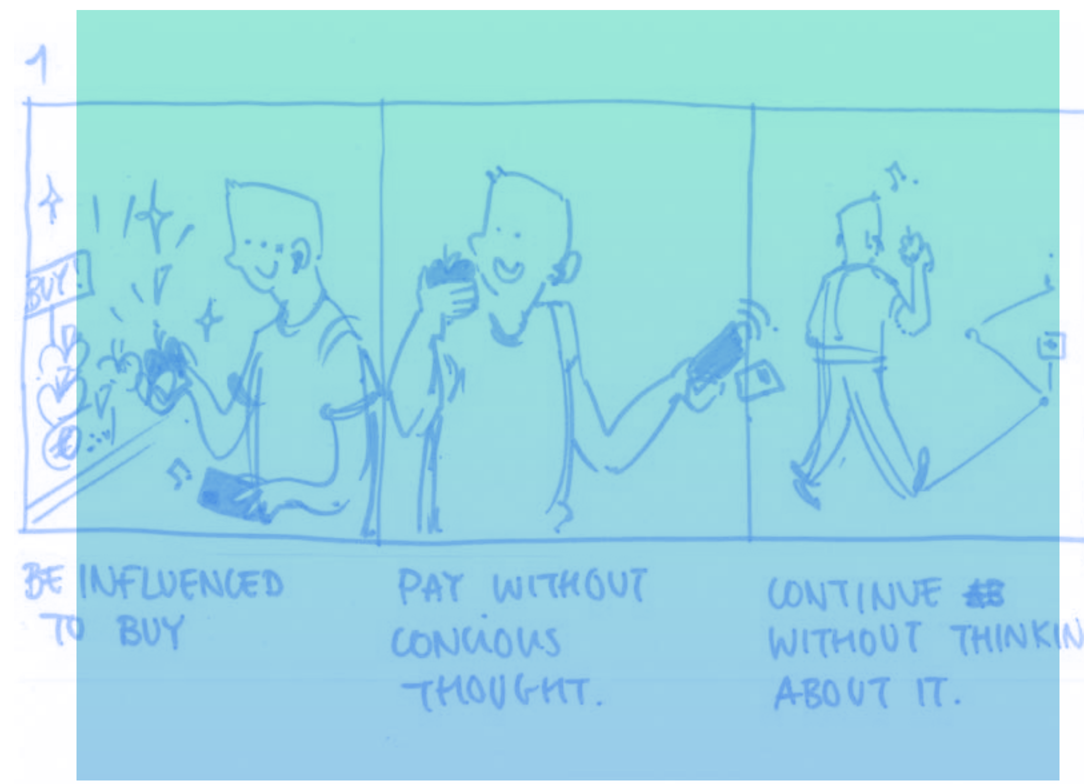


Figure 26 Illustration situation 1:undesirable payment interaction

5.7.1 INTERVENTION 1: INTERACTION ANALOGY

The interaction analogy used for the design of this intervention is:
Receiving instantaneous feedback from your body after overeating, prompting reflection and behavioral change in habits.
This analogy follows a sequence of steps that gradually improve unhealthy behaviors over time.

1. CONSUMING IN EXCESS
Unhealthy foods trigger dopamine-driven impulses, making people crave and consume them. Without any immediate feedback to stop, individuals may continue eating far beyond their needs.

2. OVEREATING LEADS TO NEGATIVE EFFECTS
Consuming too much sugary or fatty food results in physical discomfort (e.g., stomach pain, sugar crashes, or general regret). These negative effects act as signals, reminding individuals that their choices did not align with their long-term health goals.

3. REFLECTING & LEARNING CYCLES
After experiencing negative consequences multiple times, individuals start connecting their choices to the outcomes. Learning is gradual: immediate change is rare, but through repeated experiences, people refine their understanding of what works best for them.

TANGIBLE DIGITAL PAYMENTS

4. CONSUMING IN MODERATION
With past experiences in mind, individuals make deliberate choices that align with their personal limits and goals. They don't completely avoid indulgence, but they learn to exercise self-control and spend responsibly.

This analogy illustrates how immediate feedback can shape behavior, whether in eating habits or financial decision-making. By incorporating instant but non-restrictive feedback in digital payments, users can gradually develop a healthier relationship with money.

INTERACTION QUALITIES
From this interaction analogy we can distill the following interaction qualities:

1. **INSTANTANEOUS –** Feedback happens at the moment of payment in order to most efficiently link the feedback to the behavior.
2. **REFLECTIVE** – Users are prompted to pause and consider their choices based on feedback.
3. **NON-RESTRICTIVE** – Users are not restricted in (future) decision making, rather being guided to intrinsic change.

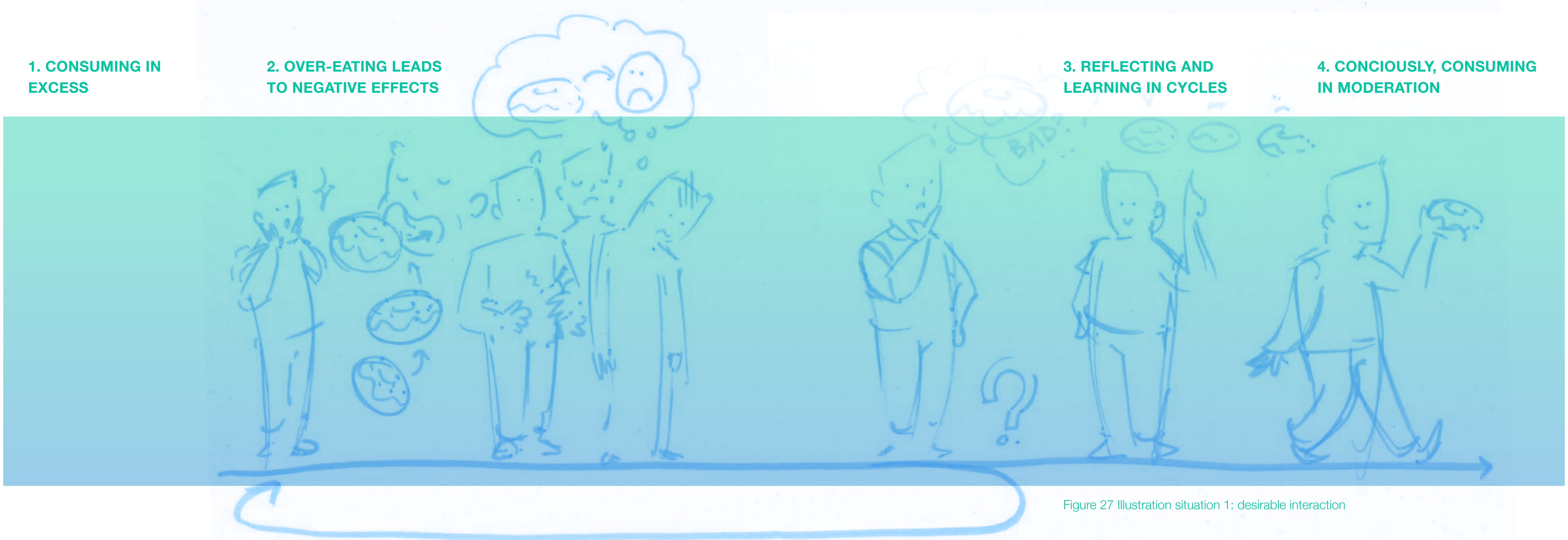


Figure 27 Illustration situation 1: desirable interaction

5.7.1 INTERVENTION 1: TANGIBLE DIGITAL PAYMENTS

Thus, the desired interaction can be described as:

With the digital euro (D€), consumers receive immediate feedback on the impact of their spending, prompting reflection through their own implicit reactions to this information. Specifically, how they feel in response to it.

Figure 28 Illustration situation 1: desirable interaction

CONCEPT
The intervention to achieve this desired interaction could look something like this:

A payment feature in the digital euro that makes the change in D€-balance explicit. Providing instant feedback about the effect spending has on the amount of money they have.

This can be complemented by a second feature:

Using "pre set budgets", where the relative decrease in balance is larger. Consumers have to actually choose where the money is coming from and what their initial intentions for this money were, thereby strengthening the perception of influence.

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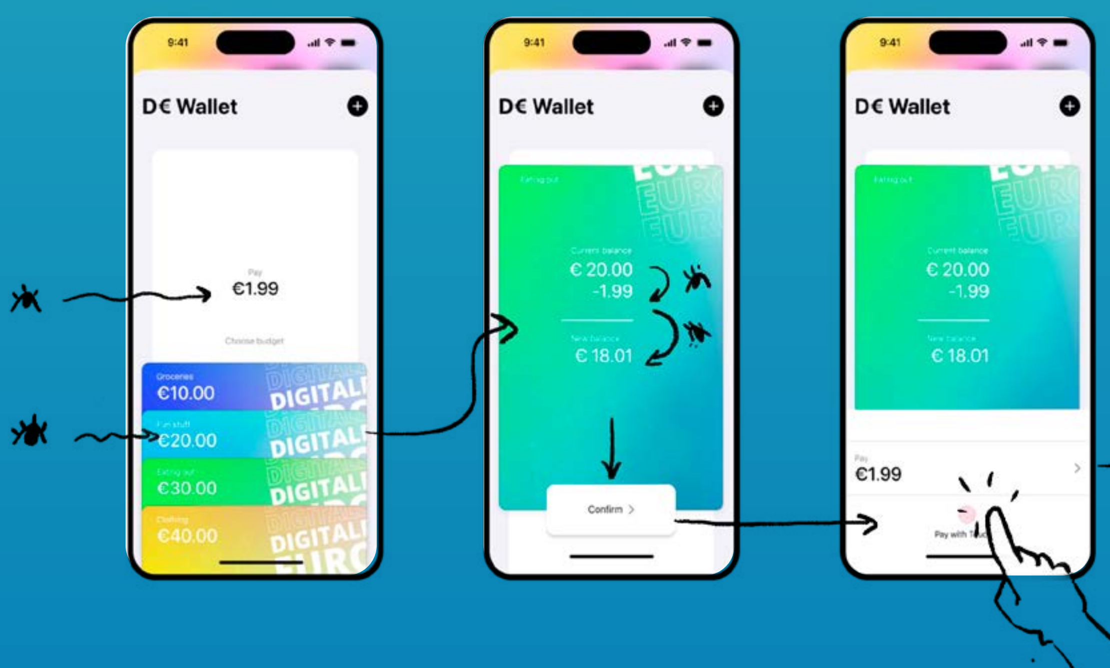


Figure 29 Overview main function intervention 1: tangible digital payments in the digital euro

CONCEPT SCENARIO:

SET UP
The first step of healthy eating analogy and internal reflection, is creating something to reflect upon, a goal, an intention. There has to be a little voice saying "I want to be healthier", I believe the same can be said for payments. For example through saying "I am happy spending up to €20 per month on coffee". Exceeding this budget means sneaking into unhealthy behavior. By creating explicit budgets for certain things via the digital euro, users can create these goals/limits for themselves to reflect upon during the payment interaction. The set up is characterized by 3 steps:

1. FIRST INTRODUCTION TO BUDGETS
D€ can be used without budget functionalities, but it is stongly promoted when you open to the homepage.

2. DISTRIBUTE BUDGETS
Based on the amount of money in the D€ account, users slide their budgets around to allocate the money they can spend. Anything not allocated should go to savings.

3. MANAGE BUDGETS
From this point onwards, users see their budgets everytime they open up the application. Setting these budgets until the next payday set a goal to stay within the budget for this time.

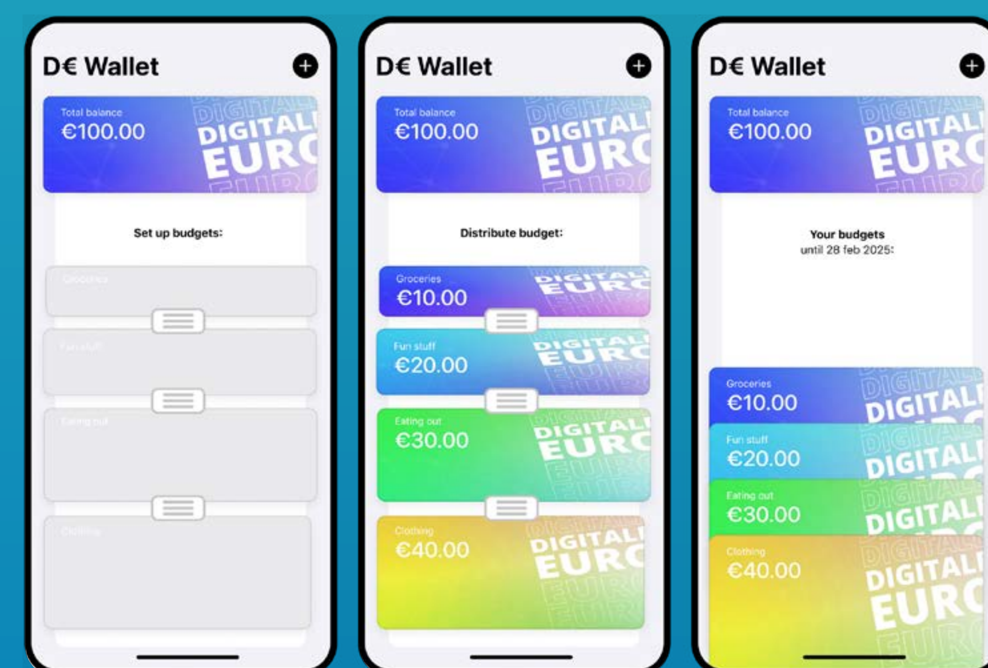


Figure 30 Overview set up intervention 1: tangible digital payments in the digital euro

5.7.1 INTERVENTION 1:

PAY WITH D€

The payment interaction focusses on making the influence of their spending tangible, in a minimally intrusive way. As we want the interaction with this product to be non-restrictive, we shouldn't be sacrificing usability for insights.

1.D€ IS EASY TO USE
The payment feature works similarly to most other forms of frictionless payment to initiate payment. Making it too difficult at this point could result in no-one adopting this means of payment.

2. INSTANT FEEDBACK
The user confirms payment and is guided to look at the amount deducted, thereby connecting this with their payment.

3. MANAGE BUDGETS
As their payment and an actual reduction of funds becomes connected, the user becomes aware of the real-ness of spending money.

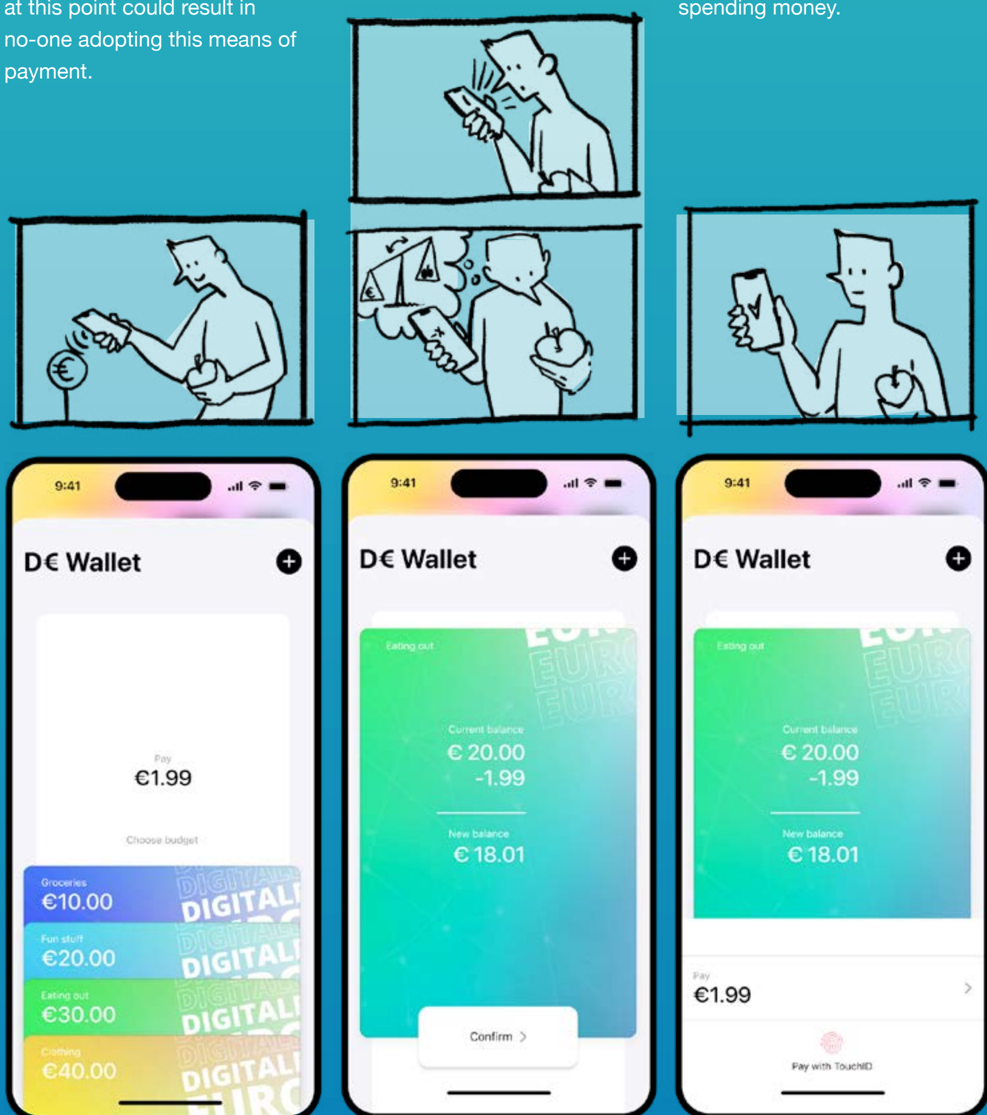


Figure 31 Overview main function intervention 1: tangible digital payments in the digital euro

TANGIBLE DIGITAL PAYMENTS

REFLECTIONS IN PROGRESS

As this process is repeated within the time period set for the budget, users see that even small purchases will have their impact and stay on top of the amount of money in their digital euro wallet.

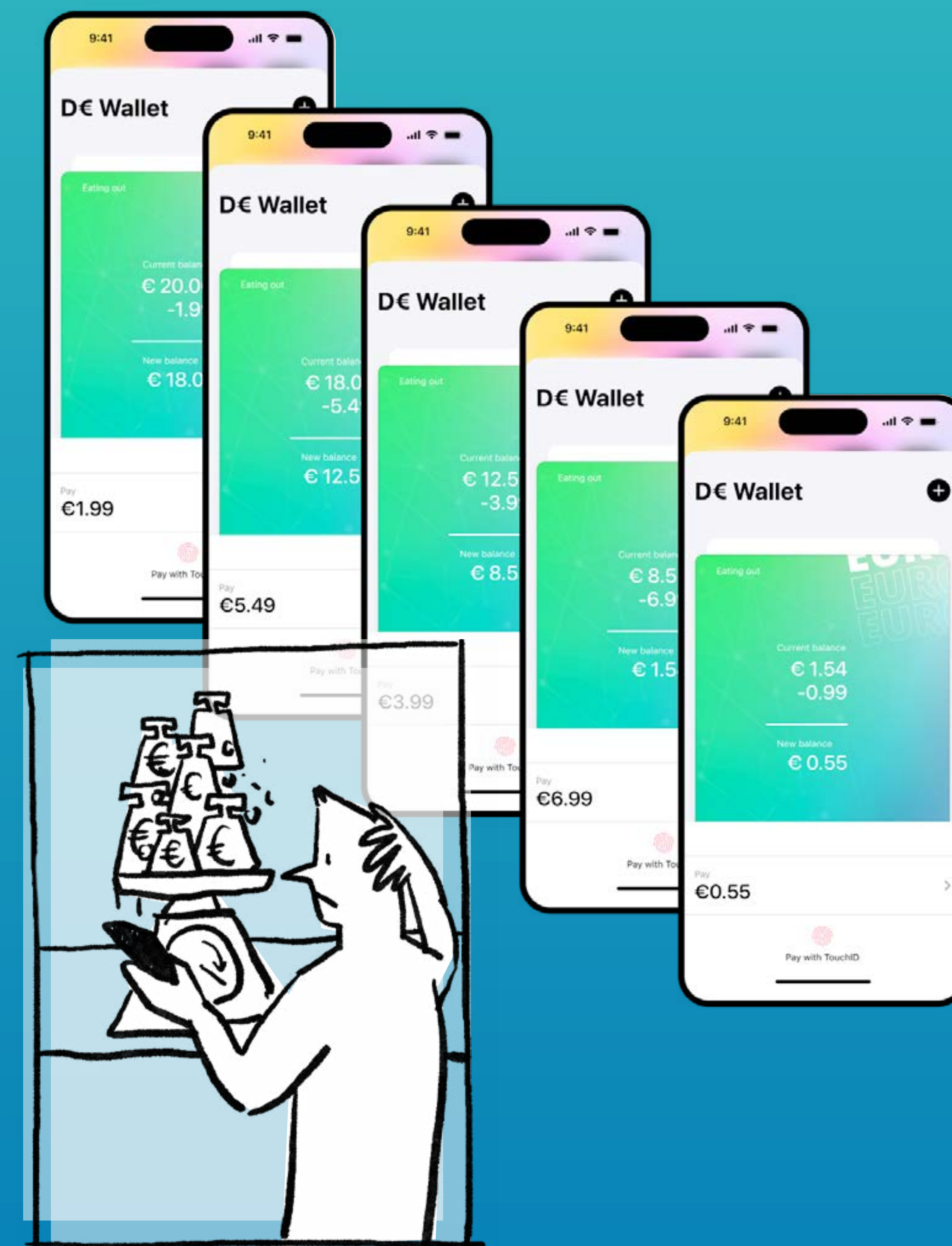
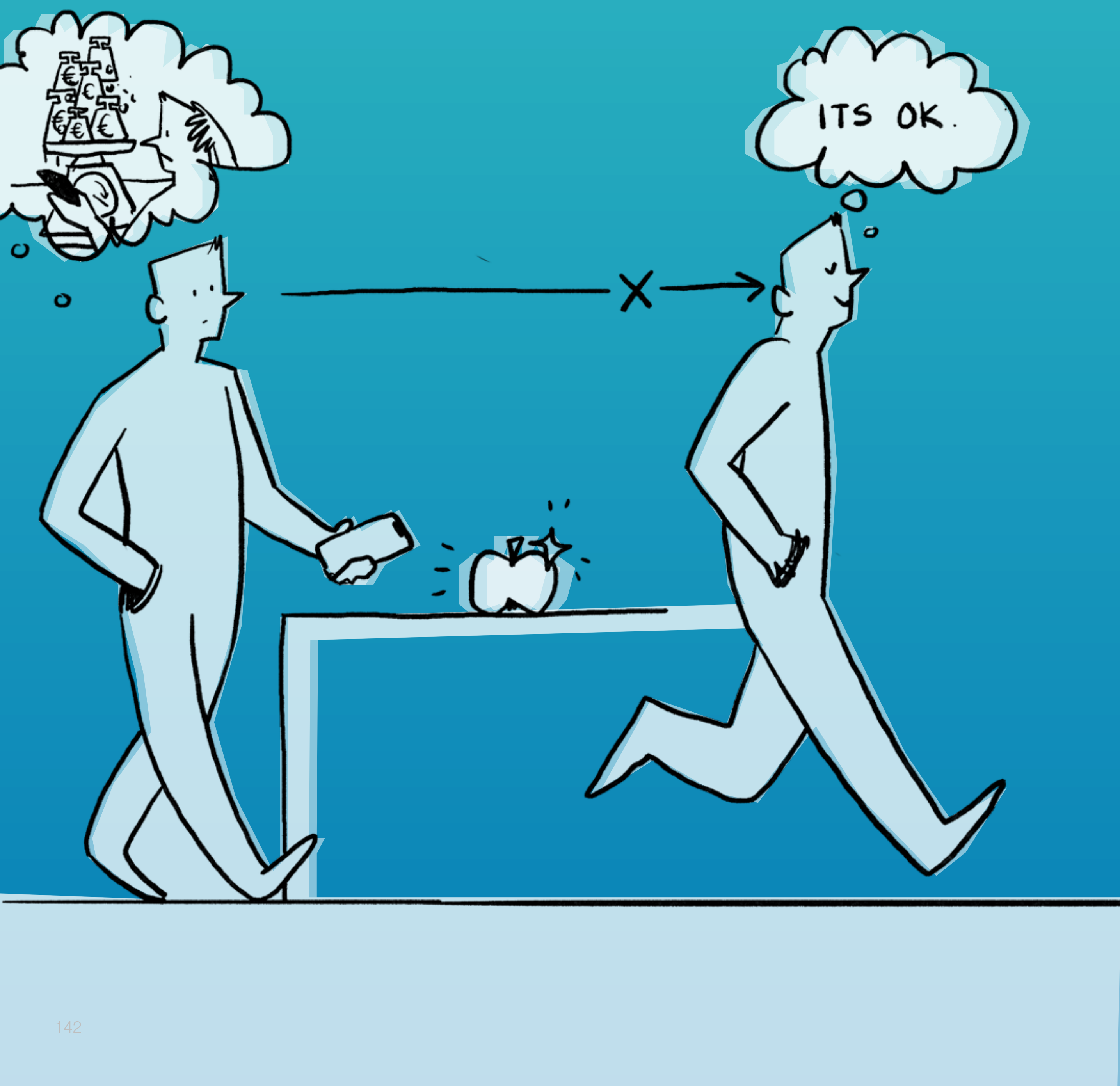


Figure 32 intervention 1: cumulative effect of payments

5.7.1 INTERVENTION 1: TANGIBLE DIGITAL PAYMENTS

Ultimately, this intervention aims for people to think about the effects it has on their balance everytime they pay. Sometimes this means buying something, because the user deems it worthy. Sometimes this may lead to conciously deciding not to spend money on something they don't want or need: something that isn't worth it.



WHY D€ SPECIFICALLY
The Digital Euro (D€) provides a unique opportunity for implementing this feature due to its distinct payment infrastructure. Unlike existing systems that operate through private schemes like Visa and MasterCard (explained in Chapter 2.3), D€ functions outside these networks. Currently, frictionless payments primarily flow through digital wallets such as Apple Pay or Google Pay.

By integrating this feature into the Digital Euro, private corporations are bypassed. Instead, the users payment data would either remain within the user's bank (which already has access to transaction data) or, in the case of locally stored digital euros, no payment data would be shared at all.

Private companies could derive significant value from data generated through budgeting and transaction tracking, but many users view such data collection as an invasion of privacy. As a public means of payment, D€ is uniquely positioned to prioritize user privacy over profit, ensuring that sensitive financial data is neither monetized nor exploited.

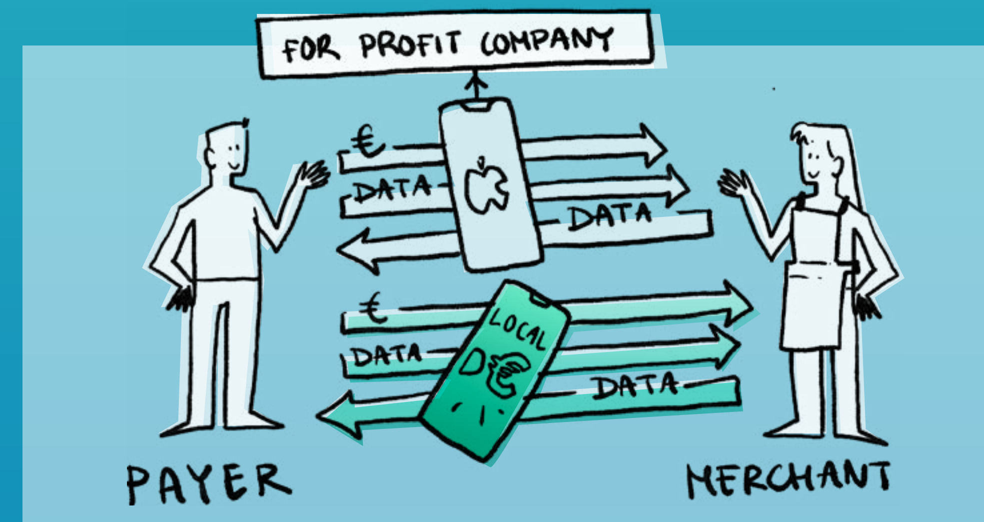


Figure 33 Overview data transfer through payments current vs digital euro contactless payments.

NEXT STEPS
The further development of this intervention should investigate the way we make payments tangible during the payment interaction.This version uses the visualisation an impact calculation, but alternatives like skeuomorphic designs (e.g., visualizing money as cash or budgets as envelopes) were also explored. Testing with users would validate which means of "making tangible" is most effective.

The technical feasibility also needs assessment. Anneloes van Gent (DNB) noted that implementing this would be challenging. Collaboration with experts in payment innovation is necessary to explore how this concept could be integrated into D€.

5.7.2 INTERVENTION 2:

UNDESIRABLE INTERACTION

SITUATION DESCRIPTION:
Trust attitude: Naive
Feeling of Agency: Resisting helplessness

Behaving naively while attempting to avoid feeling helpless stems from the fundamental shift in trust dynamics introduced by digital payments. Unlike cash transactions, where both parties can try to verify the authenticity of the money received, digital payments require the payer to place their trust in external devices and systems beyond their control. This reliance can create a sense of detachment and vulnerability. Additionally, the speed of digital transactions reduces the time available for individuals to analyze information, often making them feel rushed and powerless in the moment, further lowering their sense of financial agency. Specifically, people may feel insecure about:

- Amount of money being deducted
- Who you are sending money to
- Who you are giving your PIN-information to

2

Figure 34 Illustration situation 2: Naive and resisting helplessness

SECURE DIGITAL PAYMENTS

UNDESIRABLE INTERACTION:
This situation focuses on the insecurity felt during digital, frictionless payments. Specific aspects of this interaction that are undesirable include:

- Not having a clear overview of payment information
- Being rushed during payments
- Having to place trust in unfamiliar devices rather than your own.

To address these aspects, the payments interaction should be redesigned to make the user feel safe.

This leads us to the following vision statement:

VISION STATEMENT

"In such situations that evoke naive behavior, I want people trying to avoid helplessness to feel secure during payments, through providing delays and time to make payments based on objective information"

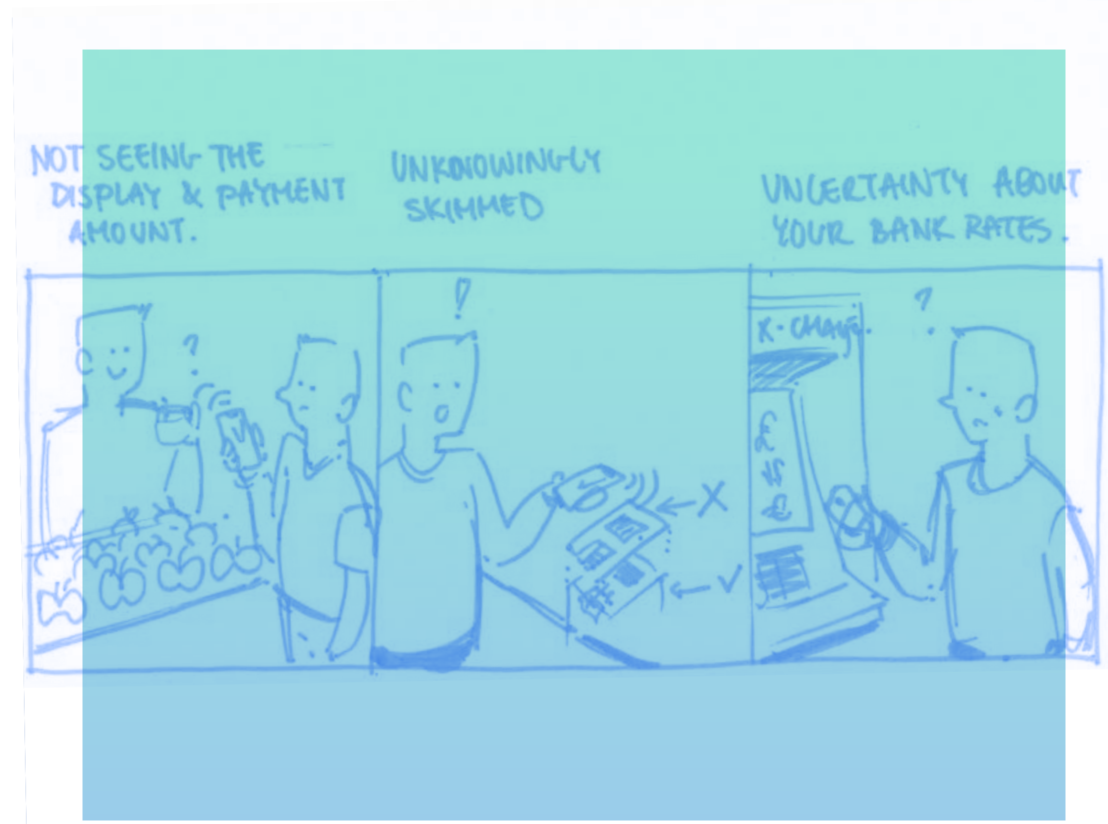


Figure 35 Illustration situation 2: undesirable payment interaction

5.7.1 INTERVENTION 2: SECURE DIGITAL PAYMENTS

INTERACTION ANALOGY

The interaction analogy used for the design of this intervention is:
Checking nutritional information before deciding to consume or buy.

This analogy illustrates how conscious decision-making in a secure and controlled environment can lead to healthier financial behaviors in digital payments.

1. DETERMINING WHAT YOU WANT TO EAT
Just as eating healthy requires understanding what you put into your body, responsible spending requires understanding where your money is going. Consumers have specific goals for their diet. Similarly, they should have goals for their spending.

2. TAKE TIME TO CHECK NUTRITIONAL INFORMATION
When trying a new food, people often assess its nutritional value before consuming it. They may check for caloric intake, sugar levels, or unwanted ingredients like palm oil or saturated fats.
Similarly, in payments, users should have access to clear, relevant information before making financial decisions, such as details about the merchant, transaction type, and potential impact on their budget.

3. DECIDE "YES OR NO" BASED ON NUTRITIONAL INFORMATION
After reviewing the nutritional information, consumers can consciously decide whether or not to eat the food.

In payments, users should feel fully in control of their transactions, deciding whether to proceed or decline based on the provided financial details.

INTERACTION QUALITIES
From this interaction analogy we can distill the following interaction qualities:

1. **INTENTIONAL –** Encourages users to actively engage with their payment choices.
2. **NON-COERCIVE** – Empowers users without restricting their freedom to spend.
3. **EMPOWERING** – Provides the right information at the right time to support better decisions.

1. DETERMINING WHAT YOU WANT TO EAT

2. TAKE TIME TO CHECK NUTRITIONAL INFORMATION

Figure 36 llustration situation 2: desirable interaction

5.7.1 INTERVENTION 2: SECURE DIGITAL PAYMENTS

Thus, the desired interaction can be described as:
When initiating a payment, P2P, in store, or at ATM's, consumers are informed about the recipient of their payment, and they are in control of the decision to pay based on this information.

Right: figure 37 Illustration situation 2: desirable interaction

CONCEPT
From this we came to the following concept direction:

A payment feature in the digital euro ensuring a transparent transaction.
The user's own trusted device provides information about the receiver of payments. For example: Name, Date, IBAN nr merchant, Amount of €. Type of transaction

The user decides to abort or confirm the payment based on this information.

This can be complemented by a second feature:

The payment is fully validated on your own device: through PIN code or biometric. Getting trustworthy information through a trusted device may improve the feeling of security in payments.

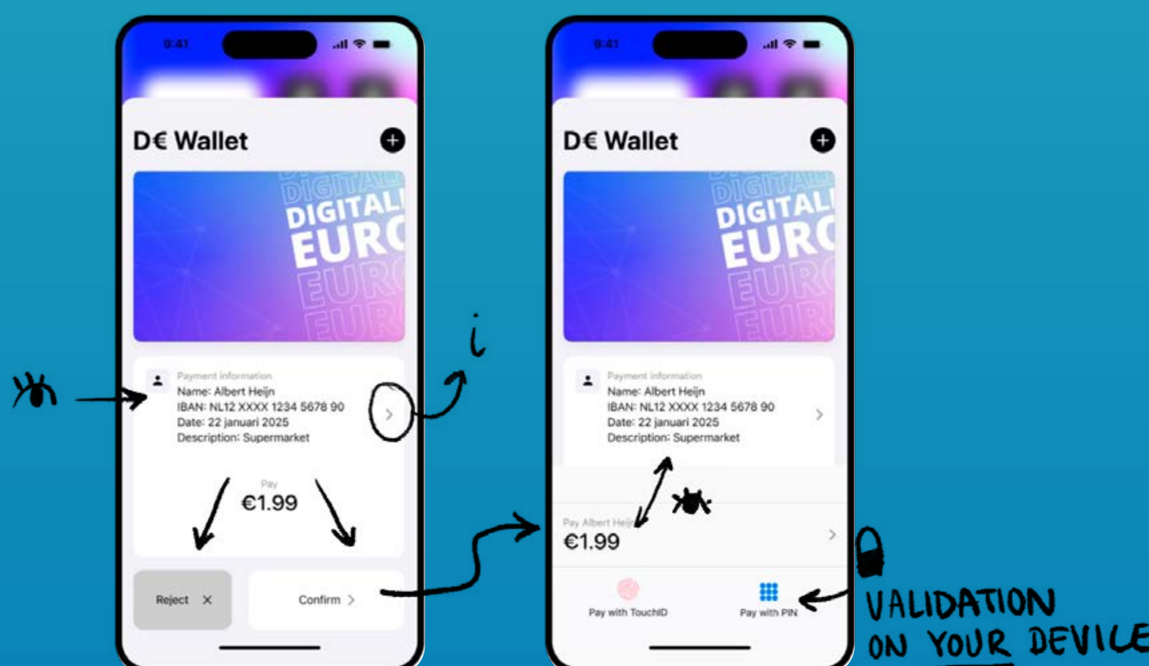


Figure 38 Overview main function intervention 2: secure digital payments in the digital euro

CONCEPT SCENARIO:
A series of mock up interfaces were created to illustrate the interaction with "tangible payments in the digital euro" and clarify how this addresses our vision: " **I want to people to feel secure during payments."**

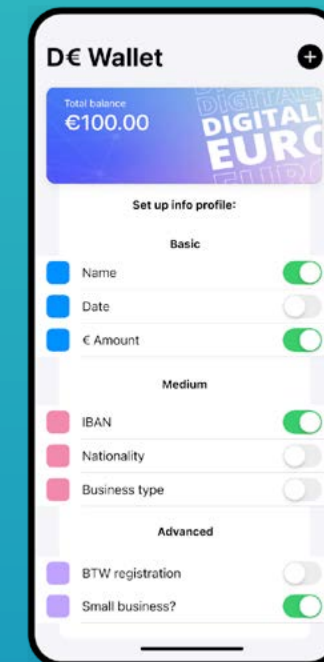
1. SET UP
The process begins with setting up personal wishes for payment information visibility. While providing information is essential, overloading users can be counterproductive. Giving users control over what information they see fosters a greater sense of autonomy and security.

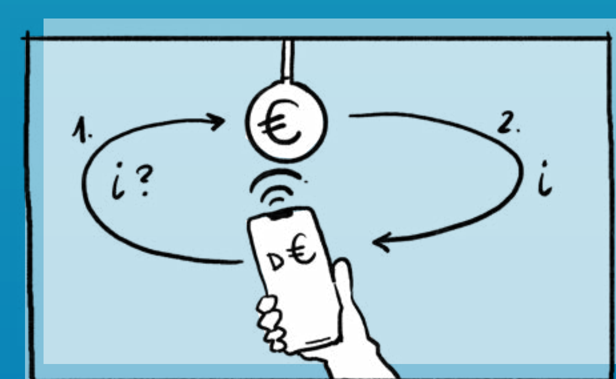
Every time a payment is initiated through the Digital Euro, users will receive relevant transaction details. To ensure transparency, merchants must provide comprehensive payment information to qualify for Digital Euro transactions.

This could imply two scenarios for merchants, who provide the information visible during payments:

1. Full Compliance: Provide all required details to ensure seamless Digital Euro transactions.
2. Partial Compliance: If any required information is missing, a red warning or exclamation mark will alert the user, potentially deterring payment.

In both cases, this information should be trustworthy and regularly validated.





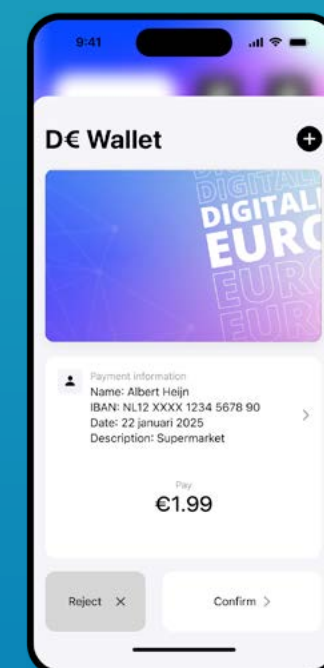


Figure 39 Overview set up intervention 2: Secure digital payments in the digital euro

5.7.1 INTERVENTION 2: SECURE DIGITAL PAYMENTS

SECURING TIME FOR CONTROL OVER PAYMENTS

The feeling of security in this intervention is created by the presentation of objective information, and the moment needed to analyse this. In the interaction analogy this moment takes place in the store, in a calm moment which often doesn't exist anymore in payments. Thus the digital euro needs to introduce this calmness, even in store, when people want payments to go quick.

In this illustration, the cofirmation is slightly delayed. There is a timer that scrolls from left to right along the confirm button (as visualised in the sequence in figure 40). When the button becomes white, the user can proceed to pay.

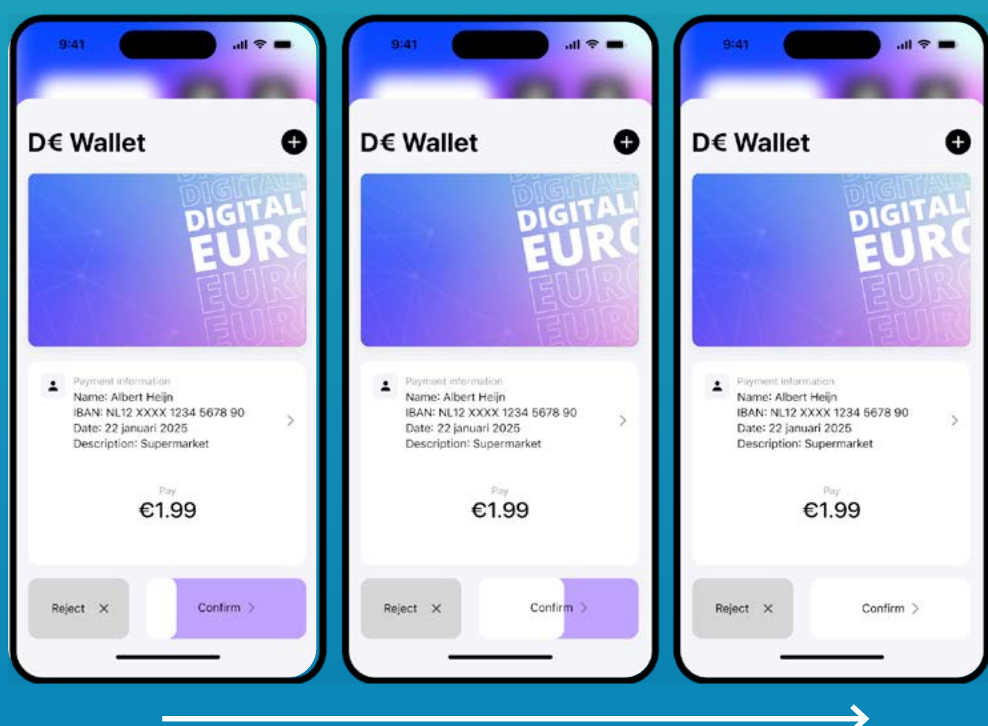


Figure 40 Overview function intervention 2: delay in payments

CONFIRMATION VIA D€

Earlier we identified the "external payment device" as a factor supporting the uncertainty in payments: the payer is required to place their trust indevices and systems they feel no controll over. A higher feeling of security could be fostered through making the verification of the payments take place on the user's own trusted device.

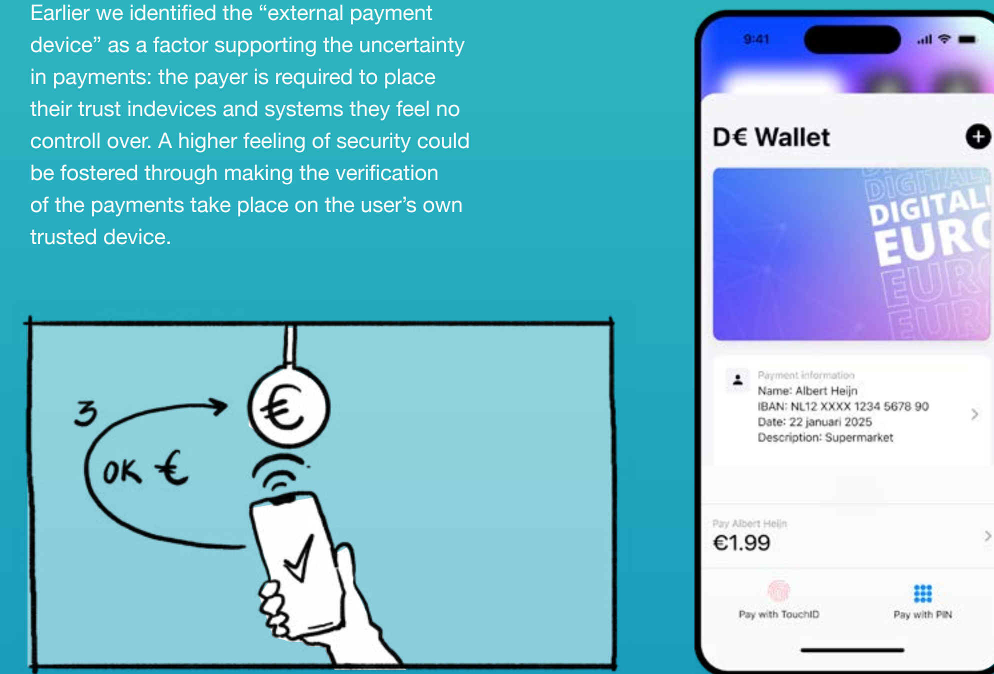


Figure 41 Overview function intervention 2: verification via device

NEXT STEPS FOR FURTHER DEVELOPMENT:

Delaying the payment interaction is a reverse movement of the trend we can currently observe. Especially looking towards the future, it would be valuable to observe the effects this will have on user and merchant satisfaction.

How people react to such features should also be investigated further. Will this delay in payments and the presentation of information support users in feeling secure during payments? How will they react if the information they see is not what they expected?

5.7.3 INTERVENTION 3: LEARNING TO USE DIGITAL PAYMENTS

UNDESIRABLE INTERACTION

SITUATION DESCRIPTION:
Trust attitude: Naive
Feeling of Agency: Chasing empowerment

Behaving naively while chasing empowerment through digital payments often means diving into new tools and methods without grasping the potential risks or the rules that come with them. Finfluencers and other profit-driven entities amplify this by promoting digital payments or investments as simple and lucrative, without taking responsibility for educating users about the dangers involved. This creates a false sense of security for individuals unaware of what they're stepping into.

Gambling with digital money, whether through speculative investments or volatile platforms, feels enticing, especially when small wins at the start create an illusion of ease and control. However, the lack of critical understanding often leads to overconfidence, and betting more than they can afford to lose. The rise of unregulated, dopamine-fueled platforms only adds to the problem, pulling people into a cycle of risk-taking that is difficult to break.

Figure 42 Illustration situation 3: Naive and chasing empowerment

UNDESIRABLE INTERACTION:
This situation focuses on the feeling of empowerment driven by addictive mechanisms withing payments. Specific aspects of this interaction that are undesirable include:

- False Empowerment – Users feel in control while unknowingly acting against their own financial well-being.
- Loss of Value Awareness – Digital money becomes abstract, making it easier to overspend recklessly.

To counteract these risks, digital payment interactions should be designed to help users recognize manipulative mechanisms and develop a stronger sense of value for money.

This leads us to the following vision statement:

VISION STATEMENT

"In situations that evoke naïve behavior, I want people chasing empowerment to resist addictive mechanisms by developing healthy financial habits and tools from childhood."

Figure 43 Illustration situation 3: undesirable interaction

5.7.3 INTERVENTION 3: LEARNING TO USE DIGITAL PAYMENTS

UNDESIRABLE INTERACTION

The interaction analogy used for the design of this intervention is:

Teaching/learning healthy eating habits as a child

Learning how to eat well requires incremental exposure, hands-on guidance, and opportunities to make and correct mistakes.

1. WANTING THE BEST FOR YOUR CHILD
Parents want to set their children up for a healthy future. They understand that good nutrition plays a key role in long-term well-being and take responsibility for shaping their child's eating habits from an early age.

2. SETTING THE RIGHT EXAMPLE
Children learn by observing the behaviors of those around them. When parents consistently choose balanced meals and demonstrate mindful eating, they create a model for their children to follow, reinforcing healthy habits naturally.

3. GRADUALLY INCREASE COMFORT WITH HEALTHY FOOD
New foods and eating habits are introduced progressively, ensuring that children have time to adjust. Instead of overwhelming them with strict rules, small steps, like tasting a new vegetable or learning to balance treats with nutritious meals, help build familiarity and confidence.

4. LEARN TOGETHER
Healthy eating is not just about enforcing rules; it's a shared experience. Parents and children explore nutrition together, discussing food choices, cooking as a team, and making decisions collaboratively. This fosters independence while ensuring guidance is available when needed.

INTERACTION QUALITIES
From this analogy, the following qualities define the desired interaction:

1. **ADAPTIVE** – Adjusts to the child's level of understanding and experience.
2. **EMPOWERING** – Encourages learning and responsibility independently.
3. **FORGIVING** – Allows mistakes to become learning opportunities rather than irreversible failures.

1. WANTING THE BEST FOR YOUR CHILD

2. SETTING THE RIGHT EXAMPLE

3. GRADUALLY INCREASE COMFORT WITH HEALTHY FOOD

4. LEARN TOGETHER

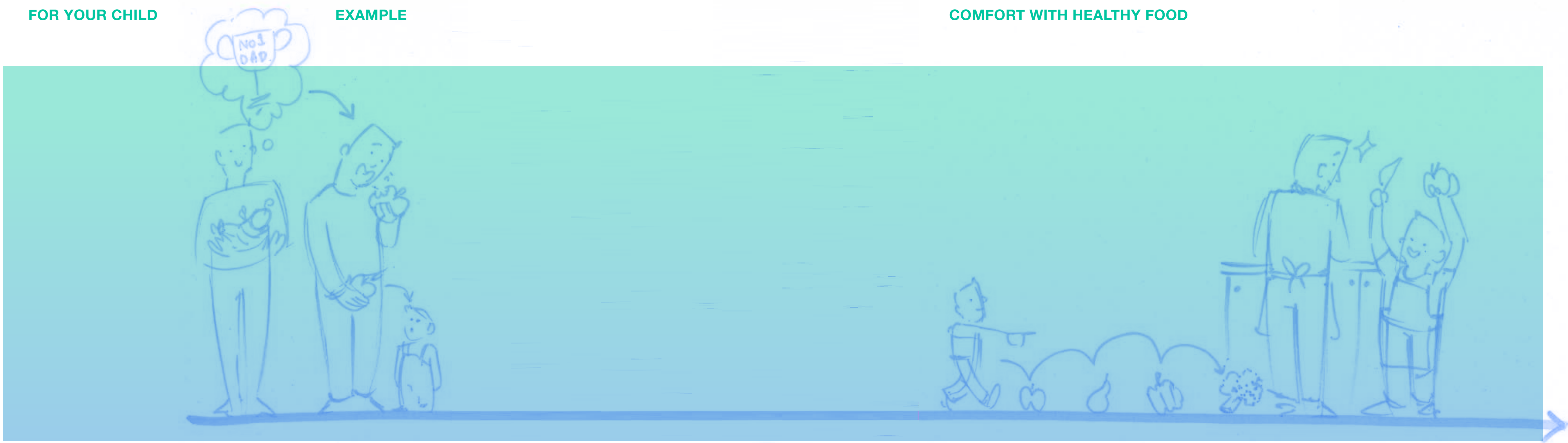
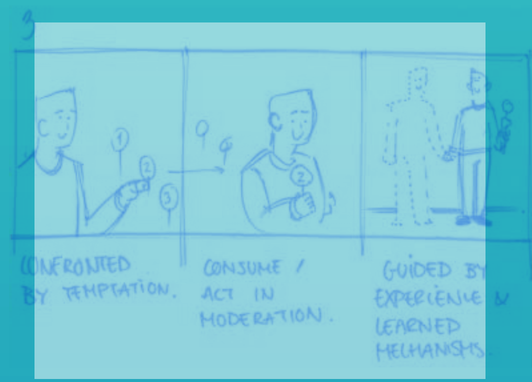


Figure 44 Illustration situation 3: desirable interaction

5.7.3 INTERVENTION 3: LEARNING TO USE DIGITAL PAYMENTS

Thus, the desired interaction can be described as:

Children learn how to handle digital money/ payments through as D€ guides children to be aware of risks around payments in a forgiving way and caring way, like a parent would.



Right: figure 45 Illustration situation 3: desirable interaction

CONCEPT
From this, we arrived at the following concept direction:

A banking and payments application with limited but evolving functionalities, designed to support children in developing financial skills. The learning process is structured around active parent-child interaction, ensuring that financial education is both guided and adaptive.

To enhance independent learning and reduce reliance on parental involvement, the application integrates a "payments buddy": a digital guide that assists children in navigating financial decisions.

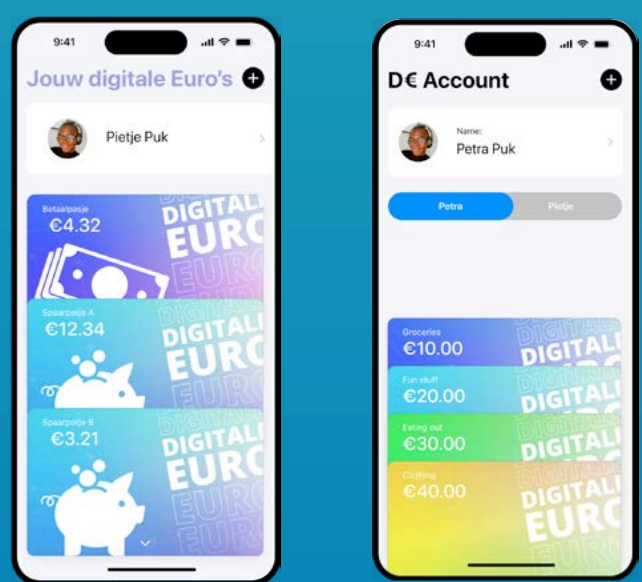


Figure 46 Overview main function intervention 3: learning digital payments in the digital euro
Simplified children's version left, connected parents version right

CONCEPT SCENARIO:

SET UP:
The digital euro learning application works with parent and child. They have to set up the app together and are continuously connected through the process parents can always observe and supervise the payment activities of their children. Outside the app, in the real world, children are guided by their parents, but in the app, the children are guided by the digital euro. Depending on their age and skills information is presented to them in an accessible way. Thereby empowering children to learn "independently" and receive feedback as suits them.

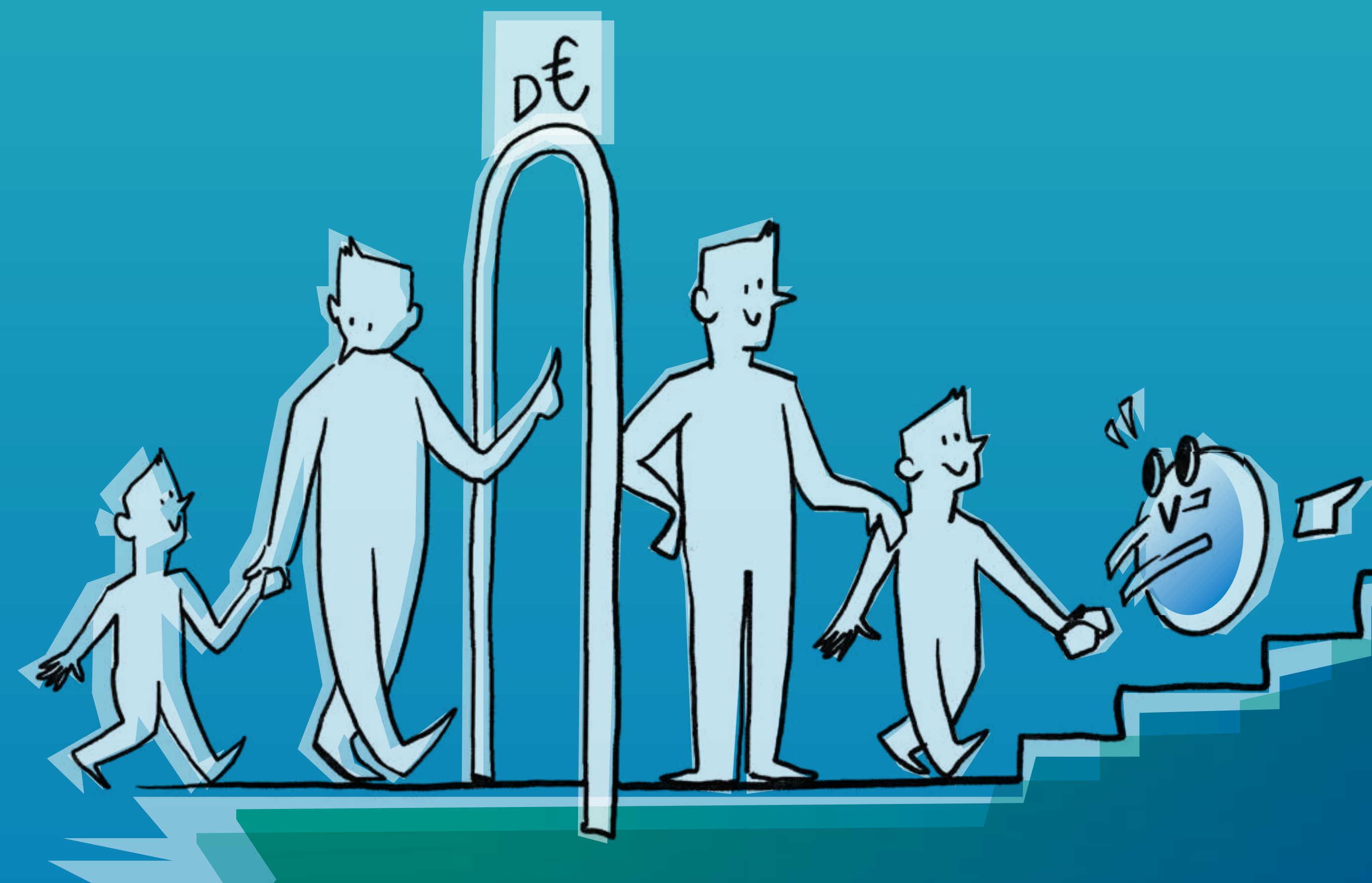


Figure 47 Overview set up intervention 3: learning digital payments

5.7.3 INTERVENTION 3: LEARNING TO USE DIGITAL PAYMENTS

PAYMENT BUDDY:
There are disparities in financial knowledge that often persist across generations as parents are the primary source of financial education for many childresn (Abbenes, n.d.). By integrating regular, structured financial education through the payment buddy feature, this intervention aims to bridge this gap, ensuring that financial knowledge is accessible to all children regardless of their family background.

NEXT STEPS:
To develop an effective financial education framework, it is essential to investigate age-appropriate learning methods and determine which payment features should be introduced at different developmental stages. Younger children may benefit from hands-on, gamified learning experiences that introduce fundamental concepts like earning, saving, and spending, while teenagers may require more practical financial tools that prepare them for real-world transactions. Additionally, special attention should be given to teaching about addictive financial mechanisms, such as impulsive spending triggers and gamified financial platforms. This requires engaging yet critical education strategies that help users recognize and resist manipulative design patterns, fostering healthy financial habits from an early age.

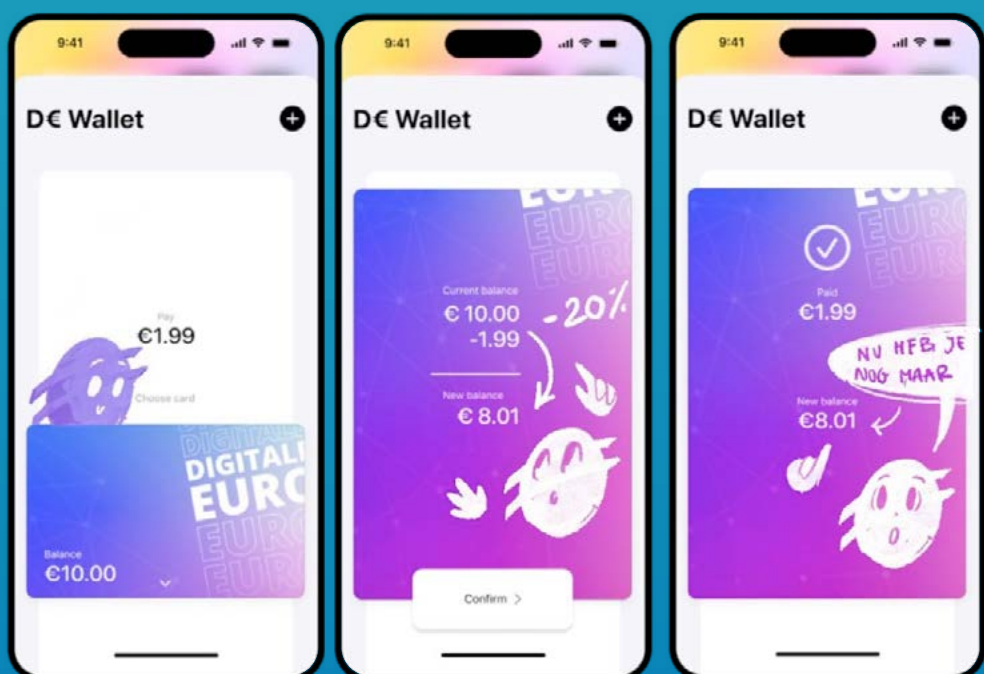


Figure 48 Overview “buddy-function” intervention 3: explorations buddy function in D€ application

Figure 49 Overview “buddy-function” intervention 3: explorations buddy function in D€ application

5.7.3 INTERVENTION 4:

UNDESIRABLE INTERACTION

SITUATION DESCRIPTION:

Trust attitude: Naive
Feeling of Agency: Chasing empowerment

Behaving naively while feeling empowered can cause individuals to lose sight of the broader infrastructure and stakeholders behind digital payments. This lack of awareness poses a risk for society at large, as increasing dependence on external parties may leave the public payment infrastructure reliant on companies that do not always act in the public's best interest. Without careful consideration, everyday transactions may inadvertently support organizations that weaken European sovereignty or channel money into industries that do not align with consumers' values.

Figure 50 Illustration situation 4: Naive and overly empowered

TANGIBLE VALUE FOR DIGITAL PAYMENTS

UNDESIRABLE INTERACTION:
Consumers are overconfident about the resilience and costs of payments due to the high-quality Dutch digital payment infrastructure. Payments are fast, appear inexpensive, and are widely accessible. As a result, people do not consciously choose payment providers or consider who they are transacting with and at what cost.

Dutch consumers do not necessarily see the appeal of D€, however, achieving the policy vision for D€ requires a minimum level of adoption to ensure public financial resilience and sovereignty.

This leads us to the following vision statement:

VISION STATEMENT

"In such situations that evoke naive behavior, I want people who are overly empowered to recognize how public payments can contribute to healthy local economies."

Figure 51 Illustration situation 4: undesirable payment interaction

5.7.3 INTERVENTION 4: TANGIBLE VALUE FOR PUBLIC PAYMENTS

UNDESIRABLE INTERACTION

The interaction analogy used for the design of this intervention is:

Purposely choosing to buy local groceries over going to a chain-supermarket

Consumers are often encouraged to buy local produce because of its positive impact on local communities and the environment. This behavior shift is largely driven by awareness and intentionality, as people recognize the values behind their choices.

1. LEARNING LOCAL IS BETTER
People become aware of the benefits of shopping locally through advertisements, social networks, or direct interactions with merchants. They recognize that choosing independent stores supports their community, aligns with sustainability goals, or reflects their personal values.

2. CONSCIOUSLY CHOOSING TO CHANGE BEHAVIOR
Once aware, individuals may begin to see themselves as people who make ethical, value-driven choices. As a result, they deliberately opt to shop at local markets instead of large supermarkets that do not align with their principles.

3. FEELING OF REWARD FOR DOING THE BETTER THING
Making a purchase that aligns with one's values creates a sense of self-actualization. The act of supporting local businesses provides both tangible benefits to the community and an intrinsic reward, reinforcing the motivation to continue this behavior.

INTERACTION QUALITIES
From this analogy, the following qualities define the desired interaction:

1. **INTENTIONAL** – Encourages users to make deliberate choices based on their values.
2. **VALUE-DRIVEN** – Helps people align their behavior with their personal beliefs.
3. **COMMUNITY-ORIENTED** – Reinforces the collective impact of individual decisions.

1. LEARNING LOCAL IS BETTER

2. CONSCIOUSLY CHOOSING TO CHANGE BEHAVIOR

3. FEELING OF REWARD FOR DOING THE BETTER THING

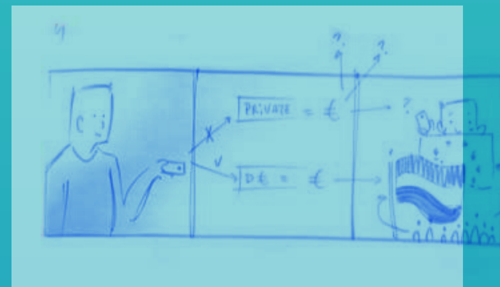
Figure 52 Illustration situation 4: desirable interaction

5.7.3 INTERVENTION 4: TANGIBLE VALUE FOR PUBLIC PAYMENTS

Thus, the desired interaction can be described as:

Consumers make decisions between means of payment based on the impact payments decisions can have for our local area and local communities.

Right: figure 53 Illustration situation 4: desirable interaction



CONCEPT
From this desired interaction, the following concept was designed.

Making the digital euro value tangible for consumers by connecting the digital euro identity with benefits/value for small merchants.

The interaction analogy indicates that people may choose to deliberately adapt their payment behavior if they know it benefits something they value. By providing value to small business owners, people may choose to pay with D€ over other methods. Especially if the merchant is a sympathetic figure, such as "mom and pops with a local supermarket" or "a kid with a web-store selling homemade crafts".

In the market driven conditions which employs volume drives prices, (digital) payments are expensive for small merchants since they cannot negotiate effectively. The focus on the amount of payments a merchant handles benefits large businesses exclusively. Thus, here is an opportunity to actually provide value to merchants: cheaper digital payments.

Figure 54 Illustration identity D€: tangible value for public payments

Figure 55 Concept marketing: communicating to people that D€ is a good product for small merchants

5.7.3 INTERVENTION 4: TANGIBLE VALUE FOR PUBLIC PAYMENTS

In order to connect the digital euro to value for merchants, there needs to be actual value for merchants. This is most efficiently done through the reduction of payment fees. At the event “Een digitale euro for iedereen”, which I attended at the beginning of this project, the merchant representative indicated that high costs would be the primary reason for merchants to resist the digital euro. Thus, if it is the cheapest option, it will likely be favored by the merchant.

This could be done through two routes:

1. D€ PROVIDES A PLATFORM FACILITATING “POOLING” OF PAYMENTS
In the current concept of the digital euro, it is expected that digital euro payments will go through commercial banks. If small merchants in a local area like a town, or a shopping center, can connect their payments, they could collectively go to a selection of banks and negotiate for the best offer. Through the digital euro app they can connect with small merchants in their area.

2. CAPPING D€ FEES FOR SMALL MERCHANTS
In a different structure, a cap on the payment fee is introduced for small merchants and adopted into law. This would mean that if you have a small amount of payments you will be charged less for payment services, thereby forcing banks to offer good prices to small merchants as well.

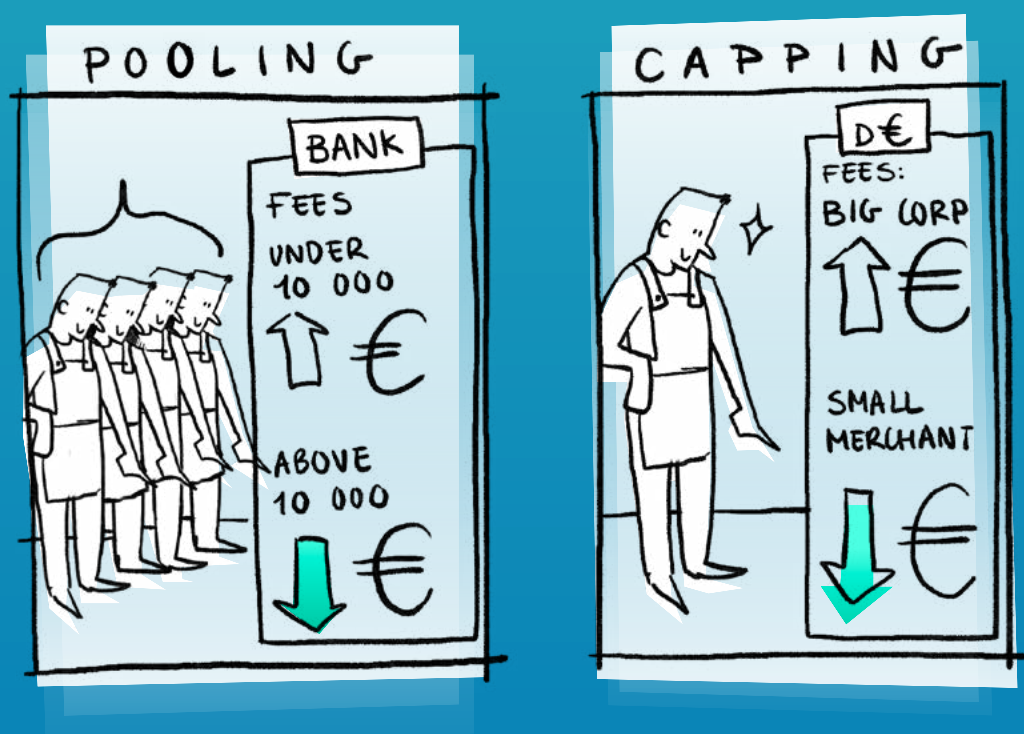


Figure 56 Illustration intervention 4: Pricing strategies D€

CONCEPT SCENARIO:

1. A SUPPLEMENT, NOT A REPLACEMENT
The digital euro doesn’t replace the other means of payment. If the merchant or customer wishes to continue using cash or private means of payment, this is no problem. If the digital euro is cheaper for the merchant, this will be their favored means.

2. COMMUNICATE VALUE
Through the merchant (or marketing campaigns) it becomes clear that D€ provides value to the merchant: choosing to pay with D€ supports their local business as it saves them in cost.

3. DO SOMETHING GOOD
Paying with the Digital Euro is a small effort. By helping your local merchant, small business, entrepreneur you do something good for your community, helping you feel good.

Figure 57 concept scenario intervention 4

The communication strategy for this intervention should be refined through user testing. Slogans such as “€ollective Payments via D€” or “Buy Local, Pay Local” emphasize the local and collective value of D€, but their effectiveness remains uncertain without further validation.

From a whole different perspective further research for this intervention should include an analysis of the economic effects this could have as it disrupts the current functioning of the payments market. When it involves the capping of payment fees, it should be investigated at what rates the cap should be set, and how “small merchant” is defined. E.g. Limited number of payments, or limited number of employees? As this intervention could significantly impact the payments market, thorough economic analysis and stakeholder consultation are essential before potential regulatory adoption.

6. DELIVER

This final chapter focuses on concluding the design process and refining the key outcomes of this thesis. According to the Design Council, the *deliver* phase involves testing different solutions on a small scale, discarding those that prove ineffective, and refining those with potential (Design Council, 2005).

In this chapter we aim to finalize answering the final research question: *"How can DNB intervene in the challenges emerging from this evolving relationship through the design of the digital euro?* Several subquestions are explored:

1. How are the research outcomes of this thesis perceived by those at DNB involved with payments?
2. How should DNB intervene in payments in the future?
3. What actionable steps can DNB take to implement the findings of this research?

Based on these insights, four project briefs and a roadmap outlining next steps were developed. These outputs aim to reduce barriers for future work, making it easier to pursue further research and implementation.

DELIVER CONTENTS **P**

6.1 VALIDATION APPROACH

This thesis investigates how the relationship between society and payments is evolving toward 2035. Because the designed interventions are intended to shape future payment interactions, direct validation with users at this stage would be unrepresentative: the social context in which these interventions would operate does not yet exist. Therefore, it was decided to validate the outcomes of this project with policy advisors from DNB.

CONTINOUS VALIDATION
As described earlier in Chapter 1.7, this project followed a process of continuous co-creation with two policy advisors from DNB's Digital Euro team. Throughout the project, weekly meetings served as some form of "micro-validations," allowing the work to be assessed as it was being developed. These discussions focused primarily on three key aspects: desirability, viability, and feasibility. These are three qualities of the design relevant for innovation (Chasanidou et al., 2015) Over the course of the project, these weekly sessions took place 25 times, providing valuable iterative feedback and ensuring alignment with the broader goals and constraints of DNB.

In addition to these ongoing discussions, the project featured three structured validation moments, involving all supervisors of this thesis:

1. **KICKOFF MEETING:** Validating the initial project scope and research intent.
2. **MIDTERM REVIEW:** Assessing the developed framework and the decision to focus on a vision for responsible digital financial inclusion.
3. **GREENLIGHT MEETING:** Evaluating the four proposed interventions for responsible digital financial inclusion, refining their direction, and determing the time allocated for their development.

These moments allowed for structured reflection at critical moments in the project, ensuring that the research and design direction remained both relevant and actionable.

FINAL VALIDATION
To assess the overall validity of the framework, vision, and designed interventions, a fourth validation moment was introduced. This consisted of a series of interviews with relevant DNB policy advisors involved in the Dutch payment infrastructure who had not been directly involved in this project. By gathering perspectives from advisors inside and beyond the Digital Euro team, this final validation aimed to understand how the thesis findings would be received within DNB and whether the proposed interventions were relevant to the broader payment infrastructure, not just the Digital Euro initiative.

The following chapter outlines the approach and outcomes of this series of interviews.

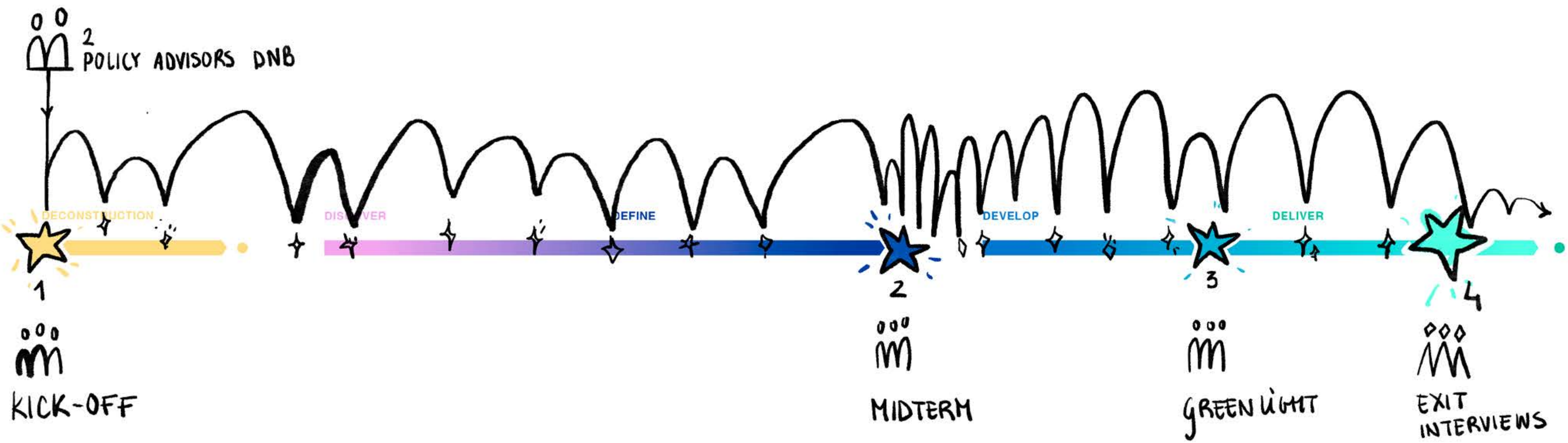


Figure 58 Visualisation validation with policy advisors from DNB along the course of this project

6.2 INTERVIEWS DNB

To evaluate the vision and concept directions developed in this project, a series of interviews was conducted with members of DNB's Retail Payments and Research department: the team I joined for my graduation internship and where I developed this thesis.

To ensure a more objective perspective, the interviews excluded those who were actively involved in the project: Huib Klarenbeek, Anneloes van Gent, and Menno Broos.

The goal of these interviews was to assess the effectiveness of key aspects of the thesis. The discussion focused on three areas:

1. Emerging challenges and vision
2. Design analogy and interventions
3. Design project approach

Following a 20-minute presentation, interview questions were discussed. Key quotes from these interviews are highlighted on the right. For detailed slides and interview transcriptions, refer to Appendix H.

VISION
The vision was well received. Sophie specifically noted that framing digital financial inclusion as "responsibly including" places accountability on organizations rather than individuals. This is in line with how DNB manages the payment infrastructure currently.

INTERVENTIONS
While not yet ready for immediate implementation and adaptation, the illustrations and design presentations were seen as inspiring by all interviewees, achieving their intended purpose.

APPROACH
The research/design methodology was positively received. While the ViP methodology can be challenging to grasp, interviewees appreciated the context clusters, framework, and interaction analogy approach as valuable tools.

VISION: "Saying 'responsible' in the vision statement creates a sense of ownership of the problem, which is missing in the current payment infrastructure."

INTERVENTIONS "The first three interventions are relevant not only for the digital euro, but for payments in general. We should see what we can do with that when making new policy."

APPROACH "The framework with 12 situations and the dimensions are very interesting to me."

1. SOPHIE COHEN TER VAERT

Head Of Department Payments Policy at DNB

VISION "I understand the vision and see the relevance of the design analogy. It really makes the project come to life"

INTERVENTIONS "The interventions are an interesting mirror for us. It is nice that they don't completely shatter our ideas, but concretely support things that we value."

APPROACH "It is great to see how you started with a very wide domain, and translated it into 4 actionable directions for further developement here."

2. MARIE CLAIRE BROEKHOFF

Researcher and Policy Advisor at the Nederlandsche Bank, work includes writing the new *vision on payments* for DNB

VISION "I'm very enthusiastic about the vision, and the research about societal movements which support it."

INTERVENTIONS "'a healthy version of payments has created interesting interventions, but I would be apprehensive to market it like that."

APPROACH "The fact that this project doesn't identify groups of people, but rather situations and attitudes is very inspiring to me."

3. RIA ROERINK

Researcher and Policy Advisor at the Nederlandsche Bank, work includes writing the new vision on payments for DNB and the digital euro

6.3 REFLECTION ON RESPONSIBILITY IN PAYMENTS

As mentioned by Sophie Cohen ter Vaert in the previously outlined interviews, *"Saying 'responsible' in the vision statement creates a sense of ownership of the problem, which is missing in the current payment infrastructure."* This highlights a recurring theme in discussions throughout this thesis: What is DNB responsible for in this domain, and what should they be responsible for?

DNB's activities are driven by a strict mandate. They identify four key objectives they aim to achieve through their activities (De Nederlandsche Bank, n.d.-a):

1. Trustworthy financial institutions
2. Stable prices
3. Resolution for struggling financial institutions
4. A well-functioning payment infrastructure

Managing the payment infrastructure is only one of these tasks. One of DNB's key tasks is the support of the cash payment infrastructure. On the digital side DNB's efforts are primarily focused on the efficiency, reliability, and inclusivity of the payment infrastructure. While consumer protection from risky financial situations, such as those identified in this thesis, is studied, it is not prioritized (Maatschappelijk Overleg Betalingsverkeer, 2024).

With the rise of frictionless payments and their growing influence, people are increasingly questioning how this debate should be interpreted. Naudts and Eijlander discuss this topic in a recent paper (2024): *"Rapid digitisation has paved the way for a plethora of innovative payment methods, aimed at eliminating payment frictions. Frictionless payments are at a crossroads of public policy objectives, including innovation, customer convenience, sustainability, consumer protection, and financial inclusion."*

In their paper, Naudts and Eijlander (2024) explore the issue of user consent in payments, noting that consent is not always explicit. A single accidental tap or an unintended card connection can trigger a payment. From a public policy perspective, they argue, it is essential to preserve the element of choice and recognize that some innovative payment methods may come at the expense of users. The introduction of the digital euro is an example of this policy at play: Offering the choice for a product not driven by profit, prioritizing the needs and protection of the consumer.

Fortunately, DNB has already taken some action, as financial law has increasingly expanded the extent of banks' duty to act in the best interest of their consumers (Naudts & Eijlander, 2024). The interpretation of legal obligations has evolved to adopt a broader, more comprehensive view. At this crossroad in the development of payment systems, DNB and other policymakers must assess the extent to which consumer protection falls within their mandate, before the impact of these payment innovations reaches a critical point.

Figure 58 Responsible digital financial inclusion

6.4 PARTNERS FOR FURTHER DEVELOPMENT

As discussed previously, DNB's mandate for intervention in the Dutch payment infrastructure is limited. If it is DNB's desire to intervene upon payments more strongly as is outlined in the future visions A, B and C, presented in this thesis, they have 2 options:

1. Adjust DNB's mandate to fully include responsible digital financial inclusion.
2. Partner with parties who are responsible for the aspects outside the mandate of DNB.

Since this thesis presents a wider vision for the future of payments, we acknowledge that DNB is not the sole actor capable of addressing these challenges. In the table on the right, key stakeholders are identified, along with their respective responsibilities and potential opportunities for intervention.

As you can see on the right, challenges A and B start with the adaptation of private banks. In this thesis some of the challenges emerge as a result of the privatization of payments. Seeing as the way these products are currently designed by private organizations, it is not weird that addressing the problem at the source would be the most effective course of action. If private parties don't seem to solve these problems, DNB and other parties overseeing the payment infrastructure could and should intervene.

Challenge C addresses public trust in payment infrastructure as a whole. This challenge is more systemic in nature and, therefore, requires involvement from institutions that rely on widespread public trust. These institutions are not driven by profit but by public interest.

NAIVE	PRAGMATIC	CYNIC
VISION A: RESPONSIBLE DIGITAL FINANCIAL INCLUSION	**VISION B: EXPERIENCING IMPACT THROUGH PAYMENTS**	**VISION C: TRUSTWORTHY PAYMENT INFRASTRUCTURE**
PRIVATE BANKS AND PAYMENT PROVIDERS: Given the payment infrastructure doesn't dramatically change, access to digital payments goes through private banks. As the closest point of contact they should ensure responsibel digital financial inclusion.	**PRIVATE BANKS AND PAYMENT PROVIDERS:** Private banks can improve their financial services and offer value through this emerging need. For example through offering financial products that make "political consumerism" more convenient or financial tools improving the impact people experience over the course of their own lives.	**AUTHORITY FINANCIAL MARKETS (AFM)** AFM is already active in investigating and monitoring the activities of financial services that are generally untrustworthy (Autoriteit Financiële Markten, 2021). Investigating how payment providers who offer trustworthy means of payment can better communicate and support this would be a valuable venture.
AUTHORITY FINANCIAL MARKETS (AFM) In the Netherlands, they are partly responsible for consumer protection in the payment infrastrcure (AFM, 2020). They will intervene if problems arise from the products developed by the market through writing and enforcing law. If the private banks don't change their products, AFM should intervene and push them to change the way payment products are designed.		**MINISTRY OF FINANCE (MINFIN)** Especially larger organizations like MinFin would be served by high rates of trust, supporting not only their own organisation, but the broader government and institutions.
MAATSCHAPPELIJK OVERLEG BETALINGSVERKEER (MOB) MOB is a discussion platform between organizations in the payment infrastructure (MOB,2024). One of their tasks is to make agreements about a safe, reliable, efficient and inclusive payment infrastructure between stakeholders. As the connecting party they should push stakeholders to prioritize responsible digital financial inclusion.		**CONSUMENTENBOND** As an independent consumer advocacy group, Consumentenbond could be a key partner in investigating, designing, and communicating trustworthy payment solutions to Dutch society.

Figure 60 Overview potential partners for development of each vision on payments

6.5 ROADMAP OVERVIEW

So far, the evaluation has primarily focused on the development of Emerging Challenge A: Responsible Digital Financial Inclusion. The interventions designed in this thesis are centered around the Digital Euro, and their implementation roadmap can align with the horizons set by the European Central Bank's D€ process.

However, as this project considers digital payments more broadly, the further development of Challenges A, B, and C can also be positioned on a parallel roadmap, ensuring a more complete approach to shaping the future of payments for the Netherlands.

NOW: 2025

HORIZON 1: AGREEMENT D€

HORIZON 2: LIVE D€

VISION 2035

DESIGN DIGITAL EURO

INVESTIGATION PHASE - ±18 MONTHS

Until there is political consensus for D€, ECB remains in the investigative and preparative phase. At this time, political consensus it is expected around summer 2026 earliest. This gives DNB the opportunity to continue developing their vision around responsible digital financial inclusion.

IMPLEMENTATION PHASE

After a decision has been made that the digital will come, the European Central Bank will start building the product. This time period includes building the initial product as well as a series of pilots across (all) euro zone states.

IMPROVEMENT PHASE

After the digital euro is live in it's full form, ECB will continue testing and improving the product. By keeping sight on the vision developed in this thesis, the vision for 2035 can be achieved.

RESPONSIBLE DIGITAL FINANCIAL INCLUSION

A

1. TANGIBLE DIGITAL PAYMENTS
2. TRANSPARENT DIGITAL PAYMENTS
3. LEARNING DIGITAL PAYMENTS
4. TANGIBLE VALUE FOR PUBLIC PAYMENTS

D€

DESIGN DUTCH PAYMENTS

The challenges and vision statements developed in this thesis are relevant to digital payments as a whole, not just the Digital Euro. The framework and vision statements serve as starting points for rethinking and redesigning the Dutch payment infrastructure in a broader sense.
While the Digital Euro is not the focus of the design here, it is possible that the insights and interventions proposed here could influence its design and implementation in the future.

NO D€?

The digital euro is still pending political and ECB approval. Even if the project would not materialize these visions remain valuable for the payment infrastructure in general. The visions and emerging challenges are then especially relevant to address, as there is no digital form of public money.

RESPONSIBLE DIGITAL FINANCIAL INCLUSION

A

IMPACTFUL PAYMENTS

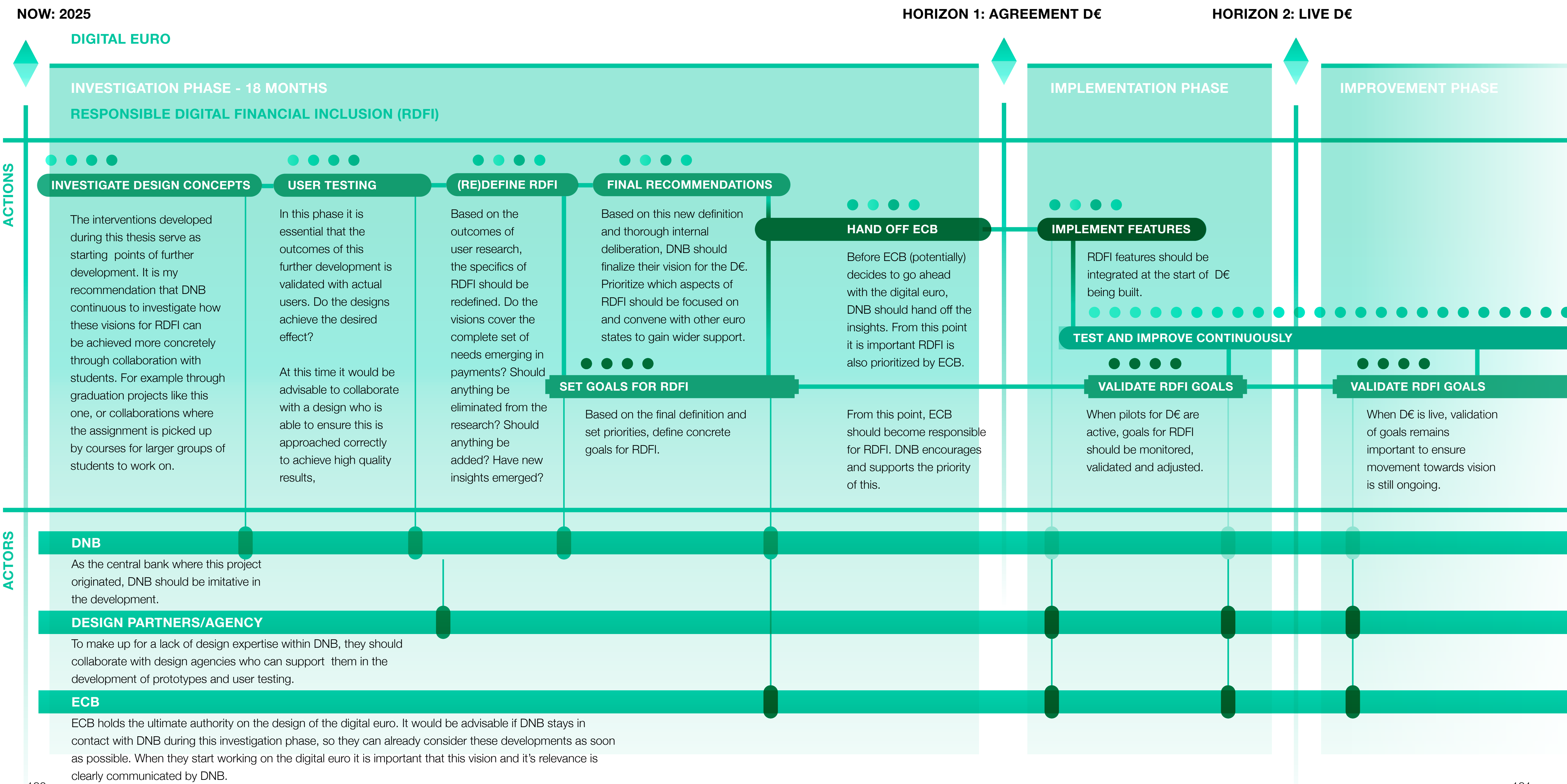
B

TRUST IN PAYMENTS

C

6.6 ROADMAP DIGITAL EURO

In order to address the development of challenge A (with focus on the digital euro) in more detail, this roadmap outlines the next steps in the development and relevant stakeholders/collaborators with this process.



6.7 DELIVER CONCLUSIONS

Insights from the interviews indicate interest in continuing this project. Both the vision and the designed interventions were seen as inspiring and valuable. They are relevant not just for the development of the digital euro, but for digital payments in the Netherlands in general.

The first step in the roadmap for the digital euro is to continue developing the concepts identified in this thesis. One way this could be done is through collaborations with students as was done with me with the writing of this thesis.

Thus a series of project briefs was developed which can be found in appendix I. Each project brief is based upon one of the four designed interventions to support DNB in continuing this work. These briefs incorporate feedback from interviews as well as personal reflections and questions that arose during the development of the interventions.

Each project brief follows the Tu Delft project brief format, which also served as a foundation for this thesis (see Appendix A).

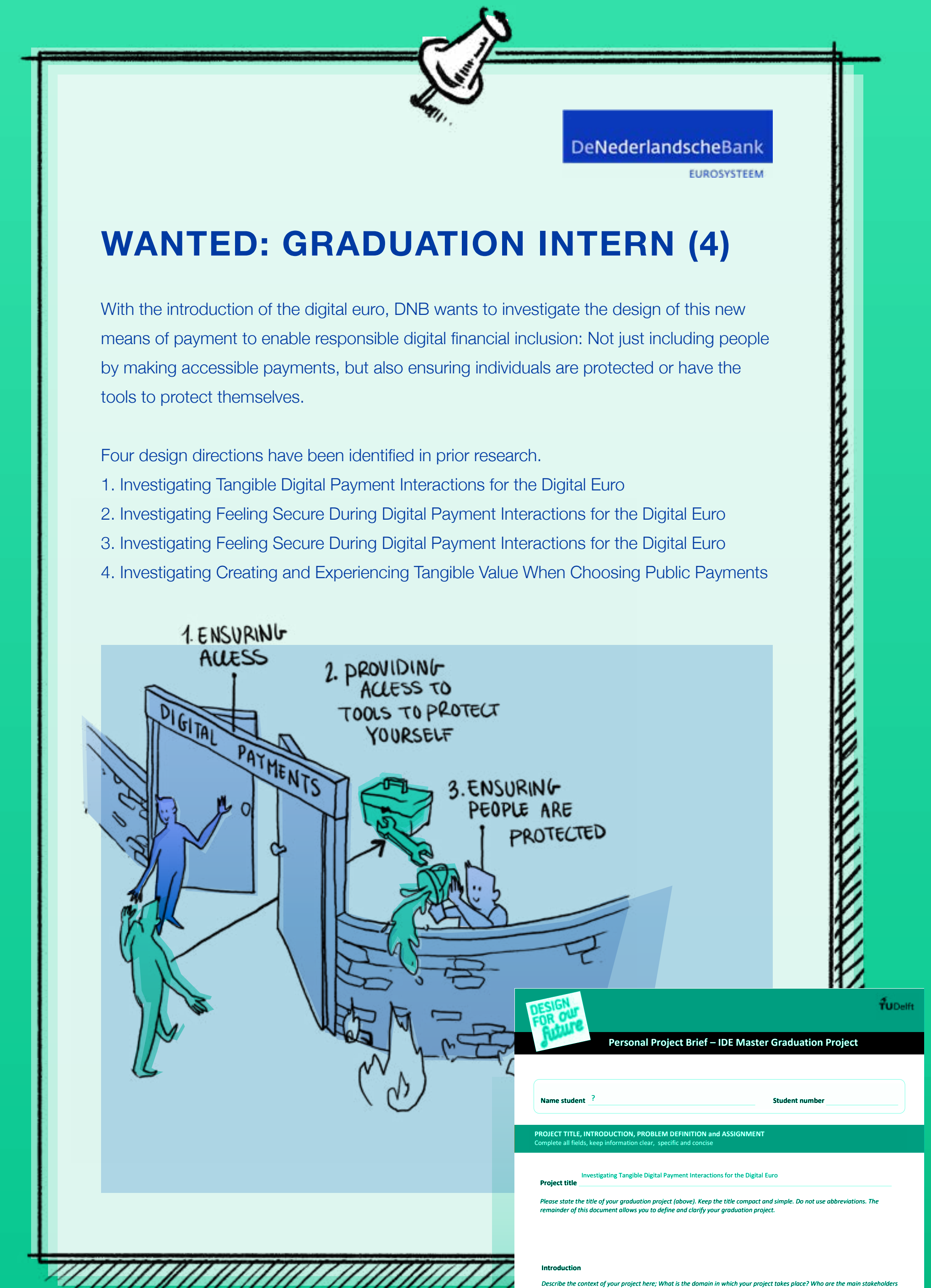


Figure 61 Illustration flyer for recruitment future thesis writers

7. CONCLUSION

CONCLUSION CONTENTS

7.1 SUMMARY OF FINDINGS

RESEARCH AIM AND APPROACH
This thesis is structured around answering three consecutive research questions to guide the design direction of the Digital Euro, based on the changing relationship between society and payments.
To achieve this, the Vision in Design (ViP) methodology was applied, re-framing the concept of digital payments in the future and identifying strategic design directions that align with societal needs. The process involved:

Analyzing the current relationship between society and payments in the Netherlands. Exploring how this relationship is likely to change by 2035 and Developing future visions. Translating one of them into four concrete interventions, illustrating how DNB could intervene to create a desirable future payment landscape.

FINDINGS PER RESEARCH QUESTION

RQ1: *What are the main design challenges in the current relationship between society and payments?*
This question focuses on understanding the existing payment landscape, the rise of contactless and frictionless payments, and their impact on society. Based on the analysis, three challenges were identified:

1. **LIMITED ACCESSIBILITY DUE TO RELIANCE ON PRIVATE MONEY**
Private payment systems prioritize profit, leaving some groups under-served.

2. **FINANCIAL LITERACY STRUGGLES**
As payments go digital, many struggle to manage their finances (Maatschappelijk Overleg Betalingsverkeer, 2024).

3. **TRUST CONCERNS DUE TO DIGITALIZATION**
Invisible providers and data-driven transactions raise privacy and control concerns.

RQ2: *Which design challenges emerge as a result of the changing relationship between society and payments in the Netherlands by 2035?*
To investigate the future relationship, 14 context clusters were identified, representing key themes likely to impact the interaction with payments in 2035. By structuring these clusters along two dimensions, *Agency and Trust Attitude*, three emerging challenges were formulated based on 12 identified payment situations and consequently translated to 3 vision directions:

	EMERGING CHALLENGES	VISIONS
A.	**UNSAFE FINANCIAL BEHAVIOR** Naive trust leads people to overlook risks in payments.	**RESPONSIBLE DIGITAL FINANCIAL INCLUSION** Payments should empower individuals to make informed financial decisions, ensuring they understand risks and can navigate digital transactions safely.
B.	**FEELING STAGNANT AND INSIGNIFICANT** A pragmatic view of financial power leaves individuals feeling powerless.	**EXPERIENCING IMPACT THROUGH PAYMENTS** Payment systems should allow individuals to see and influence the broader effects of their financial choices, fostering a sense of agency and contribution to society.
C.	**LOW TRUST IN OTHERS AND INSTITUTIONS** Cynic trust attitudes erode at the foundations of institutions trying to maintain wide welfare and financial stability.	**TRUSTWORTHY PAYMENT INFRASTRUCTURE** A reliable, transparent, and publicly governed payment system should reinforce trust in financial institutions and ensure stability for all users.

7.1 SUMMARY OF FINDINGS

RQ3: *How can DNB intervene on the challenges emerging from this changing relationship through the design of the Digital Euro?*
To demonstrate how DNB can leverage this framework, visions, and identified payment situations, Challenge A (Responsible Digital Financial Inclusion) was selected and translated into four interventions centered around the design of the digital euro. By re-framing the Digital Euro as the "healthy version of digital payments," four interventions were designed to promote responsible financial habits

Each intervention reflects some principles of healthy financial habits, emphasizing security, transparency, and financial education, thereby addressing needs emerging from the framework.

1. TANGIBLE DIGITAL PAYMENTS – Making digital money feel real and impactful through a payment app which communicates the impact of payments during the payment interaction.

2. SECURE DIGITAL PAYMENTS – Ensuring a safe and controlled payment experience by providing a moment for reflection during the payment experience and securely communicating information though your own device.

3. LEARNING DIGITAL PAYMENTS – Gradually building financial competence during childhood through a payment app specifically designed for children, to learn as they grow.

4. TANGIBLE VALUE FOR DIGITAL PUBLIC PAYMENTS – Strengthening the perceived value of public money through providing value for sympathetic merchants, and strengthening the digital euro identity as payments for the public.

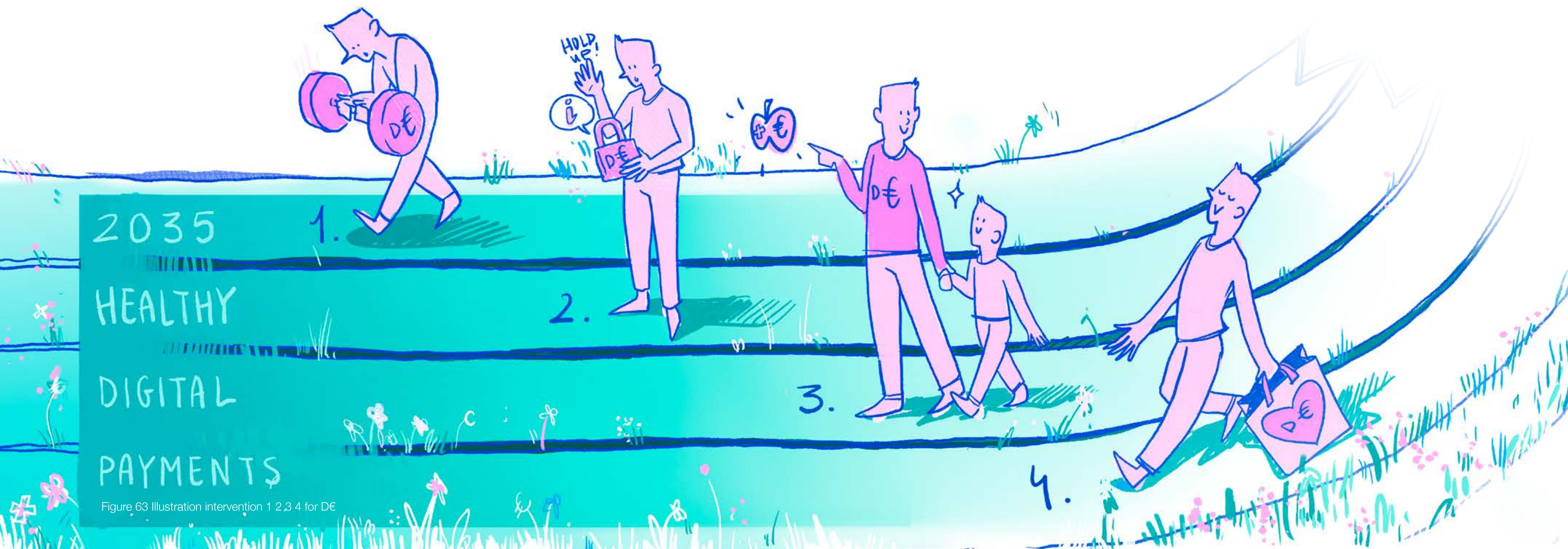


Figure 63 Illustration intervention 1 2,3 4 for D€

7.2 LIMITATIONS

EMPHASIS ON DESIGNER POSITION
A strength and a weakness is the Vision in Product (ViP) methodology inherent emphasis on the designer's perspective. While input from the Digital Euro team guided the direction, the conclusions drawn extend to payments on a much broader scale. Ideally, this balance could have been refined by involving a wider range of perspectives earlier in the process.

LIMITED USER TESTING & EVALUATION
This project did not actively involve regular users (people who pay) throughout the research or design phases. Instead, insights were gathered by attending events and engaging with stakeholders representatives and actors in the payment infrastructure. The final concepts—being highly futuristic and conceptual—were not tested with users. Future work should explore co-creation with end-users to validate and refine these ideas and to determine whether the desired effect can be achieved through these interventions.

CONCEPTUAL NATURE OF THE INTERVENTIONS
The interventions presented in this thesis serve as starting points rather than fully developed designs. While they illustrate a strategic direction, the next steps for implementation remain open-ended. Further development will require defining concrete steps for how these interventions can evolve into real-world applications.

SCOPING TO IN-STORE PAYMENTS
In the deconstruction of current payments it was decided to primarily focus on in-store payments. The designed interventions are also visualized and imaged in this context. Next to in-store payments, e-commerce and person to person payments are also interesting use cases to analyze and design for. It would be valuable to investigate how the designed interventions can be applied to this domain of payments as well.

7.3 FUTURE WORK

Given the vast scope of rethinking and redesigning the payment infrastructure—a system deeply embedded in daily life—many areas remain unexplored and offer valuable opportunities for further investigation

Following the roadmap outlined in this thesis, the most direct next steps include:

FURTHER DEVELOPMENT OF INTERVENTIONS 1–4 WITHIN THE CONTEXT OF THE DIGITAL EURO
These interventions serve as conceptual starting points, but refining them into actionable designs requires further research, prototyping, and user testing. Each of the chapters presenting the designed interventions outlines a series of recommendations for next steps in the design process.

RESEARCH INTO POLITICAL AND REGULATORY IMPLICATIONS
The digital euro represents a change in the payments landscape as the ECB tries to ensure to continued existence of central bank money in light of the diminishing use of cash. It would be valuable to investigate the broader consequences of DNB/ECB becoming active in the market of digital payments? Should the outcomes of this thesis, focusing on the interventions for the digital euro also be translated to law for private means of payment? Should private payment systems continue to exist if they do not serve the public interest? How does this intervention align with broader economic policies? Many questions remain unanswered when looking at the political implications of the vision for *responsible digital financial inclusion*.

EXAMINATION OF DNB'S MANDATE
Ensuring the availability of central bank money is within the mandate of DNB. Considering how the design visions reach not only the digital euro, but rather the total payments ecosystem, we need to re-examine DNB's mandate. Intervening on the private side of the payment infrastructure I may not traditionally fall within DNB's responsibilities. Should this mandate be expanded, or should certain responsibilities be transferred to other institutions in order to achieve the vision of *responsible digital financial inclusion*?

BROADER EXPLORATION OF VISIONS A, B, AND C
While this thesis focused on the digital euro, the challenges identified apply to the entire payment ecosystem. Investigating these visions in the context of digital payments in general could yield insights beyond the scope of DNB's role, requiring collaboration with banks, financial regulators, and consumer advocacy groups. Several decisions were made to narrow the scope of this thesis to fit within the available time. However, further research could provide a more comprehensive understanding of how payments should evolve in the future at a broader scale:

COMPARATIVE RESEARCH ACROSS THE EURO-ZONE
This study focused on the Netherlands, where digital payments are already highly developed. However, the relationship between society and payments is not uniform across Europe. Investigating whether similar challenges arise in other Euro-zone countries could provide valuable insights for designing inclusive payment solutions at a broader scale. This is especially relevant for the design of the digital euro, as it is intended as a pan-European product.

INVESTIGATING THE RELATIONSHIP WITH MONEY RATHER THAN PAYMENTS
This thesis concentrated on payments, but throughout the research process, it became evident that the broader relationship between society and money is also evolving. Payments are the means through which money flows, but they are not the same thing. Exploring how financial behaviors, perceptions of value, and economic participation are changing would be valuable. While DNB may not be the ideal partner for this research, institutions like NIBUD, which focuses on financial education and money management in the Netherlands, could be key stakeholders in this area.

7.4 PERSONAL REFLECTION

At the start of this project, my main goals were to get more comfortable with Vision in Product design (ViP) and explore how sketching could support each phase of the process. I chose payments and the digital euro as the topic of my graduation thesis because I believed its conceptual and abstract nature would be an interesting challenge in terms of visualization.

Now, looking back, three key learning points stand out:

1. THE ROLE OF VISUALIZATION IN VIP

Throughout this project, sketching and visualization played a key role, but its function changed depending on the phase:

DECONSTRUCT

Sketching user journeys and stakeholder maps helped me understand the complexities of payment systems. It also made it easier to validate my findings with DNB experts. The nature of these sketches was very rough. Drawing arrows between conceps and creating high volumes of illustrations to fuel discussion and exploration.

DISCOVER

I structured 14 context clusters based on the gathered context clusters. Using visual metaphors and sketches to define them more clearly. This helped me confidently communicate my findings during the midterm presentation. These clusters also represent new “meaning” generated by the combination of context factors. Leveraging metaphors in the visualisations helps communicate this value as it connects the cluster with a concept that already has meaning: something people recognise.

DEFINE

Synthesising thes clusters into a framework was one of the biggest challenges in this proejct. Writing out the 12 payment situations felt overwhelming and chaotic. Through illustrating each situation and connecting to visual metaphors, they started making sense individually and as a whole. The visualisations also inspired intersting conversations about my actual intended definitions and the way they were communicated.

DEVELOP

Visualizing here was especially helpful in defining the (un)desirable interactions. Given this projects future oriented approach, these situations don’t yet exist, so through visualising they became more tangible and comprehensible.
Furthermore, the developed interventions are left at an conceptual stage due to the time limitations in this project. Sketching brought these abstract concepts to life and illustrates how they provide value to payments.

DELIVERING

Here, sketching was more about presentation than exploration. Well-executed visuals made the final results more engaging and convincing. Reactions from DNB were enthusiastic about the manifestation of these ideas and the way they were presented.

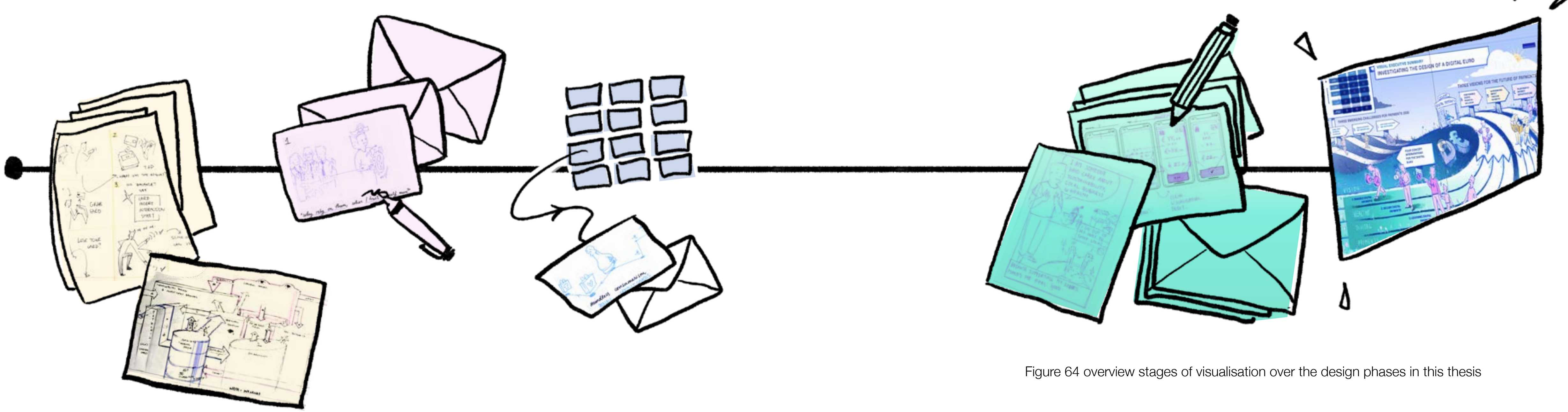
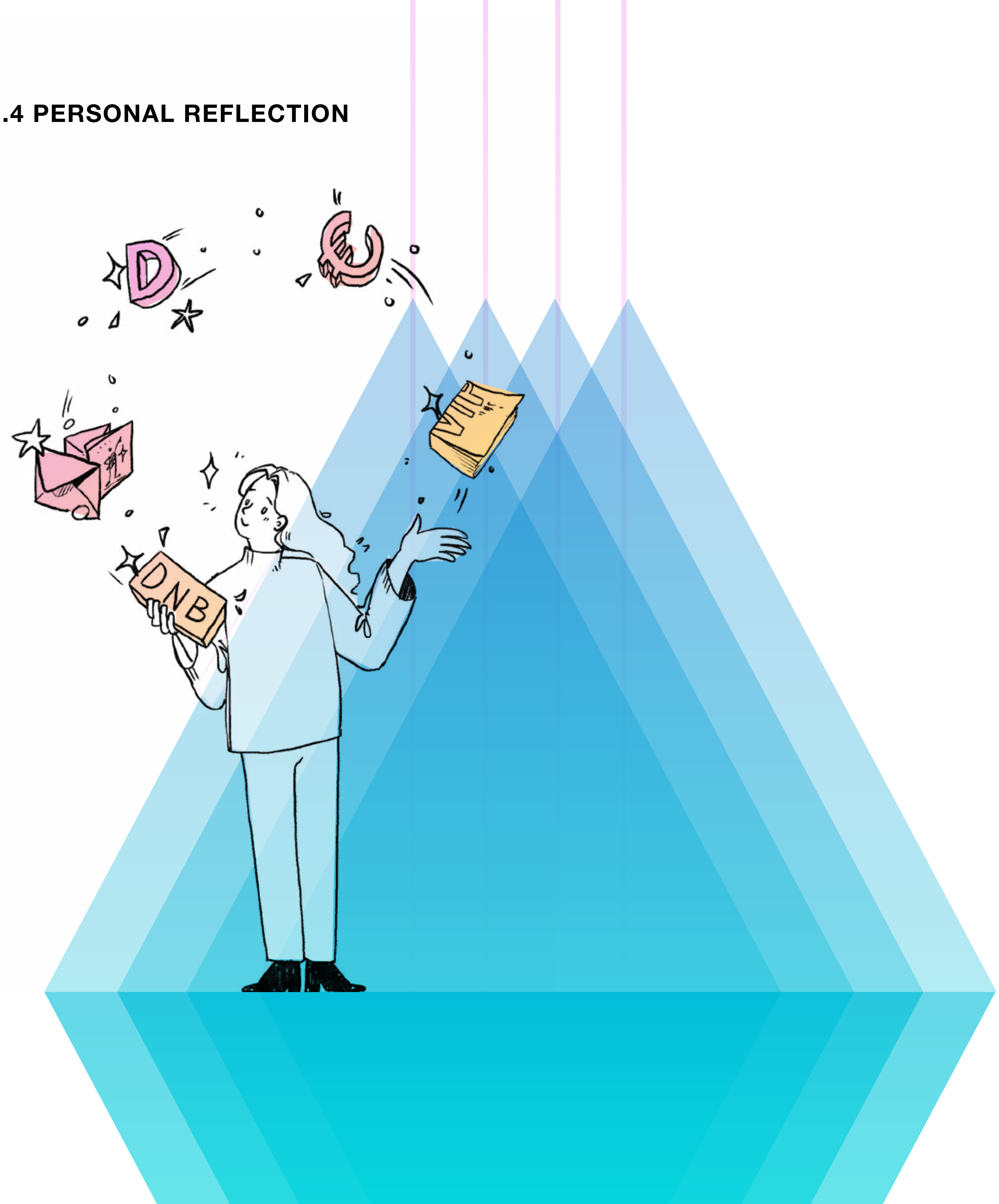


Figure 64 overview stages of visualisation over the design phases in this thesis

FINAL THOUGHTS ON VIP & VISUALIZATION

ViP forces you to rethink concepts from the ground up, and visualization was invaluable throughout this process. Text helped define things precisely, but sketches communicated meaning faster and more intuitively. Looking back, my visualizations act as shortcuts to memory, bringing me straight back to the thinking behind each decision.
This project reinforced my belief in visual thinking not just for ideation, but as a tool for structuring complexity, engaging stakeholders, and shaping impactful design directions.

7.4 PERSONAL REFLECTION



2. MAKING THE ABSTRACT TANGIBLE

Digital payments, and money itself, are highly abstract concepts. It fascinates me how we, as a society, collectively believe in the existence and continuous functioning of something so intangible as money, which is nowadays reduced to a digital balance, unbacked by any tangible product with intrinsic value.

Throughout this project, I actively tried to make things more tangible. Research and design often stay digital, hidden away in neat Miro boards, but turning it into something physical to hold, improved my feeling of control over the project. I printed and cut out my context factors into cards, and the moment I could hold my work, it started to feel real: tangible.

I kept this approach throughout: sorting findings into envelopes, moving notes around, and sketching everything on paper before digitizing. While this did create challenges when translating my work into a formal report, it helped me keep control over the complexity of this project during the process.

7.4 PERSONAL REFLECTION

3. DEVELOPING A STRONG OPINION ON PAYMENTS AND MONEY
I chose this topic for my graduation theiss because it aligned well with ViP and visualisation rather than a personal passion for finance. As the project progressed, I became heavily invested in the topic. Payments are everywhere, shaping daily life in ways I hadn't realized before. Through conversations at DNB and with anyone willing to listen to me, I started forming a strong opinion on how people handle money and how payment infrastructures (should) work.

At some point, my focus even shifted too much toward money itself, rather than payments. I had to consciously redirect my work back to the scope of payment infrastructure. I believe developing strong perspectives as I immerse myself in a topic ultimately strengthening my personal values and directing me to focus on more meaningful design.

My strong position did not go unnoticed at DNB. One of my supervisors remarked, "Ze heeft een beetje dominee in zich" ("She has a bit of a reverend inside her"). In an institution like DNB, where political neutrality is important, personal values are often kept at arm's length. But if you ask me, policy advisors at DNB should be given more space to preach—to advocate for decisions based on their own values, rather than staying purely neutral as most of them seem to only want the best for the people they work for.

Now that we've reached the conclusion, I am pleased to present my results. While my opinions and worldview as a designer have certainly influenced the development of the visions and interventions, I hope to have also provided a clear and comprehensive overview of the evolving relationship between society and payments.

Thank you for reading.

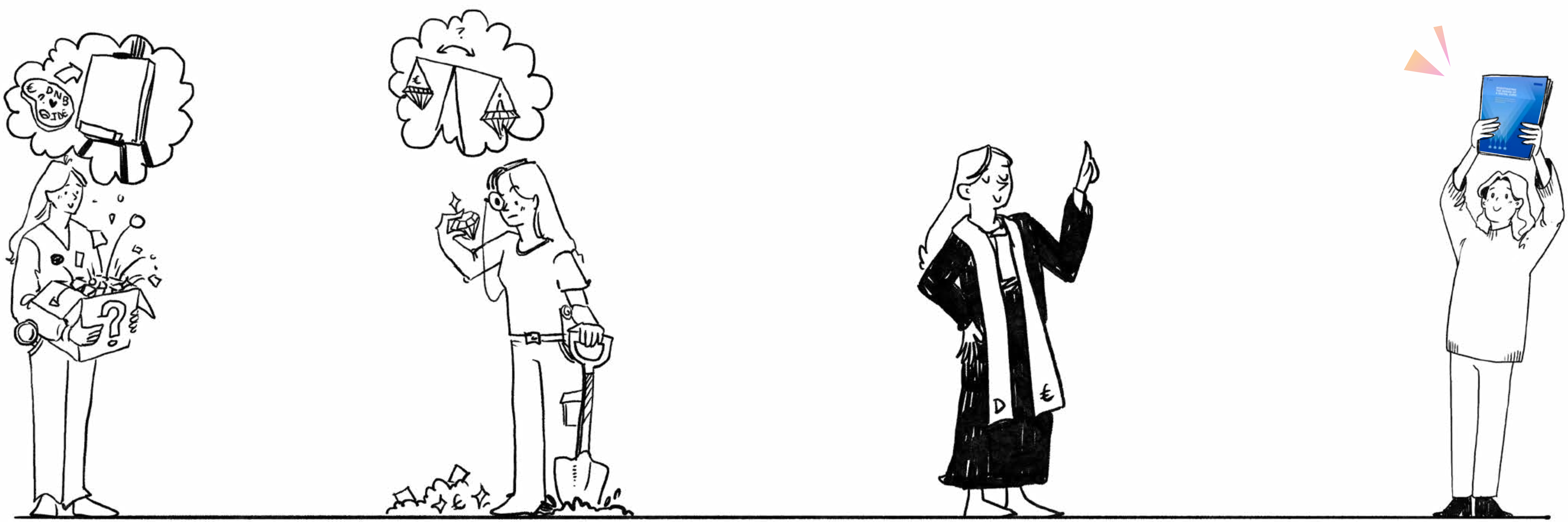


Figure 65 progression as my role as designer along the progression of this thesis.

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European Banking Union structures and dynamics

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Abstract: This article begins with an analysis of banking flows in the euro zone, through a complex network, from 2006 to 2020. This analysis allows us to observe the topology of the network through different phases of the business cycle. It is obtained that there is greater fragmentation in the network that increases in three stages, with turning points in crises. In turn, the topological structure is less random and presents more capitalized subnetworks with less risk. As for the nodes of the network, Germany gives up the position of centrality in favor of France. The determinants of the links in the network are analyzed with Machine Learning, obtaining as push and pull bank variables solvency and bank income structure, respectively, and productivity as economic variable.

Subjects: Economics; Finance; Business, Management and Accounting

Keywords: complex network; bank flows; bank integration; systemic risk

JEL Classification: G01; G15; G21; G28; C63; C6

1. Introduction

As a consequence of the 2008 financial crisis and the 2012-euro crisis, two crucial sets of measures were implemented that had an impact on the European banking landscape. Firstly, progress was made in the banking union within the eurozone, leading to the establishment of a resolution and supervision framework by the ECB for the most significant banking groups in the region. This initiative aimed to prevent the fragmentation of the banking market.

Secondly, at the regulatory level, Basel III was developed and subsequently transposed by the EU.[1] This regulation seeks to enhance the strength of European banking groups by improving the quality of regulatory capital. It also establishes leverage ratios, liquidity ratios, and financing ratios that provide financial institutions with greater resilience in the face of crisis events. All these measures have an influence on the behavior of financial institutions, requiring them to adapt to a new regulatory environment.

One of the novelties brought by Basel III was the implementation of macroprudential regulation measures. To this end, countercyclical capital requirements were established to mitigate procyclicality in the banking system, as well as capital surcharges for systemic risk. Therefore, regulatory authorities recognized the need to regulate the latent risk in the system, which may not manifest individually until crisis events occur.

There have been several studies on networks applied to the financial system. Some studies, such as Acemoglu et al. (2015), Amini et al. (2012) and Gai and Kapadia (2010), demonstrate how the financial system exhibits a robust but fragile property, specifying how connectivity influences stability. In particular, connectivity and the size of shocks interact to determine how a financial system can transition abruptly from a state of stability to a state of instability. Other studies focus on the degree of connectivity, specifically Battiston et al. (2012), which show how higher connectivity can lead to increased systemic risk whenever the initial robustness is heterogeneous and many banks are fragile, as an initial set of defaults can trigger a systemic failure.

Other studies, such as Caccioli et al. (2012) and Detering et al. (2019) have focused on exploring the impact on financial system stability based on the diversity of node characteristics. Lenzu and Tedeschi (2012) and Brunetti et al. (2019) have examined the clustering of nodes and the transmission of liquidity according to topological structures. This study employs complex network analysis to examine the European banking system from both a national and dynamic perspective. The research design raises questions about the relationship between banking fragmentation and banking stability in a novel manner.

The literature presents contrasting opinions regarding this relationship. For instance, according to Kose et al. (2009) and Jappelli and Pistaferri (2011), one of the presumed benefits of global financial market integration is its positive impact on stability, as risks are spread globally, and risk-sharing improves consumption smoothing. However, Stiglitz (2010) raises doubts about the benefits of financial integration due to contagion effects during financial crises, and Caballero (2015) discovers a significant impact of financial integration on banking crises. More recent works, such as Devereux and Yu (2020) and Inekwe and Valenzuela (2020), suggest that the impact of a crisis in integrated international financial markets is less severe compared to autarky, although such crises might occur more frequently. Given the European Union's significant reliance on banks for financing the economy, it becomes imperative to analyze how integration influences financial stability.

In the first part of the study, the focus is on banking networks, considering them highly useful for understanding the formation and concentration of risk in the banking system through the topological formation of the network, as well as its evolution over time. This perspective can constitute an advancement for regulatory and supervisory entities, marking the beginning of a new approach to banking regulation and supervision. This analysis allows observing the interaction of the network's topological structure with risk, liquidity, and the capitalization of subnetworks. Thus, one of the main contributions of the document is that its approach can constitute a new paradigm for regulatory and supervisory entities by expanding the mandate to detect topological structures that may be more unstable for the financial structure in different phases of the cycle, particularly concerning national banking systems in the Eurozone.

In the second part of the study, the determinants of banking flows in the European Banking Union, which are the links in banking networks, are analyzed. Understanding these flows is crucial for regulators and market participants as it enables effective control of financial stability. The determinants of banking flows also have implications for financial integration and market efficiency within the banking union. Utilizing machine learning techniques, we aim to identify the variables that determine the links within the network. This includes the characteristics of the pipes that transfer banking flows (i.e., the banks), as well as factors related to pressure and economic attractors. To achieve this, two datasets are established: one comprising bank variables and another containing economic variables of the nodes/countries. This allows us to identify the most influential push and pull variables for bank links/flows in both sets of variables. This approach provides insight into the determinants of bank flows, to the best of our knowledge. This is done by placing these flows in gross terms within a complex network, where there are various adaptive interactions within the network, and obtaining the determinants of these flows based on node characteristics using a machine learning methodology.

The research design aims to answer several questions regarding the banking system in the Eurozone, which constitute a novelty in the literature to the best of our knowledge. Among the highlighted questions to be addressed are:

I. How has the topological structure of the European Banking Union varied over the study period according to different measures, through different phases of the cycle?
II. How can complex networks be used to measure financial integration and analyze its evolution, identifying different phases?
III. What characteristics do the subnetworks (center/periphery) within the topological structure exhibit, and how do they interact with different banking variables such as risk and liquidity, among others?
IV. Which economic and banking push and pull variables are more determinant in the links of complex networks? With this question, we address the importance of the state of channels (banking intermediaries) in banking flows within networks, as well as the characteristics of the nodes in terms of their function as attractors and repellents of banking flows.

The research design begins with a complex network model for the Eurozone banking system, where national banking systems serve as nodes, and the links are formed through consolidated loans based on nationality within that network.

This enables us to observe the behavior of the network and its evolution throughout the study period, spanning from 2006 to 2020. We analyze the subgroups that form within the network during periods of increased fragmentation or the nodes/countries that occupy centrality measures. It will be observed that during the stage of negative interest rates, there is a greater fragmentation of the network, resulting in a decrease in links between nodes, as well as changes in centrality weights in absolute and relative terms among the nodes. These changes can have implications for the transmission of monetary policy, and it is valuable to analyze the topological structure of the network in terms of policy implications. Significantly, our study emphasizes the network-level approach to financial regulation and supervision, alongside an examination of the interplay between banking integration, capitalization, banking risks, and liquidity within the various topological structures of the European banking system.

Furthermore, an analysis of the state of the art is conducted. Section I presents the methodology of complex networks and performs the network analysis for the study period. In Section II, machine learning algorithms are used to identify the push and pull variables, and finally, the conclusions are drawn.

1.1. State of art

This paper links and adds new evidence from two distinguishable areas of research. The first area deals with complex networks applied to financial integration, with special attention to their topology that allows determining the degree of financial stability in a banking system.

According to the European Central Bank (2022), the more advanced the financial integration between the countries of the euro zone, the more one can speak of a single market for financial services. However, questions arise about how such integration occurs in relation to its financial stability. The first works on complex networks by Freixas et al. (2000) show that full (diversified) networks are more resistant to financial contagion than ring (credit chain) networks because in a more diversified system, an insolvent bank can transfer a smaller fraction of its losses to each of the banks. banks. banks. banks. your lenders. For their part, Allen and Gale (2000) also describe that a more interconnected architecture improves the strength of the system in the event of the insolvency of any individual bank, by being able to divide a bank's losses among more creditors. However, other views suggest that a denser network may favor systemic risk: for example, in the work of Bhattacharya et al. (2020), they consider various network-based financial integration measures and conclude that widely connected banks are at risk. They generate turbulence, given that their connections are very widespread, as well as that centrality reveals a significant reduction in the credit risk of the borrowing banks. Also, Georg (2013), when comparing different interbank network structures, shows that money center networks are more stable than random networks. In turn, they indicate that there is an upper limit to the volume of interbank loans for different network topologies. The limit itself depends on the topology of interbank markets and will be higher for more interconnected banking systems, for greater connectivity in the interbank market, the system can tolerate larger amounts of interbank liquidity without a substantial increase in financial fragility. In fact, for Georg (2013) networks with a large average path length are more resistant to financial difficulties and it is precisely during a crisis that the network topology matters.

Dasgupta (2004), Gai and Kapadia (2010), Ladley (2013), and Acemoglu et al. (2015) describe the robust but fragile property of networks. In normal times, connections between banks lead to a better allocation of liquidity and a greater distribution of risk among financial institutions. But in times of banking stress, greater interconnectivity can favor systemic risk. As a solution to this characteristic of networks, Battiston et al. (2012) show, through a model, that a financial network can be more resilient for intermediate levels of risk diversification, in the presence of a financial accelerator, for which advocate an intermediate interconnection, also Lenzu and Tedeschi (2012) found that, as the degree of connection to the network increases, the bank's systemic risk of the financial network will tend to increase first and then decrease, that is, a relationship convex functional. Abduraimova and Nahai-Williamson (2021) propose another possible solution for the robust but brittle feature of networks, who pay attention to the capitalization of nodes in networks, specifically for banks in the UK, and find that the largest capitalization of highly connected banks relative to their interbank exposures, significantly increase the resilience of the system and reduce the importance of network structure. In fact, Cont and Moussa (2010) find that, for a well-capitalized banking system, higher connectivity first leads to higher degree of contagion, but after a certain point, higher connectivity reduces dispersion by diversifying across links. However, in the case of an undercapitalized banking network, greater connectivity always implies more severe contagion.

Returning to network topology, Hazell and Elliott (2016) conclude that the socially optimal network is one in which institutions form groups, so that connections within groups are very strong, but links between groups are weak. This allows the risk of small shocks to be shared within clusters, but if there is a big impact on a bank, that causes defaults by other banks within its group, the weak links between the groups function as firewalls and prevent propagation to others groups. For these subnetworks, Huang and Chen (2021), highlight the importance of supervision of the banking system at the level of community subnetworks, reach this conclusion after analyzing the 2008 banking crisis in the United States. Therefore, they propose to assess the financial risk from the level of the community structure.

The second area of research deals with the study of the determinants of banking flows, which are those that connect the banking system in the networks that are analyzed. The banking networks analyzed are determined by the flows that are established between the countries/nodes, since these flows constitute the links between the nodes. According to the Committee on the Global Financial System (2021), financial flows depend on three factors. First, they depend on the characteristics that attract capital flows to recipient countries (PULL factors). Second, they depend on exogenous conditions that push capital flows out of the country (PUSH factors). Third, they depend on the channels through which capital is channeled, on the health of banking intermediaries. For example, for Forster et al. (2011) the countries that had high fiscal deficits, before the crisis, are the most affected, experiencing greater volatility of financial market variables or even a stronger reversal of financial flows.

Capital flows have generally been studied on a net basis, but a country's net position may not be a reliable indicator of its financial vulnerabilities. According to Tarashev et al. (2016), if gross inflows contract sharply, the economic consequences can be serious, even if the economy starts from a balanced net position or even a surplus. Analysis by Fabiani et al. (2021) suggests that sudden stops in flows in euro area countries tend to be more frequent and more severe than in other advanced economies, moreover, higher credit inflows may favor crises banks creating imbalances, as Caballero (2016) points out.

In general, capital inflows boost productivity and growth, according to Cingano and Hassan (2020), although these benefits may be financially offset by lower stability and poor resource projection, with declines in productivity, as shown in the articles by Gopinath et al. (2017) and Benigno et al. (2015). A greater participation of the banks of the euro zone in different jurisdictions can favor the depth and liquidity of the banking system, avoiding its fragmentation, for example, Lane (2013), advocates expanding stabilizing-type flows such as capital and debt flows of intermediaries through diversified intermediaries, that is, banks that are integrated into the entire banking union. However, according to other studies, evidence of a decrease in these bank flows is shown, for example, Emter et al. (2019) examine the drivers of the reduction in cross-border banking in the European Union since the global financial crisis and find that banks located in the euro area and in the rest of the EU reduced their cross-border banking by around 25%., especially within the EU due to deleveraging of cross-border interbank lending. He finds as factors responsible for this process the idiosyncratic disturbances in the countries of origin, that is, in the creditor countries. Indeed, McGuire and von Peter (2016) find that banks with higher household credit losses spread credit contractions across countries. Different studies such as those by Reinhardt and Sowerbutts (2015), Forbes et al. (2016) and Lambert and Ichiue (2016) explain the decline in cross-border bank lending due to stricter regulation.

This study presents a unique approach by integrating the analysis of complex networks in the Eurozone banking market with the examination of the factors influencing the connections within these networks. The research provides valuable insights into the dynamics of integration and fragmentation in the banking sector, as well as the associated risks. The study covers the period from 2006 to 2020, allowing for a comprehensive analysis of complex networks over time. By considering both banking-specific variables, such as push and pull factors, and economic conditions in the countries involved, the study sheds light on the determinants of banking flows. This holistic perspective contributes to a deeper understanding of the complex dynamics underlying financial networks.

2. Analysis

The theory of networks allows for the statistical characterization of topological structures based on their similarities or dissimilarities. In network-based banking models, the connectivity of the network has been linked to risk transmission and the characteristics of network nodes. As a common denominator, these theoretical models have established that the topology of the network and the characteristics of the nodes can interact in non-trivial ways to determine network stability.[2]

This study applies network theory empirically to the study of the banking system in the Eurozone from various perspectives. It aims to answer how the network of the European Banking Union has varied in its topology in relation to the characteristics of its nodes in different phases of the cycle. Additionally, the study seeks to determine which economic and banking push and pull variables are more influential in the links of complex networks, utilizing machine learning algorithms for this purpose. Another novelty in this analysis is to characterize the degree of banking fragmentation/integration in Europe from a new perspective.

The research is designed by considering the banking system of the union as a network in which the nodes are countries (banking markets), and the links represent financial flows between them. Using the fast gray algorithm and modularity method of complex networks, a measure is constructed to quantify the integration in the European Banking Union. The topological structures in the European Banking Union are also represented across different phases of the cycle, obtaining various statistical measures that characterize the connectivity of the complex networks. These measures allow defining the interaction between risk, capitalization (among other banking characteristics), and the network structure. Moreover, the analysis enables the characterization of subnetworks as center and periphery in global networks, identifying the variation of central and peripheral nodes in their interconnectivity and intraconnectivity in different phases of the cycle, in relation to different banking characteristics such as capitalization, liquidity, and banking risk, among others.

To achieve this, the analysis is divided into two sections. In Section 2.1, the complex network will be constructed and analyzed throughout the study period, focusing on its evolution. In Section 2.2, the influential push and pull variables for the output and input links of the complex networks formed in Section 2.1 will be identified.

2.1. Data and methodology of complex networks

The data to carry out the complex networks is obtained from the BIS database, for which the international bank loans of the most important countries in the euro zone are compiled in a consolidated manner, from 2006 to 2020, from a national perspective.[3] The countries correspond to the most important economically in the euro zone and for which data is available: Germany, France, Holland, Luxembourg, Belgium, Spain, Italy, Portugal, Austria, Greece, Ireland and Finland. With these data adjacency matrices are formed that allow us to perform the analysis of complex networks. The countries being the nodes of the networks and the loans in consolidated form the links of the networks. Presenting outgoing and incoming links according to node/country, respectively being consolidated loans granted and owed between nodes/countries.

Next, the applied methodology is developed, a network is defined as a set of nodes that represent the elements of study and links that represent the relationship between said nodes. In the object of study, the nodes are the main countries of the euro zone, and the relationships are the reciprocal bank financial flows.

Network structures facilitate the understanding of complex systems, through: I) the visualization of relationships between the elements of the system, II) the obtaining of subgroups within the network itself, and iii) the formation of mathematical and statistical models. Through the study of the topological structure, it is possible to clarify the importance of the countries in the banking network of the euro zone and their temporal evolution throughout the different stages of the economic and financial cycle. Another of the applications of the banking network of the euro zone, manifests itself by revealing the importance of the countries in said network, and through measures of centrality, the systemic risk can be evaluated with gains in macroprudential policies.

In a complex network can be defined through graphs, a graph is composed of nodes and edges. The nodes are represented by $V_{k,}$ which includes the countries of the 12 most important countries in the euro zone. $A_{(i,j)}$ represents the number of edges that start from node i and arrive at node j and represent bank flows between countries. Depending on the nodes and edges, a series of statistical measures are defined:

- *Degree of centrality*: This measure is obtained through the links related to each node, both incoming and outgoing from each node. Those countries that connect to larger subnets will be highlighted in the topological representation of the network.
- *Betweenness*: This measure reflects the number of times that a node acts as a bridge in a geodesic path, that is, the shortest length between two nodes. A larger value of this measure for a node reflects that the node observes or can control a larger amount of information.

$$Betweenness = \sum_{i<j}\frac{g_{ij}(c_k)}{g_{ij}}$$

Being g_{ij} the geodesic paths between node i and j.

Being $g_{ij}(c_k)$ the number of geodesic paths between node i and j that contain node k.

- Authority: this measure represents the relative importance of each node and is defined as the respective element of the principal eigenvector of the matrix
- A^T A, where A is the adjacency matrix, that is, a square matrix that collects the links between the nodes. If a node has large number of nodes pointing to it, it has a high authority value, and this quantifies its role as a source of information.

With complex networks, subnetworks or groups of nodes that have a greater relationship between them can be studied. For this, a general measure can be specified with the cohesion of the community or subnetwork and its separation from the rest of the subnetworks. Mancoridis et al. (1998) defined intraconnectivity for network cohesion, which is defined by link density within a community, and inter-connectivity measures community separation, which measures link density between two communities.

Being m_{ii} intra-community links, you can form $q_{ii} = \frac{m_{ii}}{m}, q_{ij} = \frac{m_{ij}}{m}$, y $q_{i+} = \sum_j q_{ij}$ which represents the estimated corresponding proportion for a comparable random network, is defined modularity= $\sum_j (q_{ii} - q_{i+}^2)$

For a community structure to be meaningful, the network is required to have a much higher proportion of internal links.

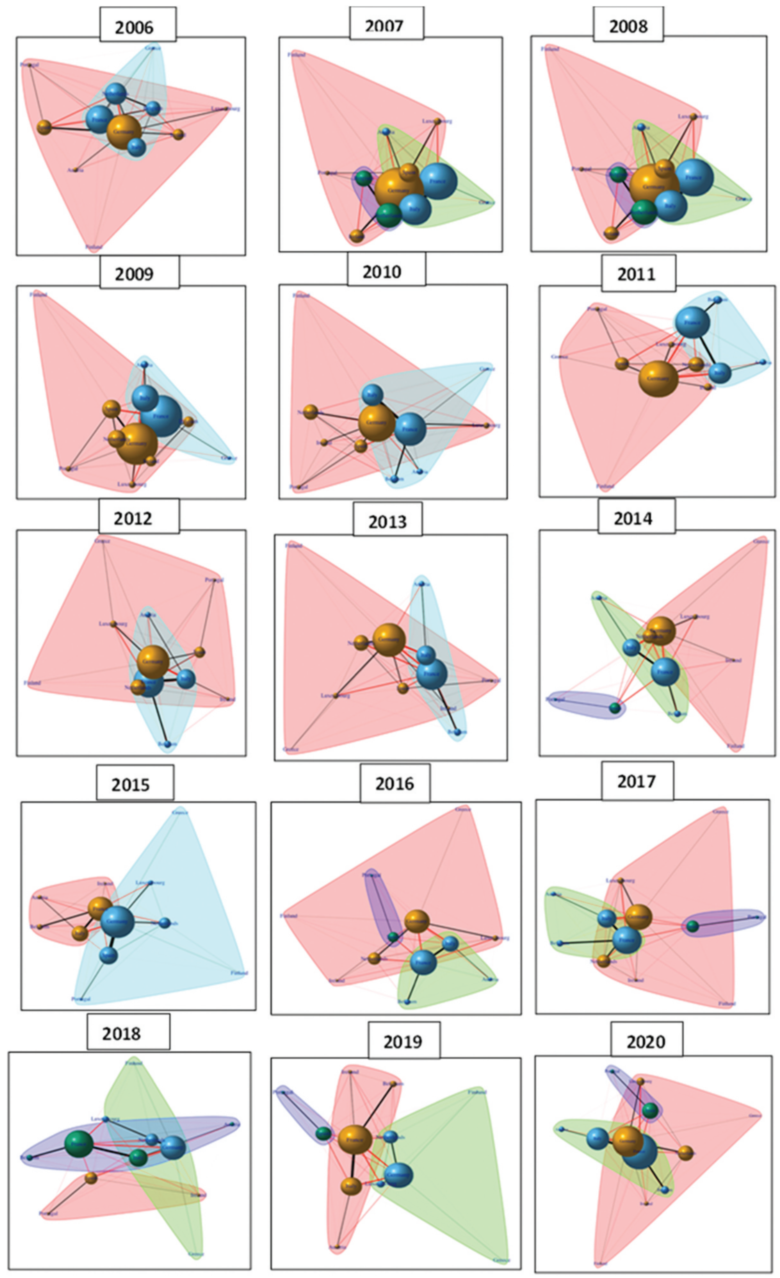
2.2. Analysis complex networks

Figure 1 shows the topological structures of the networks from 2006 to 2020, this allows us to observe the dynamic behavior of the network at different times of the economic cycle. The networks are composed of the links that represent the loans in consolidated form of the international banks, with the black lines being the subnetwork links between their member nodes and the red lines being the links between the nodes that belong to different subnetworks. The size of the spheres representing the nodes/countries represents the sum of the outgoing and incoming links per node. The groups that are formed according to the colors represent the subnets that are formed according to the cluster fast gray algorithm and modularity.

Analyzing the networks dynamically, in 2006 two groups were formed, the first encompasses France as the country with the greatest weight of links (understood as outgoing and incoming links), and which includes the Netherlands, Italy, Greece and Belgium, and the second group with the country with greater weight of links with Germany and that includes Portugal, Spain, Luxembourg, Spain, Ireland, Finland and Austria. In 2007 Belgium and Holland left the French group forming their own group, having three groups and maintaining this structure in 2008, until 2009, the year of the international financial crisis. In 2009 the groups formed are: a group formed by Austria, Italy, France and Greece and a second group by the rest of the countries with Germany as the country with the greatest weight. These two groups will remain in 2010, 2011, 2012 and 2013. With some variations such as the node/Greece, in 2011, 2012 and 2013 it leaves the French group and becomes part of the German group. Likewise, Belgium in 2010 and 2011, 2012 and 2013, moved from the Germany group to that of France. In 2014 a third group emerged, formed by Portugal and Spain, which remained in 2016, 2017, 2018 (this year Ireland joined) and 2020.

From 2014 to 2020, the two large groups formed with the two most important nodes within each of them, on the one hand, France, and on the other, Germany, continue to be maintained. In the French group, Italy, Belgium and Austria are present every year. In the group of Germany, Holland and Luxembourg are present in all years. As of 2015, it is observed that Germany ceases to be the largest node within the total network, equaling France and seeing itself surpassed, in the rest of the years until 2020. From the dynamic structure of the subnetworks, it can be seen it can be inferred that the links have been reduced from 2010 to 2017, recovering timidly from 2018 (see Figure 1).

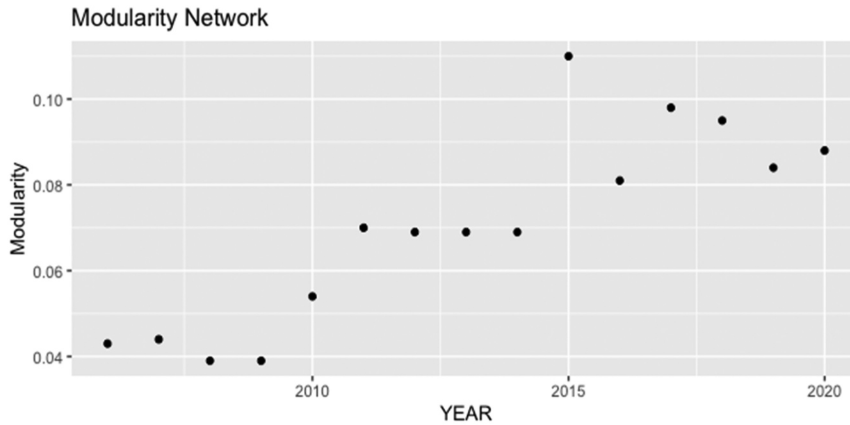
Figure 1. Networks from 2006 to 2020.[4]



The degree of modularity increases throughout the study period depending on the three periods (see Figure 2), which indicates greater fragmentation.

Figure 2 shows how modularity goes through three stages. The first from 2006 to 2009 is that it is low, so there are fewer subnets within the main network. In this first section, the modularity values are low, indicating that the network resembles a random network, in which the communities or subnetworks have a lower relationship with each other and a greater relationship with neighboring subnetworks. The second stage from 2010 to 2014, in which the value of modularity increases and therefore the intensity of the subnetworks, increases modularity meaning greater network fragmentation, reducing the relationship between networks and increasing intraconnectivity. Finally, the stage from 2015 to 2020 in which the intensity is accentuated to a greater degree. From these results it can be inferred how international banking integration in the eurozone has increased its fragmentation in the

Figure 2. Modularity.



study period. It should be noted that the highest value occurred in 2015, which can be attributed to the great economic and political instability in Greece. This instability would be transmitted through the links, affecting the network, increasing its fragmentation.

Figure 3 represents the DT, which is defined as the sum of outgoing and incoming links at the nodes. Figure 3 shows that the countries with the highest value are Germany and France, approaching two billion. Being the two most important nodes of the network. The DI, which is defined as the input links of the nodes, Germany remains the most important country. But the countries of southern Europe, specifically Italy and Spain, occupy a central place, with Italy ahead of France (see Figure 4). As for the node that has the most outputs measured by the DO (see Figure 5), France is ahead of Germany, being the great promoter of output links. By years in Figures 4, 5 and 6, it is observed how the highest average value was produced in the years prior to the financial crisis of 2008, which was reduced from then until 2015 to begin a small rebound as of 2016. It is also observed as the data before the 2008 crisis, the distribution is symmetric to gradually become a positive symmetric distribution per year, that is, there are more and more values separated from the mean to the right or higher values in our Figure 5 Regarding the variability of the three Figures 4, 5 and 6 by years, the values show greater variability before the 2008 crisis, reducing in 2009. For DI, a cycle is observed in terms of its mean values with the peak in the years before the crisis. Crisis and its minimum values in 2015, to experience a small recovery from 2016. Regarding the distribution of the data by years in the DI figure, the distribution is presented as negative symmetric in the years of euro crisis from 2011 to 2015, for the last years from 2016 to 2020, a symmetry is observed in the data. For the DO distribution, except in the years before the 2008 financial crisis, in later years the distributions are positively symmetric.

For the Betweenness measure, the two nodes that contain the greatest amount of information are France and Germany, followed by the Netherlands (See Figure 6). It is observed how in times of crisis such as 2014 or 2015, Germany and France are the nodes that act with greater intensity in

Figure 3. Degree total.

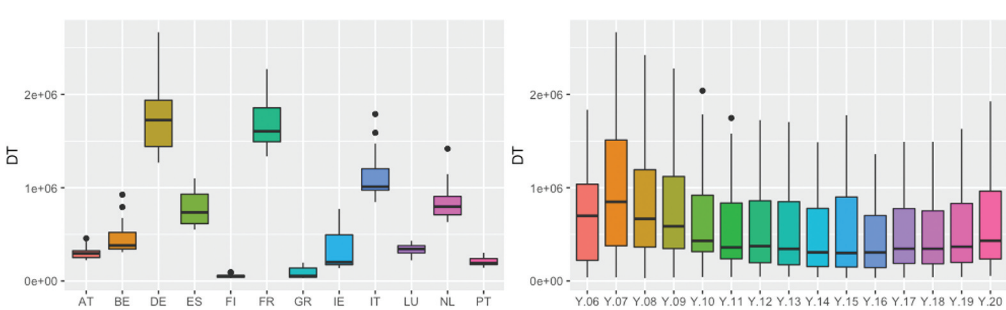


Figure 4. Degree in.

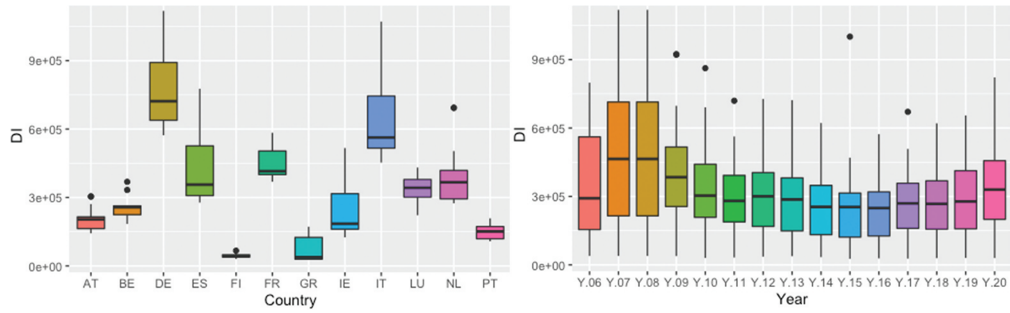


Figure 5. Degree out.

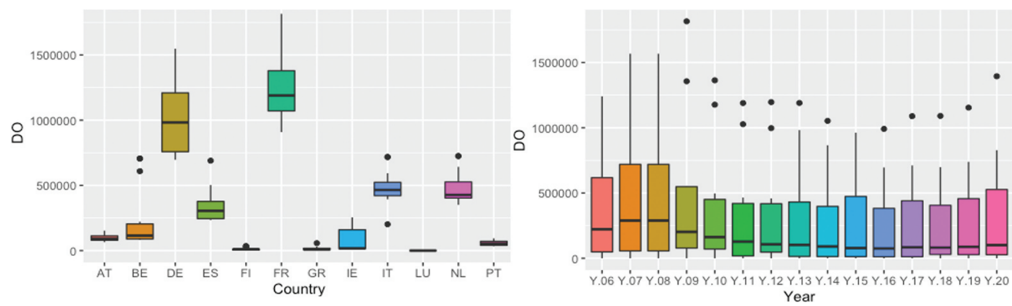


Figure 6. Betweenness.

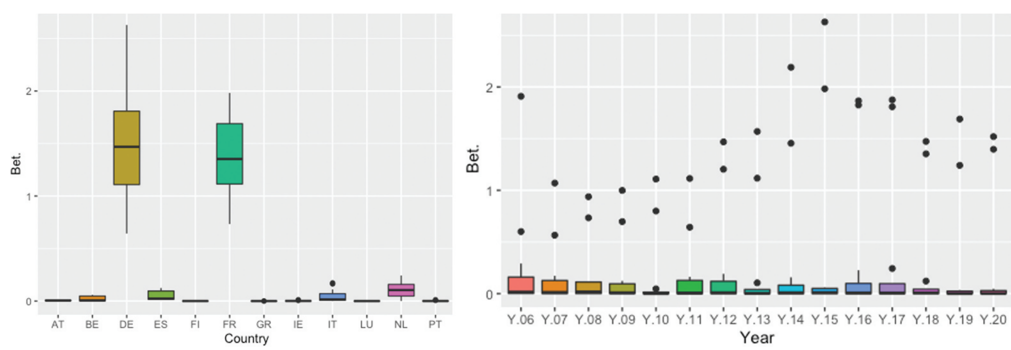
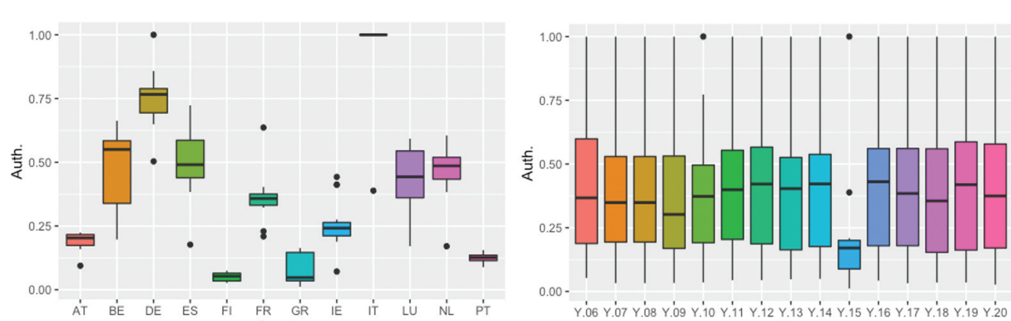


Figure 7. Authority.



a geodesic route, while the rest of the countries take lower values, presenting less deviation, as can be seen in Figure 6. Regarding the authority (see Figure 7), it is observed that Italy is a great source of information, therefore, this country is revealed as an important graph for the network, not identified with the previous measures. In 2015, in the figure by years (Figure 7), there was a sharp drop in the average, possibly caused by the Greek crisis.

Next, it will be studied to what extent the increase in modularity is related to the financial characteristics of the banking systems that represent each of the nodes/countries of the network, as well as to the economic variables of each node/country. Also, in the analysis, the measurements of the network obtained previously will be introduced to observe how it is related to the modularity of the network.

Table 1 represents the variables to be studied, specifically the analysis will be carried out from the year 2008, due to the availability of the data. These variables are obtained from the European Central Bank.

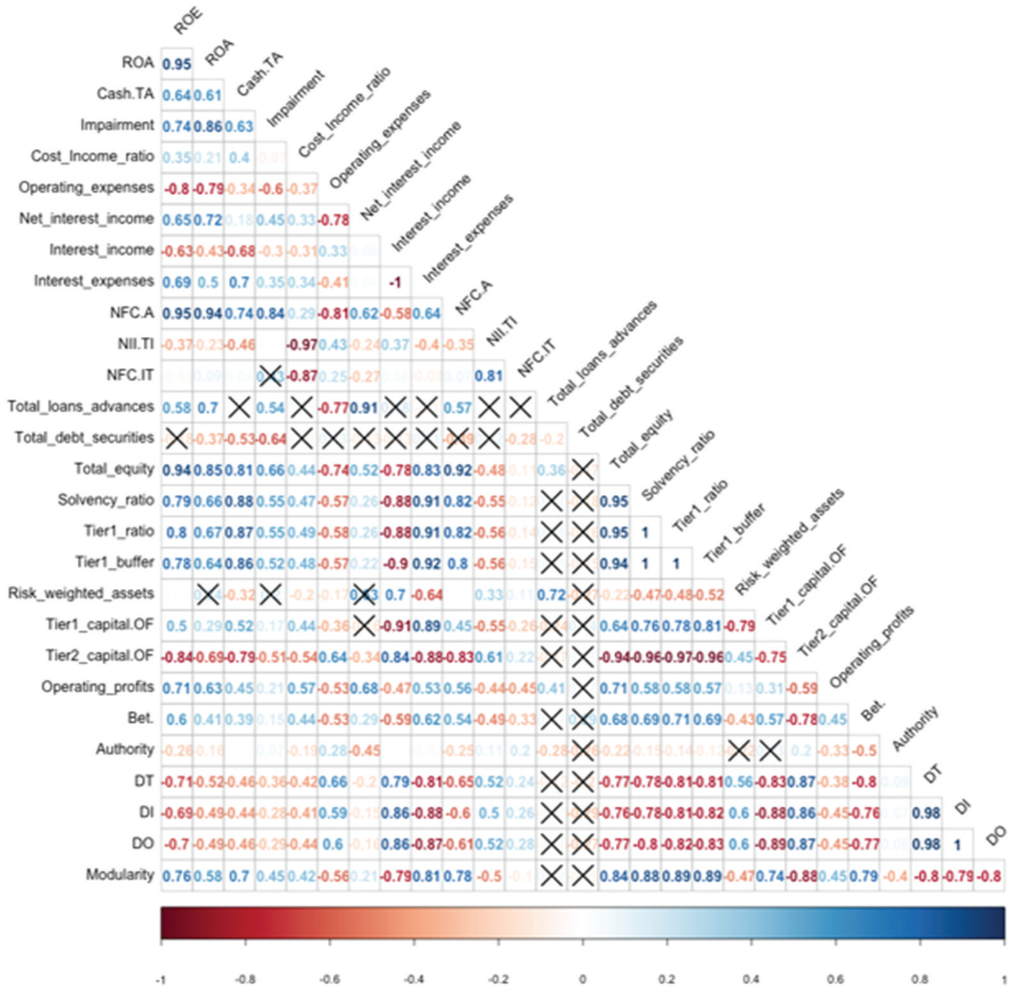
Each of the variables is averaged per year and the correlations are made (see Figure 8) in which the significant values at 95% are collected, the non-significant ones appear with a cross. Also, for those more important banking relations, an analysis will be carried out that represents other statistical measures.

The last row of Figure 8 shows the correlations between modularity and network variables. It can be seen how there is a very strong correlation between the solvency variables (total own funds, solvency ratio, tier 1 ratio, tier 1 buffer) and the modularity and negative values with the Tier 2_capital. OF solvency ratio. The DT, DO, DI link measurements also have a very high negative correlation with network modularity. Therefore, the decline in network links coincides with increased solvency of network banking systems and correlates with increased fragmentation into subnetworks. This may confirm the theory that a network with higher intraconnectivity and

Table 1. Bank variables

Bank variables	Codes
Return on assets	ROA
Return on equity	ROE
Cash and cash balances with central banks [% of total assets]	Cash.TA
Cost-to-income ratio [%]	Cost_Income_Ratio
Net interest income [% of total assets]	Net_interest_Income
Interest expenses [% of total assets]	Interest _expenses
Net fee and commission income [% of total assets]	NFC.A
Net interest income [% of total income]	NII.TI
Net fee and commission income [% of total income]	NFC.IT
Total loans and advances [% of total assets]	Total_loans_advances
Total debt securities [% of total assets]	Total_debt_securities
Total equity [% of total assets]	Total_equity
Solvency ratio [%]	Solvency_ratio
Tier 1 ratio [%]	Tier1_ratio
Tier 1 buffer [%]	Tier1_buffer
Risk-weighted assets [% of total assets]	Risk_weighted_assets
Tier 1 capital [% of own funds]	Tier1_capital. OF
Tier 1 capital [% of own funds]	Tier2_capital. OF
Total operating expenses [% of total assets]	Operating_profits

Figure 8. Correlations.



lower interconnectivity may be less risky, as it can benefit from diversification within the subnetwork and reduce exposures to other subnetworks in case of systemic risk episodes.

Regarding the average measure of betweenness of the network, it is observed that it correlates positively with modularity. This is because as the modularity increases and the intra-connectivity of the subnets is greater, the betweenness measurement increases (see Figure 6), this indicates that the central value of each subnet becomes more important as the interconnectivity is reduced, that is, the relationships between networks.

Regarding interest income and expenses, it can be seen how they are negatively correlated (the interest expense ratio is represented in negative values, therefore the correlation is positive, although it expresses a negative relationship). This would indicate a reduction in the financing and investment rates on average in the network, in turn there is an increase in the NFC.A ratio (non-financial commission on assets) on average in the network throughout the period positively related to the modularity. This last positive correlation, in addition to the increase in bank commissions due to the reduction in interest income, may be due to the reduction in competition, due to less interconnectivity and the reduction in incoming links.

Figure 9. Regulatory ratios.

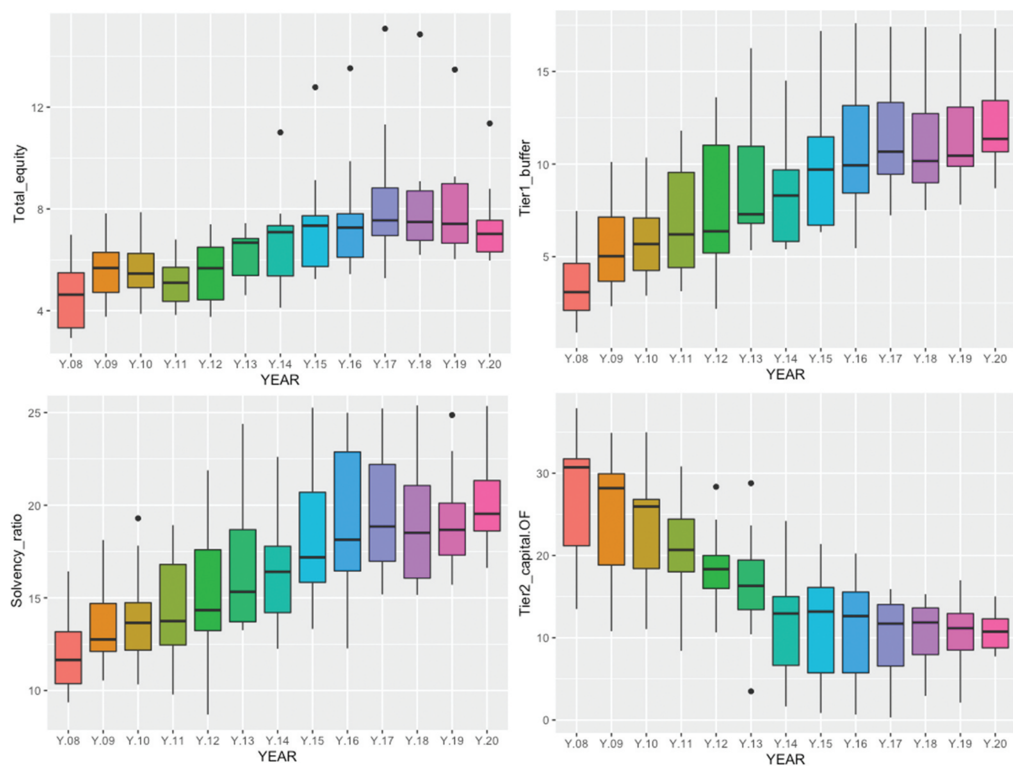


Figure 10. Cash over total assets.

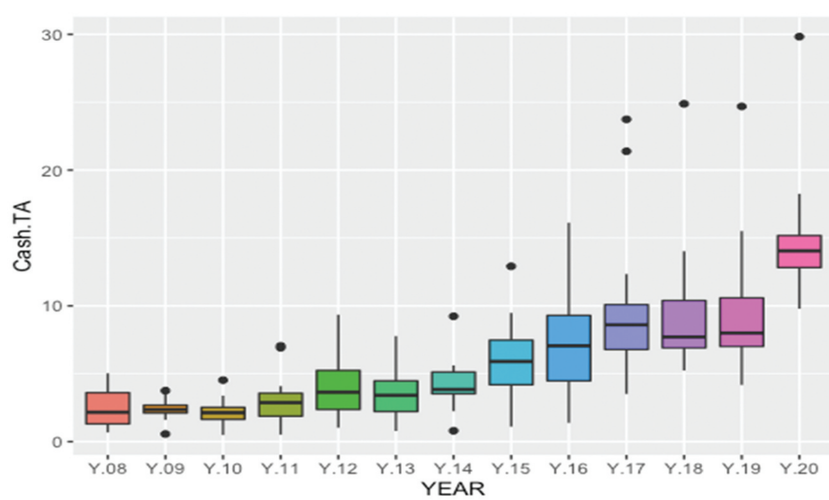
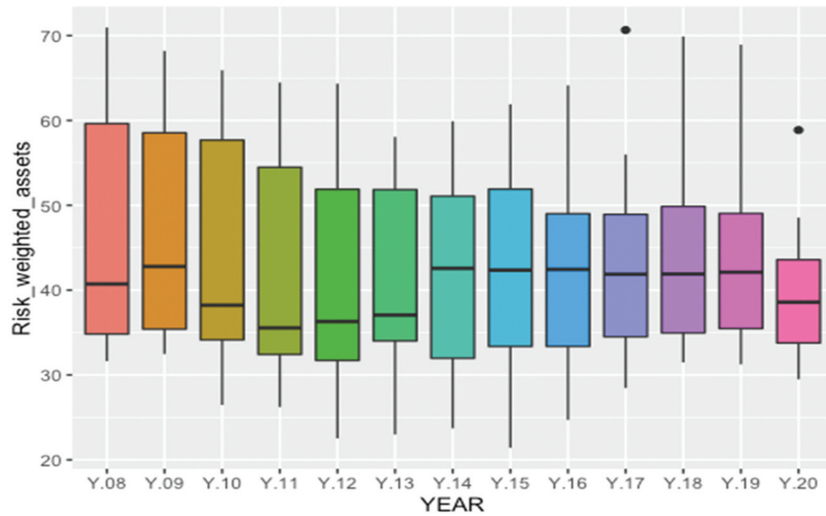


Figure 9 shows how the total equity ratio increases throughout the study period, with relevance to the higher quality Tier 1 reserve capital, as well as the solvency ratio, and the lower quality Tier 2 on equity, decreases throughout the period.

Regarding liquidity over total assets, it is observed that in the study period it has a positive trajectory, therefore, the banking nodes/systems of the countries, in the communities increase their liquidity positions, fewer investments are made (see Figure 10). Risk-weighted assets, although they show a negative correlation in Figure 8, where their change is most appreciated

Figure 11. Risk weighted assets per year.



together with the increase in modularity is the narrowing of their interquartile range. Also, in the decrease of the dispersion of the values above the median. In fact, in recent years the dispersion between the first quartile and the median, and between the median and the third quartile, has become equal. Therefore, there is a reduction in risk in the network, since the third quartile greatly reduces its variability, especially as of 2014, as can be seen in Figure 11. Correlation Figure 8 shows how risk-weighted assets are positively correlated with DI and DO, that is, outgoing and incoming links.

By country, it should be noted that the two nodes with the highest Betweenness, Germany and France, are among the nodes with the lowest risk-weighted asset values (see Chart 12). As for the risk in its risk-weighted assets by country (see Chart 12), it stands out that Austria, Spain, Greece, Ireland and Portugal are all above 40% practically during the entire study period. While the countries with the lowest risk, Belgium, Germany, Finland, France, Luxembourg and the Netherlands, are below 40% during the entire study period. Therefore, it can be said that together with the lower modularity, the opportunities for investment diversification were reduced by

Table 2. Economic variables

Economic variables	Codes
Productivity per hours worked	Productivity
Population change - crude rates of total change, natural change and net migration plus adjustment	Grow_pop.
Gross domestic product at market prices converted using purchasing power parities; ratio to total population.	GDP
Balance (Credits minus Debits)- Current account-Euro; ratio to gross domestic product.	Balance_payments
Government debt (consolidated) (as % of GDP)	Debt
Unemployment	Umployment
Inflation	Inflation
Residential property, All dwelling types, new and existing. Transaction value - actual or estimated based on other types of values, e.g., appraisals, Deflated by the private consumption deflator. Unit, 2015=100.	Property prices

concentrating more on the communities themselves. Overall, risk taking, as measured by risk-weighted assets in the network during the study period, has decreased.

2.3. Data and machine learning methodology

In this section, an analysis of the determinant variables of the outgoing and incoming links in the nodes is carried out. This analysis seeks to identify the push and pull variables of international banking flows in the euro zone. For this, the output and input links of the analyzed networks are used. Due to the disposition of the data, the analysis is carried out from 2008 to 2020, with the same countries as in the previous analysis. The push and pull variables will be determined by machine learning algorithms, specifically regression trees and random forest. Due to the complexity of this last algorithm, mathematical statistical techniques are used that will allow us to interpret its results.

The push and pull variables will be studied from two categories, a first category that encompasses the analysis of the variables that catalog the banking systems of each of the countries, that is, the flow conduits, and a second category that encompasses the economic variables of the countries.

This will produce four sets of variables: i) push bank variables, ii) push economic variables, iii) pull bank variables and pull economic variables.

To do this, the same banking variables (Table 1) from the previous section and economic variables (Table 2) presented below are taken as dependent variables. As independent variables, the outgoing and incoming links of each country/node of the network from the previous section are taken, weighted by the total banking assets of each node. Due to the availability of data on the banking and economic variables of each node/country, the study is carried out from 2008 to 2020.

To carry out the analysis, regression trees and random forest are used. A regression tree is used ,[5] which is a machine learning method to build prediction models from data. As advantages, they present an easy interpretation and their robustness to extreme values. It also enables capturing linear and non-linear relationships and there may be a link between variables. As problems, this methodology presents a remarkably high variance, that is, a small change in the data can cause different partitions of the data. This will be corrected using different Machine Learning ensemble methods such as the random forest model (the advantages of random forest in addressing the variance issue are presented in Annex 1). The regression tree follows the following model:

Let Y be a response variable and let p be predictor variables x1, x2, …, xp, where the xs are taken fixed and Y is a random variable. The statistical problem is to establish a relationship between Y and the X's in such a way that it is possible to predict Y based on the values of the X's. To do this, we want to estimate the function of its probability such as:

$$E\left[Y|x_1,x_2,..,x_p\right]$$

It seeks to obtain a minimum variance within each node τ of the tree,

$$i(\tau) = \sum_{i\in\tau}\left(Y_i - Y_{(\tau)}\right)^2$$

Where Y (τ) is the average of Ý s within the node τ.

To divide a node τ into two child nodes, τ_L (left node) and τ_R (right node), the goodness of a division s is defined as:

$$\Delta I(\tau) = i(\tau) - i(\tau_L) - i(\tau_R)$$

With this last equation, the impurity reduction is obtained when the parent node is passed to the child node, the impurity reduction is sought to be maximum.

The objective is to obtain the maximum homogeneity of those of the terminal nodes.

It is sought that R (τ) be minimized as:

$$R(\tau) = \sum_{\tau\in\zeta} i(\tau)$$

Where ζ represents the set of terminal nodes.

A random forest is an algorithm that has the following advantages: in prediction trees like all statistical models, the balance between bias and variance must be taken into account. By the concept of bias, it is understood how far the predictions from the real values are on average. Variance is understood as the variation of the model, depending on the sample used in the training phase. More complex models tend to reduce bias, increasing the predictability of the model. On the other hand, an overfit can occur, that is, the model adjusts so much to the training data that it does not correctly predict new data. Therefore, a model with a balance between bias and overfit is pursued.

In predictive tree models with many nodes, they tend to fit the training sample very well, but at the cost of greater variance. With the assembly method used in this work, a balance between bias and variance is pursued. In the method of Random Forest,[6] repeated sampling is carried out. A model is fitted with the different samples of the population, and the result is averaged, reducing the variance. For this, bootstrapping is used, generating different samples through resampling). With each of these samples a tree is made, which is not pruned, having a reduced bias but a greater variance. The algorithm's stop system is the minimum number of observations that the final nodes must have. It is a modification of the bagging model by mitigating the correlation between the trees; this is achieved by selecting the predictors at random. It prevents a very influential predictor from dominating the construction of the trees and allows other predictors to be evaluated in the construction of the trees.

The MSE estimates the prediction error of the model considering these observations that have been "left out of the training sample". This error is calculated as follows: $\frac{1}{n}\Sigma_{i=1}^{n}(\mathrm{yi} - \mathrm{yiOOB})^2$

Being yi_{OOB} the prediction for observation is obtained by averaging the individual predictions of the trees for which that observation has been left out of the training sample and real the actual value of the response variable.

To calculate the importance of the predictors, the increase in the MSE and the increase in the purity of the nodes are used. The increase in the MSE identifies the influence of each predictor on the MSE of the model estimated by the out of bag error.

$$\mathrm{MSE\ OOB}(\mathrm{Xj\ permuted}) = \frac{1}{n}\Sigma_{i=1}^{n}(\mathrm{yi} - \mathrm{yiOOB})(\mathrm{Xj\ permuted})^2$$

After this, for each variable *X* in each tree t, the difference between the two measures MSE OOB (X permuted) and MSE OOB is calculated. This difference, for each variable, is summed in all the trees, averaged and normalized between the standard deviation of the differences. The result of this process is a measure of the importance of each variable. If the predictor that is not included provides information about the model, the MSE will increase.

Figure 12. Risk weighted assets per country.

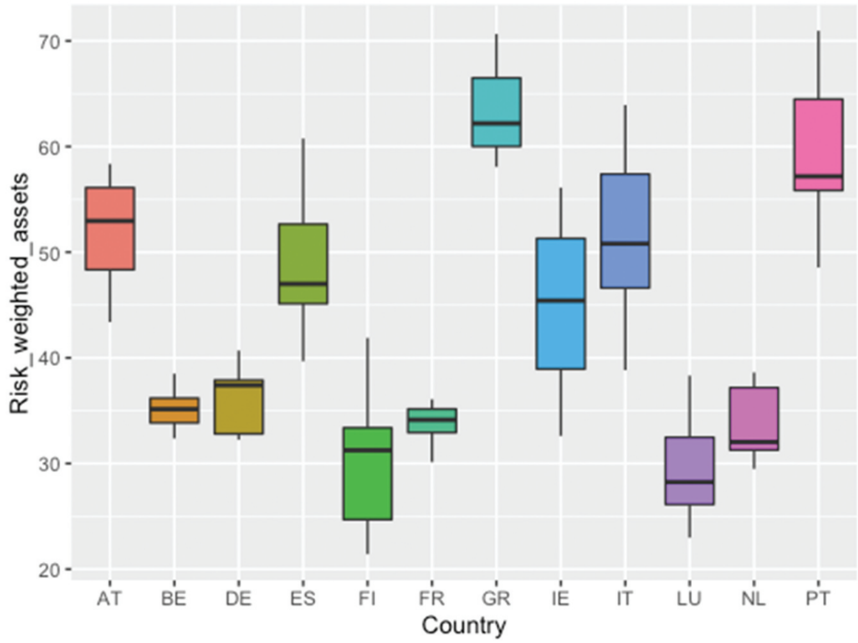
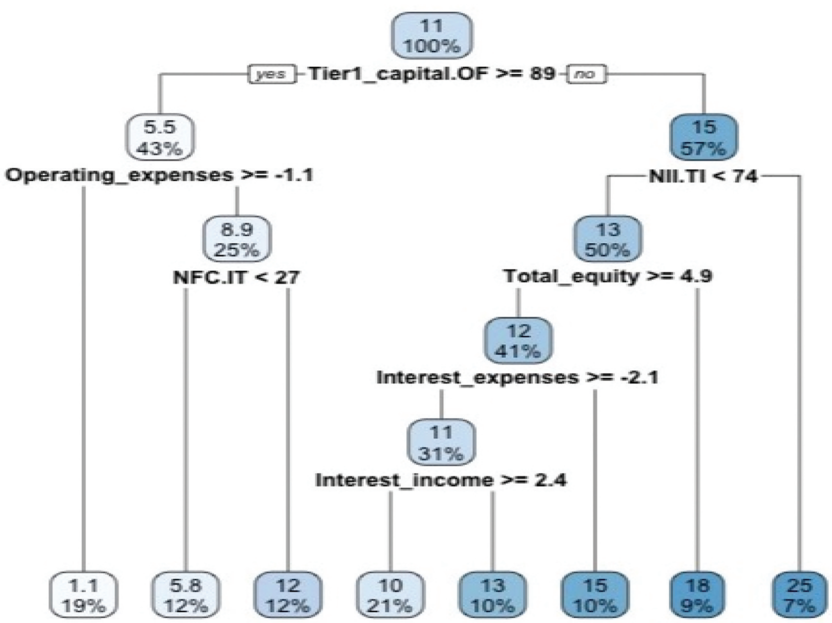


Figure 13. Regression tree (bank push variables).



The increase in the purity of the nodes is calculated by the decrease in the MSE, which is calculated as the average decreases. Therefore, the higher the value, the greater the contribution of the predictor to the model.

Next, the regression trees are developed and subsequently the random forest to determine the banking and economic variables in the outflows of funds (granting credits abroad) and the inflows of funds (granting credits to the interior). Also, in the random forest, different methods are used in the interpretation of the results of the variables. Also, in the random forest, different methods are used in the interpretation of the results of the variables. Specifically, the functions of partial derivatives and alluvial graphs.

2.4. Analysis of bank push variables

Figure 12 shows the regression tree on the dependent variable outputs, that is, the loans granted from each node/country to the rest of the nodes/countries.

The regression tree shows that the most important variable is TIER1 capital over equity, which is the most determining variable. When this ratio is not greater than or equal to 89%, the outputs represent an average of 15%. While when it is greater than 89%, the outputs represent an average of 5.5%. It can be inferred that for very high values of this ratio, banking systems make fewer loans to other countries. Therefore, when own funds approach higher quality capital, the activity of granting loans to other entities, in other European jurisdictions, is less. This may be due to stricter regulatory criteria regarding the quality of capital. In the second division of the tree, when the interest margin on total income is greater than 74%, the largest outflows occur, with a value of 25%.

On the other hand, for smaller amounts of expenses, we have operating expenses over total assets. In the first level branch, own funds greater than 89% and operating expenses greater than −1.1, that is, with lower operating expenses over total assets, there are fewer outflows of funds, this fact may be due to less activity.

In the final sections, when the equity coefficient is greater than or equal to 4.9 (see Figure 13), the outputs are lower (values 13) than when they are less than 4.9 (values 19). Indicating that leverage plays in favor of exits.

The RMSE or root mean square error, as it is not linear, gives greater weight to larger errors and is interpreted as:

$$\sqrt[2]{\frac{1}{n}\sum_{j=1}^{n}\left(y_j - \hat{y}_j\right)^2}$$

The MAE or mean absolute error is linear and all errors are weighted equally and interpreted as:

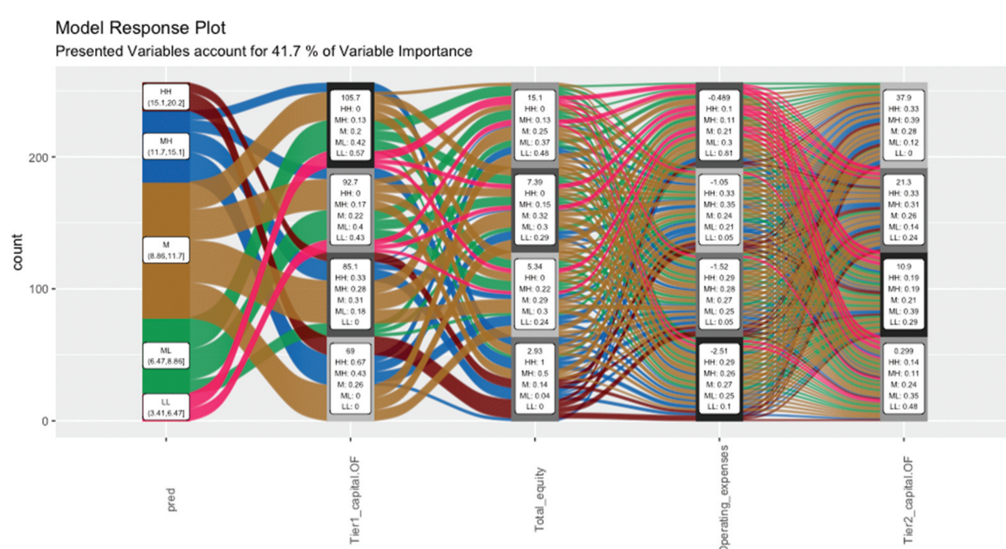


Figure 14. Alluvial (bank push variables).

$$\frac{1}{n}\sum_{j=1}^{n}\left|\left(y_j - \hat{y}_j\right)\right|$$

The RMSE when making the squares of the errors is penalizing the outliers more. Therefore, the MSE from this last point of view would be more robust. The table shows how the random forest improves the predictions in the regression tree. For this, the models have been trained on 80% of the sample and the remaining 20% have been evaluated, obtaining improvements in the prediction with the random forest as observed for all the models (see Annex 2)

For the random forest, the most important variable in determining outflows is Tier 1 over equity (see Annex 3).

In the alluvial flow diagram, it is a method based on Sankey diagrams[7] with which we interpret random forest models. First, the dependent numeric variable, are transformed into 5 bins of equal rank, which are filled with "LL" (low-low), "ML" (medium-low), "M" (medium), "MH" (medium high), HH (high-high) by default. On the x-axis the variable pred. represents the dependent variable. The dependent variables are represented in the following columns. In each rectangle of the independent variables, the five codes established in the independent variable and the percentage of each of the five scales of the dependent variable that passes through each dependent variable are presented. Each dependent variable in turn in the graph is divided into 4 boxes that categorize the data, showing in each of them the average that it reaches with the values in ascending order. For example, in the first dependent variable (Tier 1 on own funds) the values of LL (dependent variable) are distributed by 0.53 in the highest values of Tier 1 on own funds with a mean of 105.7, and the 0.43 remaining in the second highest values of the same dependent variable with a mean value of 99.7. The graph of alluvial colors shows the relationship between the variables (see Figure 14), specifically it is observed that the pink color that starts from the low values of the output variable (interval of 3.41 and 6.67), is related to high values of TIER1 on own funds, as well as with high and intermediate values of the ratio of total own funds. As well as with high values of operating expenses, following the pink lines. The pink graph indicates that high values of tier 1 capital to capital and of the capital ratio, as well as operating expenses are related to each other, as well as low values of expenses. On the other hand, the dark brown and blue plot indicates the opposite, that is, high values of the outputs are related to low values of the three dependent variables, which

Figure 15. Partial derivatives (bank push variables).

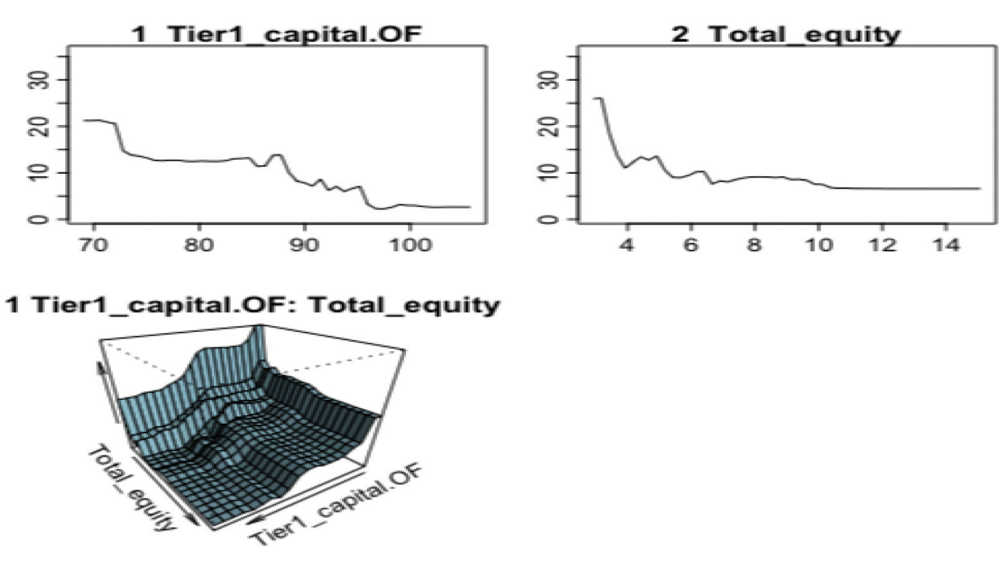


Figure 16. Regression tree (bank pull variables).

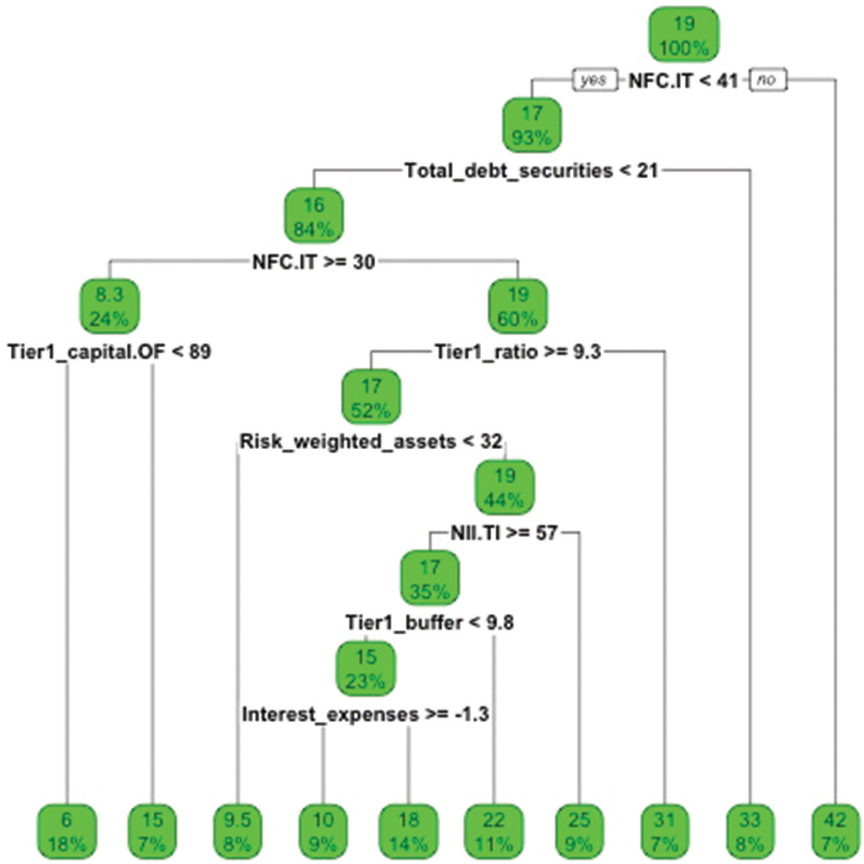


Figure 17. Alluvial (bank pull variables).

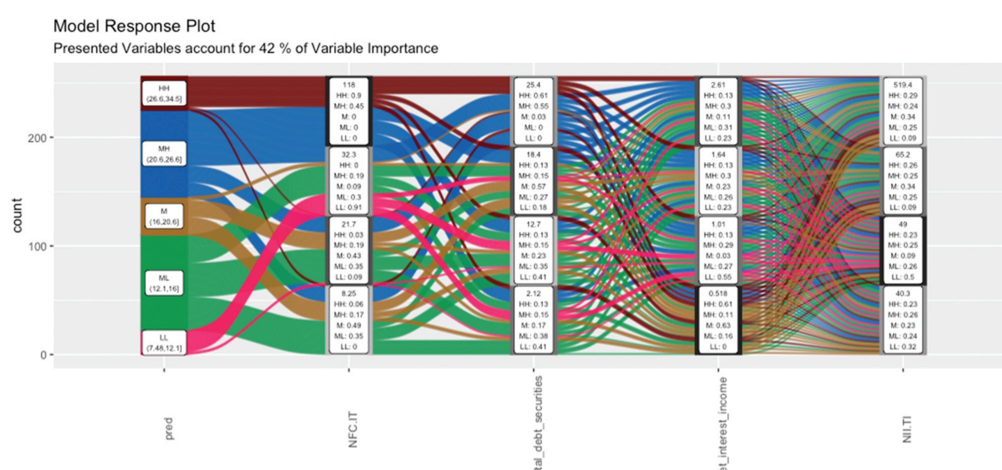


Figure 18. Partial derivatives (bank pull variables).

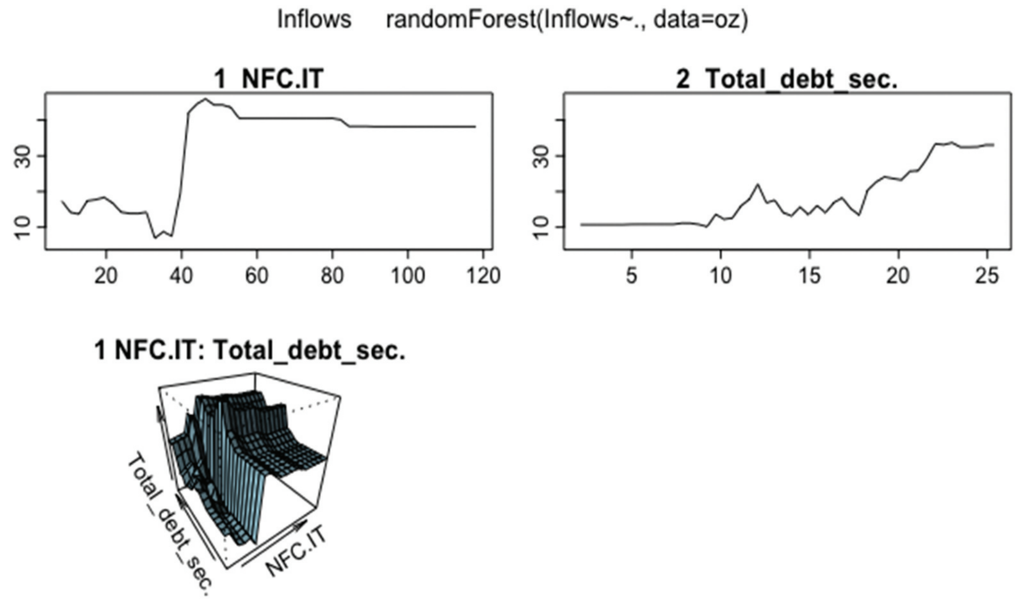


Figure 19. Regression tree (economic push variables).

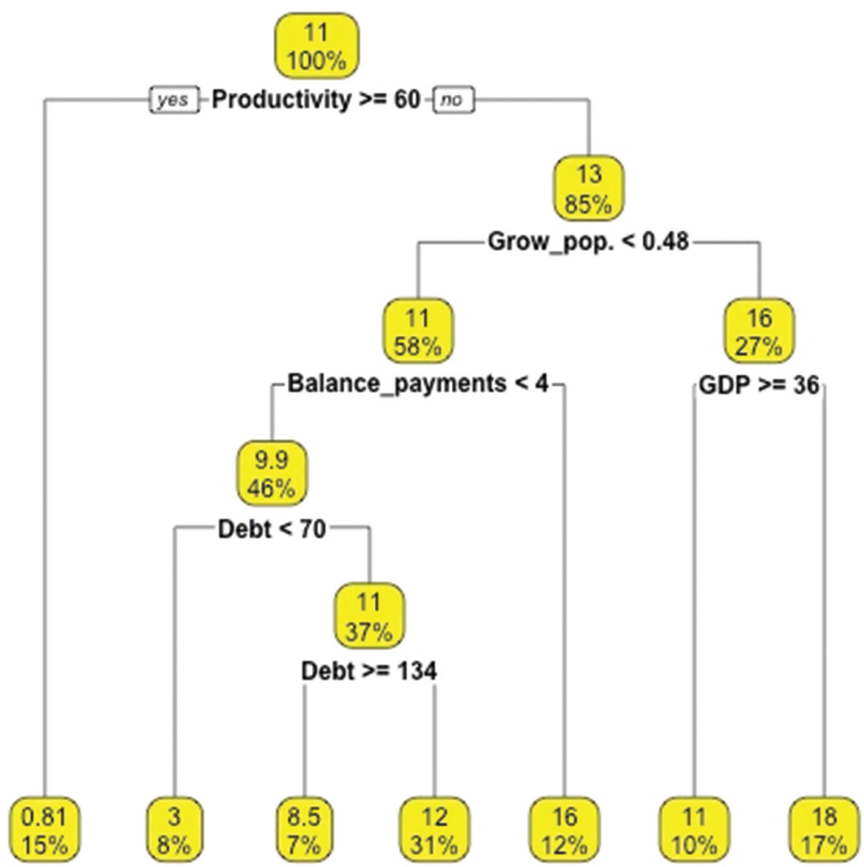


Figure 20. Alluvial (economic push variables).

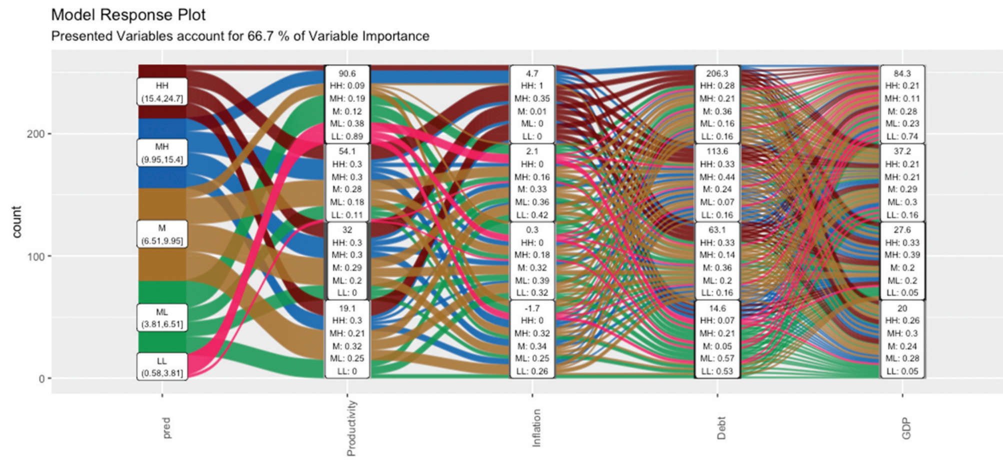
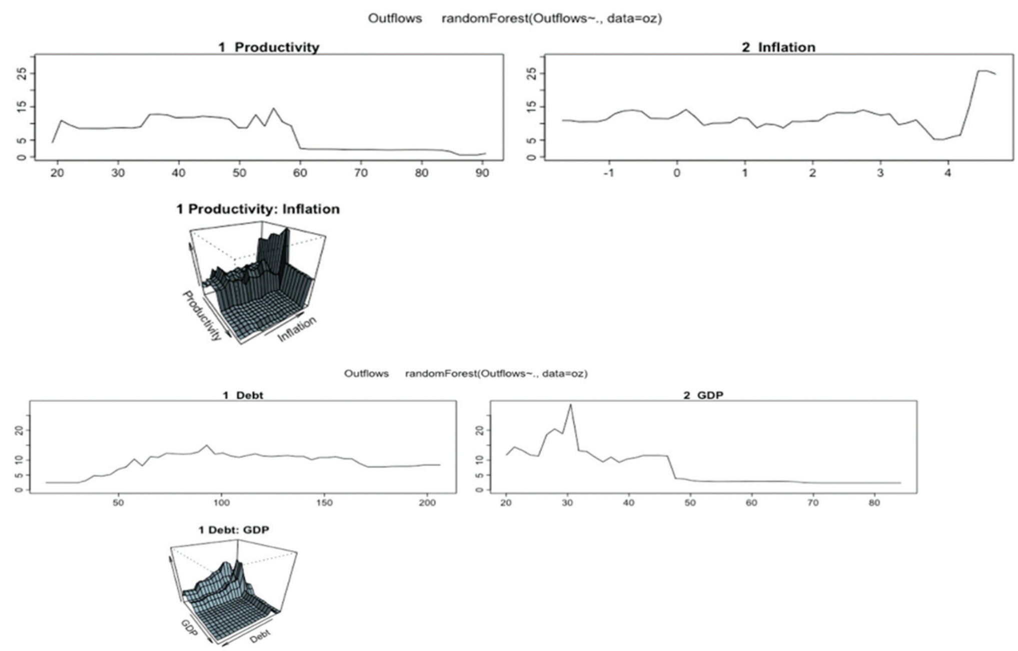


Figure 21. Partial derivatives (economic push variables).



first appear indicating an inverse relationship in the random forest model. Therefore, in the banking systems analyzed, when the capital and highest-quality capital ratios are high, the banking systems grant fewer loans abroad, there are fewer outflows, operating expenses in these circumstances are lower, and vice versa. These relationships are shown as shown in Figure 15 with the partial derivative functions.

2.5. Analysis of bank pull variables

Figure 16 shows the regression tree on the dependent variable inputs, that is, the loans granted to each node from the rest of the nodes. It is observed how the variable NFC.IT represents the most important variable, specifically when commission income exceeds 41% of total income, the largest inflow of funds via loans is presented. Between 30 and 40%, the lowest inflows of funds occur. For values less than 30%, there is an intermediate inflow of loans (an average of 19%). These results can be explained by the fact that when commissions occupy a very high percentage of revenue, then the interest margin has less weight on total

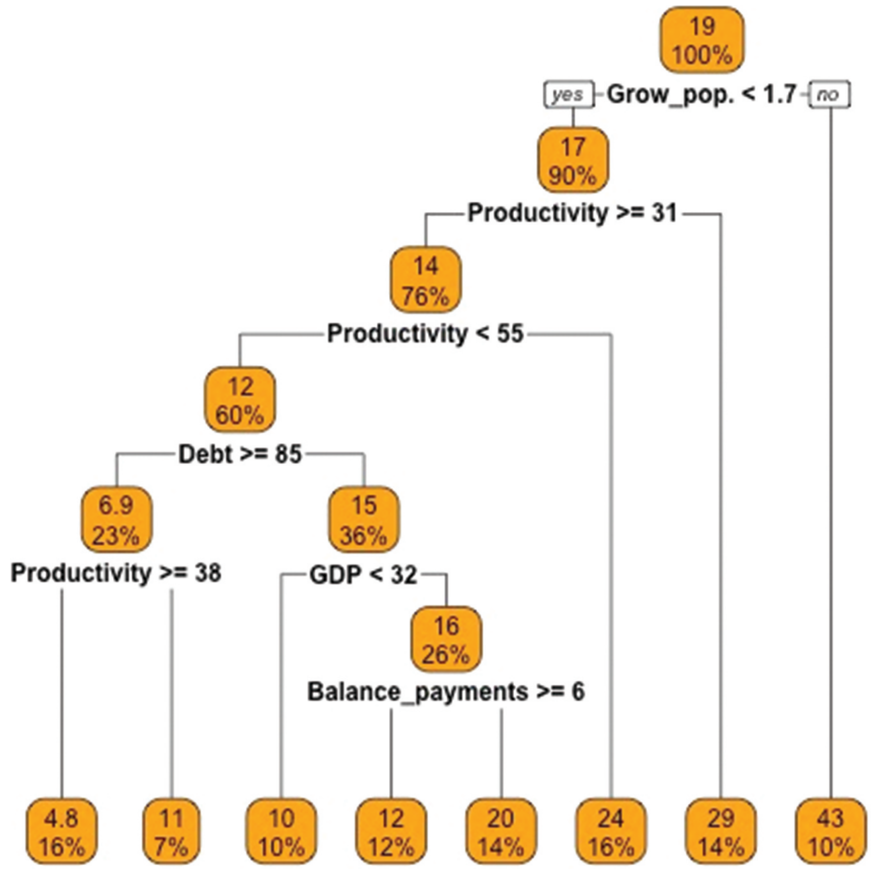


Figure 22. Regression tree (economic push variables).

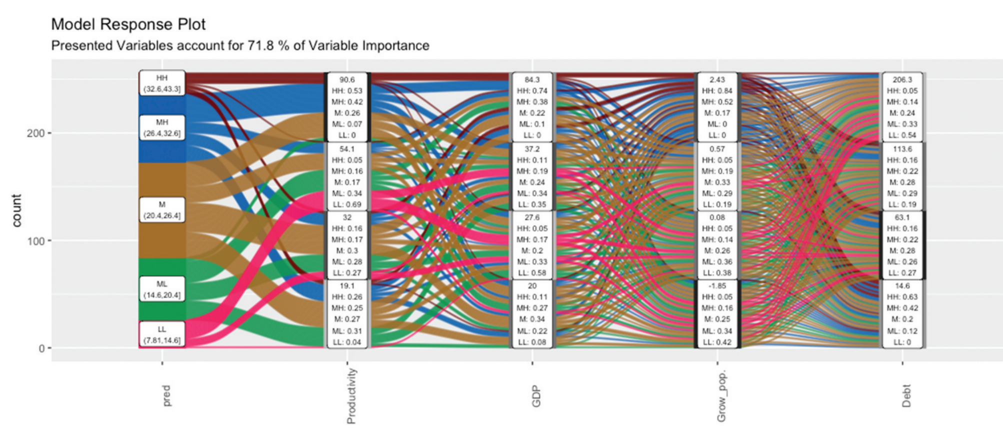
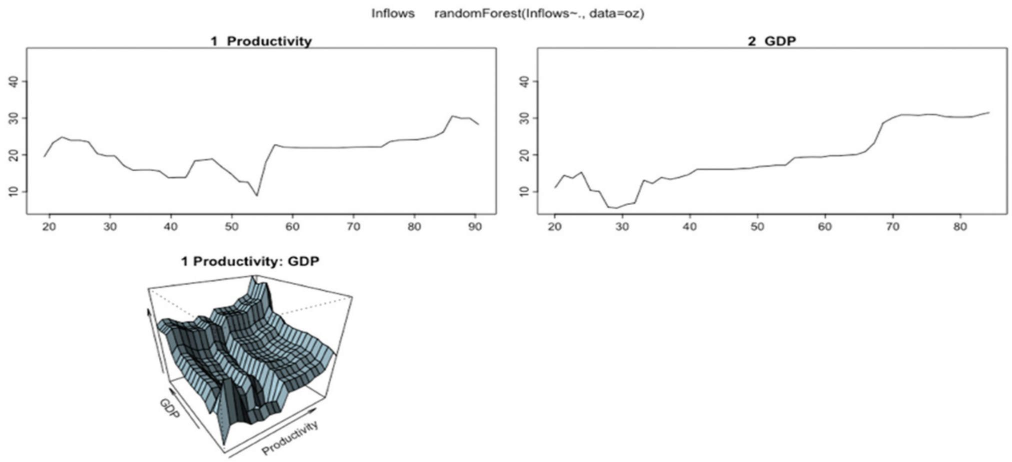


Figure 23. Alluvial (economic pull variables).

revenue. This may be an indication of low competition; it may also be an indication of great dynamism in the national market. Therefore, investment opportunities are sought in these markets. On the other hand, when the structure of total income, on commissions, represents between 30% and 40%, the inflows are lower because they correspond to banking systems with greater competition. For low values of commissions over total income, the banking

Figure 24. Partial derivatives (economic pull variables).



markets would appear in a low phase of the cycle or with high competition, which would mean investment searches in other markets. The second important variable in the regression tree that appears is the debt assets over total assets, when it takes values less than 21, fewer bank loans are generated with an average of 16%, for values greater than 21 the inputs represent 33%. Therefore, when banking markets increase their investments in debt assets, they occur in growth environments, in which companies borrow with the intention of undertaking new investment projects, and in turn, international loans reach these economies.

Annex 4 shows how the most important variables are NFC. TI and total debt titles. The Alluvial graph (see Figure 17) shows how there is a direct relationship between the inflows and the NFC.IT variable and the Total Debt Securities variable. When commissions are high over total income, either due to less competition or a greater number of operations due to a more favorable phase of the cycle, the inflows are higher. As for the total debt securities variable, the direct relationship is explained by a better phase of the cycle with higher debt issues and higher inflows for its financing. Figure 18 shows the graphs of partial derivatives of both variables with respect to the inputs.

2.6. Analysis of economic push variables

Figure 19 shows how the greater the productivity, the granting of credits abroad is very low, specifically at 0.81. For lower values of productivity 60, the granting of credits abroad, are higher, taking values of 13. In the next branch, the population growth is found, when it is less than 0.48%, the granting of credits is lower, with values of 11, for values higher than 0.48%, on average, the granting of loans is situated in average values of 16. In the next branch that comes from the latter, there is a greater granting of loans, when the GDP is lower than 36.

Productivity, debt and GDP appear (see Annex 5) as the most important variables. Specifically, with the Alluvial graph (see Figure 20) a negative relationship between outflows and productivity is observed. While the relationship is direct with inflation for high values of it. Therefore, in an economy with high productivity, outputs are lower, as well as when inflation is high. It is assumed that when productivity is low, more investment opportunities are sought in other countries. Figure 21 shows that for GDP values greater than 47, the outflows are greatly reduced, which indicates that for high-growth economies they require more financing and their outflows are smaller.

2.7. Analysis of economic pull variables

In the regression tree (Figure 22) the first variable that appears is population growth, for values of this variable greater than 1.7, the largest international loan concessions are produced with values of 43. This would occur because we would be in economies that produce wealth, increasing their workforce and creating families or receiving immigration. The second variable in the division in the tree is productivity, for values greater than or equal to 31 there is a lower credit output, specifically the average is 14 and for productivity values less than 31 the credit output takes a value of 29. Between 50 and 31 productivity, the average loan takes values of 12. For productivity values greater than 55, the average granting of loans abroad is 24. This fact indicates that when productivity is low, the greater granting of loans. This may occur due to fewer investment opportunities due to lower productivity values. But for high productivities there is also a large granting of loans, this may be due to greater competition in the markets than for intermediate productivities, in which there are fewer outflows of funds via loans.

Productivity is once again the most important variable in entries, followed by the GDP variable (see Annex 6). According to the Alluvial chart (see Figure 23), the relationship between productivity and loan inflows is direct, as well as for higher GDP growth rates. As the graph of the functions of partial derivatives Figure 24 is observed.

3. Conclusions

In the work complex networks are used to analyze interbank loans in the euro zone. It is concluded that fragmentation in the euro area has been increasing in the euro area between 2006 and 2020, identifying three phases in which fragmentation gradually increases. The turning points in the increase in fragmentation coincide with crisis events.

The topology of the networks, weighted by the outgoing and incoming links, shows a clear center formed by Germany and France, with the former losing prominence in favor of the latter throughout the study period. According to network measurements, Germany and France are the largest information managers in the network, although as the largest source of information the most important node/country is Italy.

The measure of fragmentation in the modularity network shows a positive correlation with the solvency measures. The subnets that are formed have a lower risk measured by the solvency of the nodes and by the assumption of risks. Higher fragmentation is also associated with higher liquidity at the nodes.

As policy implications, there is greater security in the network due to its greater solvency and lower assumption of risk together with greater fragmentation. The analysis could be useful for combining euro zone banking regulation, supervision and integration with network and sub-network risk.

It is concluded that solvency is the most determining variable for the outflow of bank flows with an indirect relationship and the income structure measured by the ratio of commissions to total income is the most determining variable for the inflow of funds. The most solvent banking systems would be less willing to take risks in other jurisdictions and, if this is the case, it would be in banking systems with less competition and/or an expanding banking market.

It is concluded that from an economic perspective, productivity differentials are the main determinants of bank flows in the euro zone, increasing the receipt of funds and decreasing outflows in a country with high productivity.

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Notes

1. REGULATION (EU) No 575/2013 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 26 June 2013 on prudential requirements for credit institutions and

investment firms and amending Regulation (EU) No 648/2012.
2. Examples of some of these works can be found in Amini et al. (2012), Acemoglu et al. (2015), Battiston et al. (2012), and Caccioli et al. (2012).
3. McGuire and Wooldridge (2005), Muñoz de la Peña and Rixtel (2015) and the Basel Committee (2019) develop different advantages and disadvantages of collecting bank data from different perspectives of the BIS databases.
4. In Figure 1, the topological structures of the European Union's banking systems are presented, grouped by clusters and according to the years of study.
5. The strengths and weaknesses of the regression trees is developed by Loh (2011) and the development of the algorithm by Breiman et al. (1984).
6. Breiman (2001) develops the advantages of random forest.
7. Sankey diagrams are developed and explained by Riehmann et al. (2005) and Lupton and Allwood (2017)

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Appendices

Annex 1. Random Forest
The Random Forest algorithm offers several benefits for reducing variance. Among the key advantages of Random Forest in addressing variance are the aggregation of multiple decision trees. By combining the predictions of multiple decision trees, Random Forest reduces the impact of individual trees that may overfit or have high variance. Therefore, the ensemble model tends to provide more stable and reliable predictions.

Additionally, the algorithm introduces random feature subsampling. In other words, Random Forest introduces randomness by considering only a random subset of features at each split when constructing individual decision trees. This randomness feature reduces the risk of overfitting and helps the model generalize better. By considering different subsets of features, Random Forest captures a more diverse range of information from the data, leading to reduced variance.

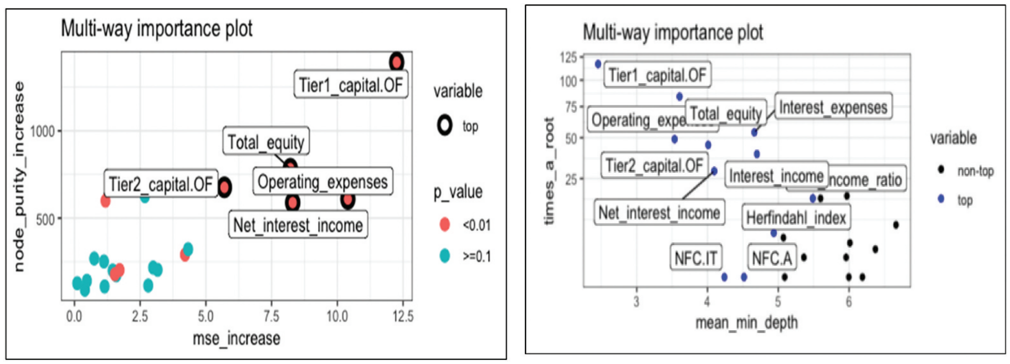
Random Forest utilizes the sampling technique called bootstrapping, which involves randomly extracting subsets of the training data with replacement to train each decision tree. This sampling strategy introduces diversity in the training data for each tree, contributing to variance reduction. By constructing different data subsets for each tree, it allows the ensemble to capture a wider range of patterns and reduces the likelihood of overfitting.

Therefore, Random Forest aggregates the predictions of all decision trees in the ensemble by taking the average. This averaging process helps smooth out individual errors and reduces the impact of outliers or noise in the predictions. By combining multiple predictions, the ensemble model becomes more robust and less prone to high variance.

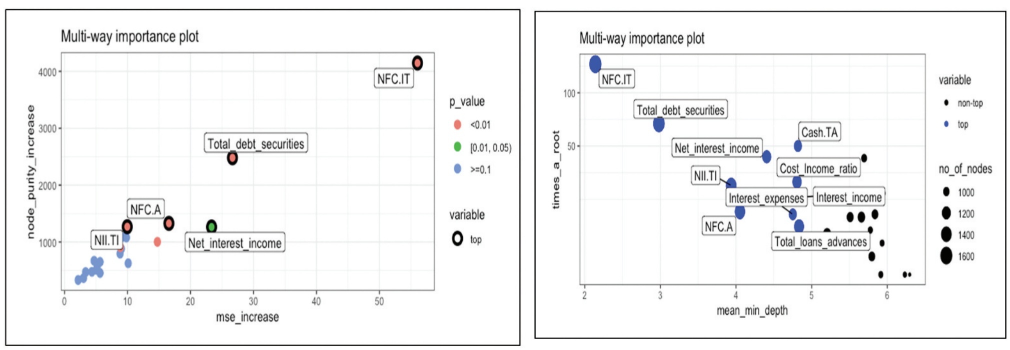
Annex 2. Models

MODELS	RMSE	MAE
PUSH BANK REGRESSION TREE	7,158	4,607
PUSH BANK RAMDON FOREST	2,146	1,198
PULL BANK REGRESSION TREE	8,717	6,639
PULL BANK RAMDON FOREST	7,764	6,143
PUSH ECONOMIC REGRESSION TREE	5,234	4,086
PUSH ECONOMIC RAMDON FOREST	1,751	1,226
PULL ECONOMIC REGRESSION TREE	7,551	4,721
PULL ECONOMIC RAMDON FOREST	5,243	4,236

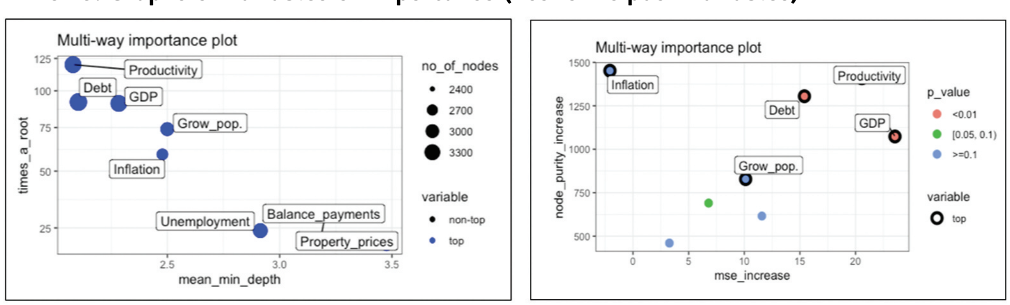
Annex 3. Graphs of variables of importance (bank push variables)



Annex 4. Graphs of variables of importance (bank pull variables)

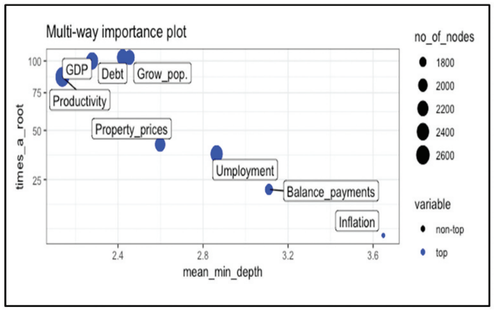


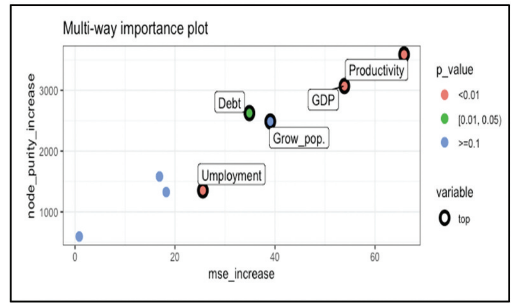
Annex 5. Graphs of variables of importance (Economic push variables)



https://doi.org/10.1080/23322039.2023.2256192

Annex 6. Graphs of variables of importance (Economic push variables)





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The digital euro: a materialization of (in)security

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ABSTRACT
The European Central Bank (ECB) has entered the preparation phase for the potential issuance of a digital euro. The digital euro under consideration represents a retail central bank digital currency (CBDC), a digital representation of central bank money that is intended for use by the general public. This article foregrounds the digital euro as an infrastructure that furthers European security ambitions. It argues that the development of the digital euro is a materialization of European (in)security rationales that aim to secure pan-European financial transactions amid growing geopolitical tensions. It focuses on the development of the technology and analyses how central bankers' scenarios of the future manifest in the anticipated design and prototypes. While the provision of a financial infrastructure is the most decisive security-related implication of the digital euro, the introduction of a new form of public money is the decisive financial feature with potentially wide-ranging implications for banks. Although the ECB seeks to balance the interests of banks and other financial actors in the development of the digital euro, its plans are still met with criticism. Finally, the article argues that the ECB exerts itself more explicitly than before as a geopolitical actor in its own regard.

KEYWORDS
CBDC; digital euro; financial infrastructures; geopolitics; European security

Introduction

> '*We need to prepare our currency for the future. While we haven't yet decided whether to issue a digital euro, we're getting ready.*'
>
> (Post by Christine Lagarde on X, Oct 18, 2023)

On 18 October 2023, the Governing Council of the European Central Bank (ECB) made an important, possibly historic decision. After two years of research on the development of a digital euro, it decided to move to the 'preparation phase' of the project. Based on first deliberations in which several important decisions have been taken, the form of the digital European currency will take shape ever more concretely over the coming years, even before the final decision on its issuance is made.

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On the day of the public announcement, the ECB launched a new website that would address a wider audience than the rather technical design which the ECB website usually displays. The website features a design and blue-purple color scheme that is different from the rest of the ECB's website, as well as two short video clips that showcase the benefits of the digital euro. The first clip highlights the words 'easy, safe, fast, reliable' as features of the digital currency and explains its concrete use cases, such as sharing bills and paying online and offline across Europe. The second video portrays the digital euro as embodying European 'shared values' that need to evolve and highlights the words privacy, inclusion, and euro area. It also explains that the digital euro would 'strengthen Europe's autonomy in the digital world' and make the European payments sector 'more resilient'. Both videos end with the appeal to 'embrace the digital era with the digital euro' (ECB, 2023e, 2023f).

This article analyzes how the digital euro aims to fulfill its promise to strengthen European autonomy. Going beyond the perspective of future use cases and claims of making payments more convenient, I argue that the most important implication of the planned central bank digital currency (CBDC) for international political economy (IPE) is its infrastructural ambition. The digital euro is based on and adds to European security rationales and thus explicitly links (geo)political concerns with a digital currency. It connects the introduction of a retail CBDC with the development of a digital infrastructure that enables its usage. What is perceived as threatening in the realm of payments is the fact that euro-denominated retail payments, especially those across European borders, rely to a large extent on non-European payment providers and processors. These dependencies on non-European actors were already framed as a security issue by the European Commission in 2020. This article shows how these considerations have intensified since Russia's aggression against Ukraine in 2022 and connects it to an intensified and more explicit involvement of the ECB in geopolitical developments.

The intensification of geopolitical tensions and the use of financial sanctions for political aims made the interconnection between global payment infrastructures and geopolitics increasingly visible (de Goede & Westermeier, 2022). As financial networks, such as SWIFT but also payment networks, such as VISA and Mastercard are perceived as geopolitical actors, policymakers seek to establish new or other ways to secure money transactions independent of foreign interference. Such efforts include those to develop alternatives to established systems, such as SWIFT and the correspondent banking system by countries that oppose the dominance of the US within these systems (Nölke, 2022). While much scholarly attention has been directed to implications for the hegemony of the US dollar (McDowell, 2023; Zhang et al., 2023), little attention has been directed to the financial security efforts of countries and regions, such as the European Union (EU) that are widely perceived to be close US allies but that are often heavily dependent on US-based providers of digital payments and credit card networks. In these cases, the currency is mostly irrelevant. Instead, the dependent regions' security efforts aim at the infrastructural level, meaning the technologies and actors that enable transactions.

This article analyzes the development of the digital euro as a financial infrastructure that seeks to further European security rationales. While the project is still in its infancy, studying the phase of deliberation and planning allows a glimpse into infrastructural 'hardwiring' (de Goede, 2021). That is, this article analyzes how contemporary political ambitions and expectations about the future are brought to bear in the concrete design of financial technologies. As the current moment in time is widely perceived as transformative in technological and geopolitical regards, this article connects two interrelated questions: How do financial infrastructures shape European security rationales, and which rationales shape financial technologies that aim to become future infrastructures?

The following places the study of CBDCs at the heart of IPE: CBDCs question and potentially reconfigure established relations between states, central banks and financial institutions *via* and in financial technologies. They are not just a tool, but a key site for (re)designing international financial relations. The following thereby expands lines of research that have foregrounded the importance of financial technologies and financial infrastructures in the study of IPE (special issue edited by Bernards and Campbell-Verduyn (2019), Brandl and Dieterich (2023), Campbell-Verduyn and Giumelli (2022) and Robinson et al. (2023)). To account for the interrelations between digital currency, security and infrastructure, the article proposes to conceptualize the digital euro as a process of materialization of (in) security that is shaped by and shapes financial and security rationales. It focuses on the development of a financial technology and how central bankers' expectations of the future manifest in its planning and anticipated design. As this technology is not yet accessible for research, official documents published on the digital euro serve as the main entry points to the infrastructural politics of the digital euro. The following thereby traces the development of a financial infrastructure as a discursive-material process and shows how the discursive and the material are closely entangled.

The analysis rests on reports that document the digital euro project. By January 2024 the ECB lists more than 110 different publications on the topic on its website (ECB, 2024). While these include interviews, speeches and technical publications, two central documents stand out: The 'Report on a Digital Euro' (ECB, 2020) and the ECB's 'stocktake on a digital euro' (2023c). These reports summarize the processes around the topic. For a detailed understanding of the technical development, their analysis is supplemented by more detailed reports on the design choices and detailed development of the digital euro. The ECB provides regular reports, working papers and presentations on the topic. Further reports are provided by the Bank for International Settlements (BIS), which has become a main place for and actor in discussions and developments relating to CBDCs (Swartz & Westermeier, 2023). The basis for selection of reports to analyze was thematic relevance to the nexus of CBDCs and security as well as a thematic focus on the concrete design of CBDC infrastructure. The two mentioned main reports provided by the ECB (2020, 2023c) hereby serve as focal points for the wider discourse.

As central bank communications are the main source for this analysis, they must be understood as strategic, as a literature on central bank communications has shown (Diessner, 2023). The ECB carefully crafts and prepares its external communication. While it aims to explain and thereby legitimize its plans and considerations for the digital euro, its communication is limited by a specific understanding of the ECB's mandate and its self-depiction as a technocratic European institution. At the same time, the development of the digital euro is a challenge for the ECB's communication strategy. Until recently, central bank communication has been geared primarily toward financial market audiences that are able to interpret central banks' 'signaling' (Abolafia, 2007). The digital euro, however, requires support by the EU's co-legislators, the Council of the EU and the European Parliament, as well as – eventually – European citizens. To gain broader support for the project, representatives of the ECB have thus engaged in numerous public events with stakeholders, market participants, political actors and NGOs. As plans to introduce CBDCs have been a topic at several high-level conferences and meetings, many public conversations and speeches, most notably speeches by high-ranking ECB representatives, are also part of the enfolding discourse on the digital euro. This discourse has thus far been limited mainly to the central banking community, stakeholders, market participants and think tanks. To supplement the analyzed material, the author has attended several events, on and offline, dedicated to the digital euro. On these occasions, in conversation with speakers and attendants, the author gained contextual knowledge on the process and how it is perceived. The analysis also includes prototypes as part of the digital euro infrastructure to exemplify how discursive claims materialize in the technology. To sum up, the analysis focuses on two main reports and further public communication by central banks and other financial institutions – reports by the ECB, the Bank for International Settlements (BIS) and the International Monetary Fund (IMF) – which are supplemented by statements by stakeholders, market participants and consulting companies as well as statements gathered and conversations at events dedicated to the digital euro.

The article proceeds as follows. The next section explains how the study of the digital euro connects the literature on financial infrastructures with that on the techno-politics of European security. It also provides the conceptual framework to study the digital euro as a materialization of (in)security. The section entitled "More than public money" provides an introduction into the current stage of development of CBDCs and furthers the argument that their crucial innovation is the underlying infrastructure. The following sections report on the empirical study of how the digital euro is developed as a European security project and how these security rationales intersect with the established financial architecture. The final section links the development of the digital euro to broader developments that might be captured as the geopolitization of central banks before the conclusion.

Infrastructure as materialization of (in)security

By conceptualizing the digital euro as a materialization of (in)security, the article connects scholarship on the importance of (financial) infrastructures with studies on European security that focus on the role of technology. This section first discusses the literature regarding financial infrastructures before it links these considerations to the study of the interrelations of finance and security and the role of technologies in European security.

Securing financial infrastructure

The importance of infrastructures in IPE has been discussed in two regards. On the one hand, studies on infrastructural power that refer to Michael Mann's (1984) work emphasize from a macropolitical perspective how states exert power in processes of financialization that have led to new forms of state-market hybridity

(Coombs, 2022; Coombs, Forthcoming). While this approach is most relevant for analyzing how digital currencies transmit state authority and challenges the boundaries between public and private spheres, a different strand of research is better suited to studying the development of the digital euro. That strand builds on insights both from the Social Studies of Finance and from Science and Technology Studies to focus on the socio-technical relations around mundane technical objects that enable global finance and financial processes (Pinzur, 2021; Pinzur, Forthcoming; Brandl et al., 2024). This article thus uses a conceptualization of infrastructure that takes into account its materiality (in the making) as much as the ideas and knowledge that shape this materiality (Bernards & Campbell-Verduyn, 2019; Beaumier & Kalomeni, 2022).

Infrastructure is understood as 'an articulation of materialities with institutional actors, legal regimes, policies, and knowledge practices that is constantly in formation across space and time' (Anand et al., 2018, p. 12). Infrastructure in this mode of inquiry is thus integrally material and socio-political and provides an entry point to the political economy of technology. As the digital euro has not taken its definite shape, the analysis here foregrounds the process of materialization. Despite their seemingly immaterial virtual character, digital currencies require a material infrastructure of wires, satellites, computer hardware and electronic devices, and even though software and databases seem more malleable than these materials, their materiality has also been emphasized (Dourish, 2017). As Anand et al. (2018, p. 12) argue further, in reference to Edwards et al. (2009), infrastructures have 'histories and "grow" incrementally in a dynamic temporal, spatial, and political environment (…) They are formed with the moralities and materials of the time and political moment in which they are situated.' The following analyzes how the infrastructure of the digital euro is shaped by the political moment in which it is developed, and it provides a tentative look at the potential socio-political repercussions of the ECB's digital currency.

The digital euro is a technology that aims to become infrastructural for European financial and security architectures. Yet, no system is inherently infrastructural; it can only be observed in an infrastructural relationship (Slota & Bowker, 2017, p. 531). In the process of its development, security and financial rationalities intersect but also compete. Both rationalities are present in communications about the digital currency, which seeks to advance the European security aim of strategic autonomy and contribute to the digitalization of the European economy. As this article discusses, the two rationalities do not easily converge. There are profound doubts about the financial benefits of the new digital currency, while its security implications remain largely uncontested.

The security aims of the digital euro – strategic autonomy and resilience – are not the first security rationales to enter discussions in the field of finance. Already before, but in particular after the 11 September 2001 terrorist attacks in the US, the fight against terrorism has driven the use of financial transactions to counter illicit activities. This form of financial security relies on the surveillance and analysis of transactions and the ability to 'follow the money' (Westermeier, 2023). Following the global financial crisis that began in 2007, several contributions have also analyzed how finance itself is handled as a (potential) security problem (Morris, 2018). As capital buffers resemble the concept of stockpiling and stress testing resembles the practice of scenario planning, these perspectives have shown how post-crisis financial governance adopted new security logics that ultimately entered the field of finance (Tellmann, 2009). Increasingly, financial markets themselves have been perceived as a referent object of security, as part of 'critical infrastructure' which needs special protection – primarily to withstand the next financial crisis. This framing of financial markets as infrastructures involves a shift in understanding them not as 'market institutions but as the vital basis of the economic itself' (Langenohl & Van Riet, 2020, p. 3; Langenohl, 2022). The securitization of financial infrastructures, meaning their depiction as being threatened and in need of protection, is still present, but the perception and anticipation of potential threats to financial infrastructures have shifted as the empirical sections discuss. Increasingly, security efforts aim at protecting financial infrastructures themselves for two interconnected reasons. First, they seek to gain greater local governance over payment systems that are often run by international corporations. Second, they want to secure financial connectivity domestically and internationally to ensure the basis for economic exchange. Both rationales are also present in the securitization of the European financial infrastructure.

Materialization of (in)security

Scholarship that engages with the nexus of technology and security at the intersection of International Relations and Science and Technology Studies has foregrounded how the EU's security agendas have worked to bring new policy areas, such as technology and innovation into high politics (Hoijtink & Leese, 2019; Bellanova & Glouftsios, 2022; Müller & Richmond, 2023; Campbell-Verduyn & Hütten, 2023). The terminology of strategic autonomy originated in the security realm but has since been extended to other policy areas. Notions of strategic autonomy and (digital) sovereignty are a way to link technology with geopolitics (Monsees & Lambach 2022). They have become key elements of several European rationales as they address Europe's lack of influence over the management of the material basis underpinning its economy. Lambach and Monsees describe strategic autonomy as a European attempt to respond to a changing geopolitical landscape and to position the EU within that scene (ibid.). Such concepts lack a clear definition which however contributes to their adoption by a broad range of actors because they serve as empty signifiers, such that their lack of concrete meaning actually helps to build shared socio-technical imaginaries. They shape collective 'security thinking in the digital and technological domains, by organizing and bridging civil–military political and policy agendas, and by opening windows of opportunity for decision-making and EU-level joint action' (Csernatoni, 2022, p. 397).

This article bridges the literatures on the (politics) of financial infrastructures and the techno-politics of European security. The development of the digital euro is understood as a process of materialization of (in)security that connects public and private actors, their knowledge, legal regimes and material formations, such as the development of front- and back-end solutions, and existing and developing payment systems. Claudia Aradau (2010, p. 503) has shown how the 'materialization of infrastructure emerges in intra-action with material-discursive practices about "foundations of society"' and how these are perceived to be threatened and secured. Aradau thereby expands to the sphere of security the works of Karan Barad (2007), who has demonstrated how 'matter and meaning are mutually articulated, and neither can be reduced to or explained in terms of the other' (ibid., p. 152). Aradau thus conceptualizes the process of securitization as a process of materialization that involves material and discursive practices. The empirical sections that discuss the digital euro as a European security project track how the digital euro is a materialization as much as a discourse on the matter. It is thus not a product, but a process of, materialization of European (in)security.

More than public money – central bank digital currencies

CBDCs have become a major topic within the central banking community. In a 2020 survey, the BIS found that more than 60 central banks are engaged in work on CBDCs (Boar & Wehrli, 2021). By the time of writing, this number had already increased to 114, and several projects have developed from research into pilot phases (CBDCTracker, 2024). What the BIS survey also shows is that the motivation to consider the introduction of a CBDC varies among countries, especially between 'advanced economies' and 'emerging markets and developing economies'. For example, 'financial inclusion' is a major motivation for the introduction of a CBDC in the former, less so in the latter. Specifically, the digital yuan is often connected to China's geoeconomic aspirations, which would make CBDCs the 'new technological arena for US–China monetary competition' (Huang & Mayer, 2022). Thus, the introduction of a CBDC hinges on domestic circumstances and challenges, as well as the perception of international dynamics (Ehlke et al., Forthcoming).

Although most CBDCs are still in the development phase and have not yet been issued widely, it is still possible to scrutinize the rationales and narratives that the differing projects employ. These early stages of infrastructural planning and fleshing out the design already foreshadow the infrastructural geopolitics that are envisioned and thus materialize in the architecture of the new currencies. Infrastructures of all sorts, especially large public projects, entail a certain vision of the future, and the way they are designed favors certain ways of usage over others. Infrastructures embody the cultural, political and societal conceptions that are dominant at the time of their planning and construction, and they carry specific notions about anticipated future developments (Folkers, 2017). Arguably, the design phase is the most political phase of infrastructural contestation and deliberation. Decisions made at an early stage entail and foreclose options that might follow.

Based on broader analysis of publications on the topic of CBDCs, Kuehnlenz et al. (2022) offer a comprehensive introduction. They focus on the type of money that CBDCs represent. As a first step they distinguish between three types of money that the current monetary system entails: '(i) cash, in the form of coins and banknotes created by the central bank, (ii) central bank reserves, which are the reserve balances of commercial banks held at the central bank and (iii) commercial bank money in the form of deposits held by the private sector at commercial banks. An important distinction between these types of money is that reserves at the central bank as well as cash are both the liability of the central bank, while commercial bank deposits are the liability of commercial banks' (p. 4). These three types of money are not equal. While central bank money can be considered to be risk-free, this is not the case for private money. As commercial banks may default, private money carries a certain risk. Whereas commercial banks have already had access to digital forms of risk-free central bank money for several decades in the wholesale payment system, the only form of risk-free central bank money which the public can access is cash. This would change with the introduction of retail CBCDs.

This article foregrounds CBDC as infrastructure, meaning the materiality (in the making) as well as the ideas and knowledge that shape this materiality. The two features of the CBDC – digital public money and its infrastructure – are inextricably linked. Digital money is inherently tied to the infrastructure that enables the storage and transactions of the digital currency (Caliskan, 2020; Westermeier, 2023). CBDCs are not simply issued; they are designed. The design choices determine how the digital currency can be used and how it enables and disables financial relations. The infrastructure is the crucial element that brings digital money into being. Bluntly put, the innovation of retail CBDCs is not the fact that it is public money, but that public money is stored on a digital ledger and is thus digitally transferable and accessible. Crucial differences between CBDCs thus lay in the concrete architecture of their infrastructure. Two fundamental choices exemplify how the design of CBDCs alters how they enable financial relations.

One fundamental design choice is the technically mediated relationship between the central bank and citizens. A one-tier model would make the digital currency directly accessible for end users without intermediaries such as banks. The central bank would handle all payments and provide services to the end users. This model, however, is seen as 'inefficient, as it detracts from the central bank's main role of providing monetary and financial stability' (BIS, 2023). Most central banks favor either a two-tier model or a hybrid CBDC model in which private actors would handle most direct interactions with the end users while central banks would use differing mechanisms to manage transactions. The ECB decided at an early stage that it would prefer a hybrid model in which the digital euro is intermediated by the private sector (ECB, 2022).

Another profound design choice is the underlying ledger in which transactions are stored. In the case of private cryptocurrencies, the digital ledger – typically a blockchain – records transactions in blocks and authenticates them using specific mechanisms. Whenever users transfer digital money holdings to one another, this results in an update to the database of monetary records. Apart from the form of money they provide, another crucial difference between cryptocurrencies and CBDCs is the form of the ledger, thus the underlying data infrastructure. While Bitcoin relies on a decentralized system that records all transactions on a ledger that is distributed across a network, CBDCs will most likely rely on permissioned blockchain or similar ledgers that are not publicly accessible. Studies indicate that most central banks prefer a centralized ledger, updated by a single entity, i.e. the central bank (Sun et al., 2022). The ECB has published a study on a prototype which relies on a centralized infrastructure that will be discussed in more detail below (ECB, 2023a). The following section explains how these design choices as materialization of (in)security are entangled with broader European security efforts.

Securing the 'lifeblood of the european economy'

> *'Once relegated to the back-office, payments have become strategically significant. They are the lifeblood of the European economy.'*
>
> (European Commission, 2020)

'Payments have left the obscurity of back-offices and made it to the political and strategic level.' When Mairead McGuinness, European Commissioner for Financial Stability, Financial Services and the Capital Markets Union, made this statement near the end of 2020, she offered three reasons why payments had become relevant for high politics: Briefly, digital transformation, transactional data and strategic autonomy. That the payments sector is part of the digital transformation is one of the most 'visible signs': Paying contact-less or with the mobile phone has become routine in most places. The second reason is the increasing use of electronic and digital payments as a 'data goldmine'. As payments provide insights into people's lives, their behavior and preferences, transactional data have gained relevance for companies whose business models are data driven (McGuinness, 2020). Transaction data are especially valuable for companies whose business models are data driven, most of which are non-European (Ferrari, 2020; Westermeier, 2020).

The increasing use of money as a form of data is linked to the third aspect that the Commissioner names as a driver for the political importance of payments, which she connects directly to the EU's aim of strategic autonomy. She states that, 'Whoever controls payment systems increasingly controls our modern, highly digitalised economies.' However, within Europe control is not in the hands of Europeans, as the Commissioner explains. The cashless payment solutions – mainly credit/debit cards and increasingly digital means of paying *via* apps – that Europeans use when they pay across borders within or outside of the EU are not provided by European companies. She refers here to the dominance in Europe of US payment giants VISA and MasterCard in intermediating European payment transactions. Approximately, 70% of European card payment transactions are managed by payment-related service providers that originate outside of Europe. Notably, a substantial level of market concentration is observed among these non-European entities, particularly in segments, such as card transactions and online payments (Ioannou et al., 2023, p. 69ff; ECB, 2019).

The task to preserve European autonomy in payments was not seen as a task for central bankers right from the start of the debate. In 2020, the hope of European policymakers to counter the dominance of non-European payment giants rested on the shoulders of private companies, mainly the so-called European Payments Initiative (EPI), a private effort to create a pan-European payment system. In July 2020, a group of 16 major European banks from five countries (Belgium, France, Germany, the Netherlands and Spain) announced their support for the EPI. This group of supporters grew to 32 European banks and payment service providers in 2021. The EPI sought to offer a card for consumers and merchants across Europe, a digital wallet, and enhanced P2P payments. Customers should thus be able to enact transactions across Europe with a pan-European system. The project was also supported by the European Commission, and the national governments of Belgium, Finland, France, Germany, the Netherlands, Spain and Poland issued a joint statement endorsing the EPI (Federal Ministry of Finance, 2021). The ECB also welcomed the initiative, offered technical support and hinted at public policy possibilities to help the private solution gain traction (Finextra, 2019). Government-level support would be limited to policymaking and regulatory adjustments, while the EPI had hoped for financial aid (European System of Central Banks [ESCB], 2020).

In 2021, it appeared as if the EPI would add itself to a considerable history of failed European projects (Judt & Krueger, 2014). It ran out of steam and lost the support of most of its stakeholders as 20 banks pulled out of the project. Competition between several participants and the high cost of the implementation of a new payment scheme were the main reasons cited. For banks, it seems cheaper and easier to continue their cooperation with US credit card companies. In addition, the payment landscape differs among European countries. Some (digital) options have already been made available by national actors in some countries, but not in others. In April 2023, the EPI issued a statement that announced a reset of the project with plans to develop a digital wallet to facilitate instant payments across Europe. At the time of writing, the EPI develops 'a groundbreaking payment solution tailor-made for Europe's present and future' which foremost entails a wallet application.[1] As both the EPI and the digital euro now aim to become platforms for European payments, their relation and possible cooperation is not inevitable, but likely.

The rise of the digital euro is linked to, but certainly not precipitated by, the failure to establish a privately-run European payment solution. When the EPI was initiated, the possibility that a European CBDC would be developed was already being discussed. However, at that time the German Bundesbank and Banque de France had hoped that the EPI would succeed as they assumed that a private solution would be implemented more quickly than a CBDC that would be years in the making (Smith-Meyer, 2021). Further factors the central bankers cite as drivers of the development of CBDCs in general are cryptocurrencies (foremost the discontinued Libra project) as private alternatives to the public–private payment systems and the fact that other non-ECBs are developing digital currencies, foremost the digital yuan. These developments are perceived as risks to the established financial system and the position of central banks within the monetary system (Swartz & Westermeier, 2023).

The digital euro – a European security project

> When you look at your wallet and you look at your telephone and see the applications that you use for payments or the cards that you use for payment, you very soon realize that those means of payments are not necessarily European. (…) So we just have to be careful. Some people will call it sovereign autonomy, I prefer to call it resilience because that's really what it is.
>
> (Lagarde, 2023)

This section analyzes how the digital euro project developed between 2020 and 2023 with a focus on two major reports on the topic. As it will be shown, the tone and the level of detail changed during this time, most decisively after the Russian aggression against Ukraine started in 2022. While earlier speeches and publications were much more cautious about whether the digital euro would be developed and which benefits it would have, central bankers have become more determined and proactive in explaining the aims and benefits of the project. This also reflects a development within the central bank: At the beginning, around the year 2020, the project produced more questions than answers, as members of the ECB project group recount at public events. Increasingly, the project has become a shared effort of the ECB and the central banks of the Eurozone, and its prospects have become clearer – including to central bankers themselves. Two main reports mark these developments and show how European security logics manifest in the development of the digital euro.

In a first step in January 2020, the Governing Council of the ECB established a High-Level Task Force that would advance work on CBDCs in the euro area. In October 2020, the task force launched the first significant publication on the digital euro, the 'Report on a Digital Euro', which sets out several reasons for proceeding with a digital euro. Several future scenarios are used to argue for the implementation of a digital euro linked to specific design recommendations. Scenarios are themselves a security practice and 'technique of uncertainty producing imaginative accounts for plausible futures' (Opitz & Tellmann, 2015). Scenario planning lies within the realm of preemptive security logics which seek to prevent certain perceived threats from materializing. Scenarios provide narratives that help to construct wanted and (in the eyes of the central bankers) unwanted financial futures. At the same time, these scenarios provide legitimation to act in the present with their reference to future-oriented security rationales such as strategic autonomy and resilience that have been transferred to the domain of payments.

The 'Report on a Digital Euro' presents seven such scenarios. It is remarkable that most of them describe a future in which the digital euro already exists in order to highlight the positive expected effects for Europe and the European economy. One scenario (ECB, 2020, p. 9) addresses external threats, such as when 'a form of money other than euro-denominated (i) central bank money, (ii) commercial bank deposits or (iii) electronic money becomes a credible alternative as a medium of exchange and, potentially, as a store of value in the euro area'. Under this scenario, a CBDC issued by a foreign central bank could be made available to European citizens, resulting in 'currency substitution as well as an increase in foreign exchange risk in the euro area economy.' Or 'technology firms [could develop] payment solutions not denominated in euro (such as global stablecoins) that could achieve a global footprint and become widely used for European retail payments.' The report explains why these developments are perceived as threatening: 'Such developments would foster innovation but could also threaten European financial, economic and, ultimately, political sovereignty.' The task force thereby links the topic of the digital currency to the foundations of Europe by posing a threatening scenario.

The 2020 report, which lays the groundwork for the further development of the digital currency, thus already establishes the connection between Europe's security politics and its currency. Not long before the report was published, ECB President Christine Lagarde (2020) gave a speech in which she summarized the two driving factors that push the Eurosystem to strengthen European payments capabilities: 'The first is changing consumer preferences and the second is competition to dominate payments on a global scale.' While this first driving factor is perceived as given (consumers will continue to shop online), Lagarde describes the second driver in more detail, referring to the reliance on 'foreign providers' which present a risk amidst the 'evolving global context': 'We are seeing an increase in protectionist policies, as sanctions and even exclusion from payment systems in recent years have shown. This presents new risks of payment disruption—especially for jurisdictions that are overdependent on dominant system providers' (Lagarde, 2020).

With her remarks on sanctions, Lagarde thereby stresses that the use of sanctions and exclusion from payment systems is a potential challenge that is not limited to adversaries of the US – as the EU experienced first-hand in 2018. That year, after the administration of US President Donald Trump pulled completely out of the Joint Comprehensive Plan of Action (JCPOA) – the so-called Iran Deal – the financial messaging network SWIFT disconnected Iranian banks under pressure by the US administration (Robinson, 2022). For Iran's European partners who still adhered to the deal, the infrastructural disconnection of Iran made it impossible to uphold their commitments under JCPOA and to conduct trade with Iran. The situation led them to set up INSTEX as a European workaround for the established financial system and raised awareness that the threat of infrastructural disconnection was not limited to US adversaries (de Goede & Westermeier, 2022).

After the start of the Russian aggression against Ukraine in February 2022, the tone and priorities in the speeches of European officials on the digital euro shifted remarkably. In September 2022, Burkhard Balz, member of the Executive Board of the Deutsche Bundesbank, lists 'strategic sovereignty in European payments' as the first reason 'why we need a digital euro' (Balz, 2022). Members and representatives of other European institutions are even more explicit in linking the digital euro to most of Europe's existential issues. At a November 2022 conference, Thierry Breton, Commissioner for the Internal Market, characterized payments as a matter of sovereignty due to the lack of pan-European payment solutions. At the same event, Nadia Calviño, then Vice President and Minister for Economy and Digitalization of the Spanish Government, described the development of the digital euro as a 'highly geopolitical challenge' and argued that 'we have to see that this is underpinning the new world order which is in the making these days' (European Commission, 2022). The digital euro is thus directly linked with European geopolitical considerations, which are subsumed under the framework of strategic autonomy.

From scenarios to prototypes

A year later, in 2023, the ECB published another major report that summarizes the results of the investigation phase. 'A stocktake on the digital euro' does not provide scenarios but instead voices European insecurities, stating that,

> A digital euro would also address risks stemming from geopolitical tensions. The fragility of global supply chains exposed by the coronavirus (COVID-19) pandemic and Russia's war of aggression in Ukraine has painfully demonstrated the risks of relying exclusively on external suppliers for basic needs. (p. 4)

This could be read as drawing remarkable parallels between the European reliance on Russian gas to its reliance on predominantly US payment providers. The report continues by providing three ways in which the digital euro would strengthen Europe's resilience:

> First, it would ensure that, in addition to European private payment solutions (which so far have remained national), there would be a payment solution for the euro area under European governance. This would support the strategic autonomy of Europe's entire

> payment ecosystem. Second, a digital euro would be able to rely on its own underlying infrastructure. This would enhance the overall resilience of Europe's electronic payment system in the event of cyberattacks and technical disruptions. Third, a digital euro would also provide a pan-European platform on which European PSPs [payment service providers] could build services with pan-European reach for their customers. (p. 5)

These statements directly link to the comments made by Christine Lagarde cited at the beginning of this section on the aim of the design process. She prefers the term 'resilience' over 'strategic autonomy'. Whereas 'strategic autonomy' puts an emphasis on European efforts to gain a higher degree of independence, the term 'resilience' invokes a more technical nuance of governing uncertainty. Indeed, resilience enacts the logic of preparedness to anticipate unforeseen events and to be prepared for their occurrence. Unlike precaution or preemption, the logic of preparedness does not aim to stop a future event from happening. Rather, it focuses on limiting the effects of a possible event that threatens to disrupt everyday life (Anderson, 2010). The term 'resilience' originated in ecology and is now widely used in various areas, such as social psychology and disaster management (Walker & Cooper, 2011).

Within financial governance, resilience entails the conviction that future crises cannot be prevented, but their effects can only be limited. This rationale is taken a step further with the digital euro. Evelien Witlox, Program Manager of the digital euro project, explained at a 2022 event with industry experts that the resilience of the digital euro would depend on its usage (the extent to which it is widely accepted), whereas the presence of the infrastructure would already serve the goal of strategic independence (see also presentation by Witlox, 2022). The digital euro could provide a fallback solution if the scenario of a 'foreign digital solution' (hinting at the digital yuan which is already in use) expanding within Europe were to materialize and if geopolitical tensions intensified (Ioannou et al., 2023, p. 113). This line of thinking has also been evoked by the IMF, which proposes that a 'CBDC could serve as a "redundancy" system to complement non-CBDC payments, thereby potentially increasing payment system resilience. This would not necessarily require a high degree of adoption—as long as the CBDC is available, it would fulfill a useful role' (Soderberg et al., 2023). As central bankers stress in conversation and at public events, they work with a long-term perspective of five, 10 or 15 years and toward preparing for any future crisis that might occur. They still refer to the profound insecurities of the future, as Fabio Panetta, former member of the ECB Executive Board and currently Governor of Banca d'Italia, does when he states that preserving European autonomy would be even more critical in the future, 'as further expansion of large technology companies into payments would make the concerns I have outlined even stronger and more pressing' (Panetta, 2023).

How does the discourse of preserving European autonomy and promoting resilience materialize in the plans for the digital euro? A 'Prototype summary' (ECB, 2023a) provides concrete design options, such as the one for online cases, that is displayed in Figure 1. It shows how the underlying infrastructure of the digital euro could take shape and how tasks might be distributed between public and private actors once the digital currency is launched. In the described prototypes, the ECB would provide the back-end of the digital euro which includes the 'core settlement engine' which is later called N€XT, 'a bespoke design developed from scratch by the Eurosystem' (ECB, 2023a, p. 5). The architecture of N€XT is based

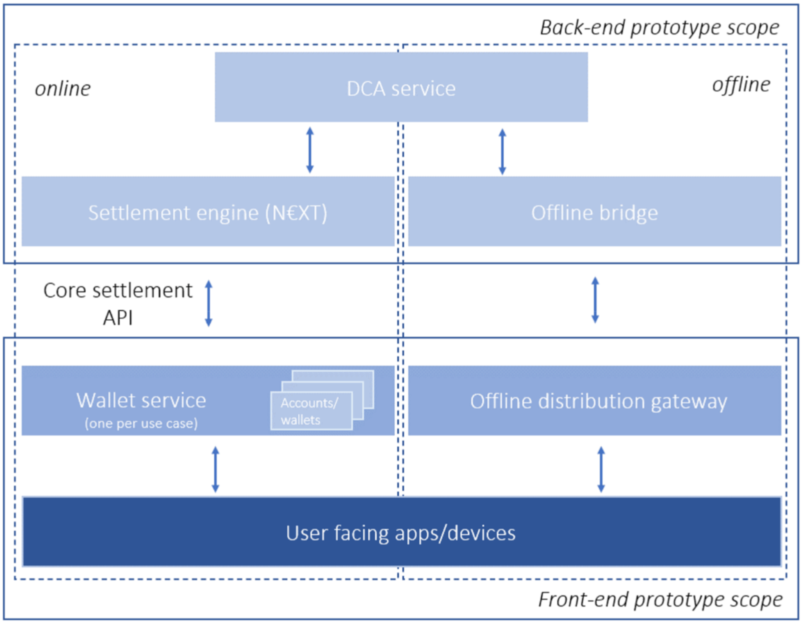

Figure 1. Front- and back-end prototype scope, taken from Digital euro – Prototype summary and lessons learned (ECB, 2023a, 2023b, 2023c, 2023e, 2023f, p. 4).[2]

on a UTXO data model, which is also used by distributed ledger technologies. This core technology would allow the Eurosystem to have control over central bank money settlements. Using so-called Application Programming Interfaces (APIs), the ECB enables the interaction with payment service providers that would provide applications for end users (the front-end). APIs are already established as a governing tool in payments and were a focal point of European Payment Service Directive 2 (PSD2, see Westermeier, 2020). The offline model, however, could be based on different data models and technical designs (ECB, 2023a).

The prototypes are thus materializations of (in)security as they show how the Eurosystem seeks to fulfill its aim to 'rely on its own infrastructure, thereby strengthening resilience' (ECB, 2023b). The ECB seeks to provide the core functions of the digital euro. In addition to the components that the Eurosystem will source internally, such as payment settlement, the institution issued calls for applications for digital euro component providers in January 2024 with contracts valued at up to €1.1 billion (ECB, 2024). The concession regime also specifies that only 'EU Nationals that are controlled by EU Nationals' are eligible as candidates, tenderers, members of a temporary grouping or subcontractors, i.e. any legal entity with registered offices in an EU member state or any natural person that has the nationality of an EU member state. The document also specifies 'control' as 'the ability to exercise a decisive influence on an undertaking, directly, or indirectly through one or more intermediate undertakings' (ECB, 2024, p. 4). These remarkable specifications for component providers show that the ECB aims to assemble the infrastructure of the digital euro exclusively by European actors.

The materialization of the digital euro thus mirrors how European security is perceived to be threatened and how it may be preserved. In terms of the design concepts for the digital euro, matter is not simply generative, introducing new elements into existence; rather, the materialization of the digital euro has effects beyond its concrete design. Given the close interconnection within the central bank community and ongoing collaborative initiatives between the ECB and other central banks, their actions are closely monitored and factor into the considerations of other central banks. Of course, the ECB's plans for the prototypes are also essential for private payment providers that seek to provide the digital euro. The next section discusses the challenges that the materialized security rationales entail for the existing financial architecture.

Balancing finance and security

> How central banks navigate the digital era – such as innovating their payment systems and issuing digital currencies – will also be critical for which currencies ultimately rise and fall. This is an important reason why the ECB is exploring in depth how a digital euro could best work if launched.
>
> (Lagarde 2023)

Designing a digital currency entails the reimagination of the monetary system (Swartz, 2018). As discussed above, all parts that form the established financial system can potentially be adjusted and given new purpose, including the role of the central bank, the role of intermediaries, the form of cross-border financial transactions and the usage of public-private *vs*. public money. Therefore, the ECB's announcement that it would pursue the development of the digital euro created significant uncertainty for market participants and international partners and adversaries.

The decision to develop a retail CBDC immediately raises questions about the role of (other European) intermediaries. The ECB has repeatedly emphasized that they want the private sector to play a crucial role in the new monetary system – disintermediation was not on the table (Panetta, 2021). This ruled out the one-tier model of CBDCs in which the central bank issues the digital currency which is directly accessible to end users. Instead, the favored model is an intermediated one, which means that the CBDC is issued by the central bank and accessible for end users *via* commercial banks and other payment service providers.

During its two-year investigation phase, the ECB provided regular updates and cooperated with different stakeholders, most notably market participants and their stakeholder associations. The ECB closely interacted with the European Commission on a range of policy, legal and technical questions related to the digital euro and exchanged views with the European Parliament and the finance ministers of the euro area. Last, representatives of European civil society organizations are invited to seminars where ECB experts present their work. Still, the communication of the ECB has been primarily directed toward close circles of experts and practitioners. The public debate about the future of the European monetary system has only slowly started. Yet, banks and other service providers are alerted and raise concerns about the implications of the new CBDC as its design as a security infrastructure has implications for the financial industry.

While the provision of a financial infrastructure is the most decisive security-related implication of the digital euro, the introduction of a new form of public money is the decisive financial feature. Within the hierarchy of money forms, CBDCs as public digital money would fall in the highest rank, above private money which is backed by public institutions (Murau & van't Klooster, 2023). In the past, the ECB did not draw attention to the differences between public money and private money. On the contrary, as Braun points out, the ECB and the German Bundesbank rather entertained 'folk theories of money' that dominated the public conception of the monetary system, which hold that 'all money is created equal, that banks are intermediaries, and that money is exogenous' (2016, p. 1067). But with the introduction of the digital euro, the ECB now emphasizes the differences between private and public money. Amidst the perceived threats relating to cryptocurrencies and money managed by non-European entities, the ECB has begun using the analogy of central bank money as a 'monetary anchor for payments' (Panetta, 2021).

The new emphasis on the public character of CBDCs, however, poses a challenge to the established financial system: If one can access the safest form of money, why should one hold a lesser form of money and keep it in an account at a commercial bank? Although the ECB does not say what exactly a 'monetary anchor' entails, banks argue that the 'anchor' itself would raise the risk of uncontrolled disintermediation of the banking system. The ECB reacts to these concerns by emphasizing that the use of the digital euro should be limited to a means of payment. The amount of digital euros that each citizen can hold could be limited to, for example, €3000 and thereby discourage the usage of CBDC accounts as a store of value. The ECB also stresses that they seek to limit the spectrum of services it offers compared to a bank account held with a private bank (Bindseil, 2020, p. 26). According to the current plans, the digital euro would be public money on a digital infrastructure, but it would nevertheless be a public-private endeavor as the ECB wants private actors to act as payment service providers, meaning they should provide the applications and means to access the digital currency. The infrastructural affordances, however, require a separation of public money and private money, represented in differing accounts for the digital euro and private money.

The paradoxes in the planned design show that the ECB seems to walk a tightrope to establish the digital euro as a security infrastructure but avoid making it too financially successful. One banking representative at an industry meeting made the comparison that the ECB would not only build the road but also the cars which drive on it, thus providing an analogy for the design of a CBDC that combines infrastructure and the value that it circulates and stores. The ECB's communication insists that it seeks to have a share in the market for payments, but it does not want to disrupt the market altogether. Economists have been vocal about these contradictions, arguing that the digital euro would not resolve market inefficiencies and questioning the 'unique selling proposition from the user's perspective compared with existing payment systems' (Bofinger & Haas, 2021). Potential users might largely ignore the new CBDC, as for a typical household the planned digital euro would have serious disadvantages: There would be the need to hold a parallel commercial bank account as there is no overdraft facility, and the €3000 threshold would require extensive monitoring. A report for the ECON Committee of the European Parliament, prepared by the former member of the supervisory board of the ECB, Ignazio Angeloni (2023), comes to the conclusion that the '"solution" that a digital euro entails does not have a well-identified "problem" behind it—in terms of inefficiencies or dangers of the status quo.' The report summarized the economic arguments against the digital euro: 'The payment system is already efficient and constantly progressing; there are no "market failures" suggesting central banks should be directly involved; CBDCs will not succeed because central banks lack the necessary expertise to win the market; CBDCs may put financial stability at risk; CBDCs would distort and discourage private investment and innovation' (p. 20). In short, from Angeloni's economic perspective the digital euro would foremost pose a potential threat to the established financial order.

Despite the criticism coming from banks, analysts and economists, the ECB seems determined to continue with the development of the digital euro. While tensions between security and financial logics remain, the ECB seeks to resolve them by developing the infrastructure of the digital euro as a public-private endeavor. Thus, private companies are expected to provide parts of the new financial infrastructure. While money has long been a public-private 'template' (Ingham, 2020, p. 62ff), this has not been the case for the pipes and rails that enable its circulation. As the economists' remarks show, payments are perceived as a market in which private actors compete for a market share, less as an infrastructure provided for public use. While not radically challenging this perception, the digital euro can also be interpreted as a step toward turning payment infrastructure into a public-private template that mirrors the character of money that it helps circulate.

The geopolitization of central banks?

> *'The time to think about how to respond to changing geopolitics is not when fragmentation is upon us, but before.'*
>
> (Lagarde et al., 2023)

As the analysis of the proposed digital euro as a finance/security infrastructure has shown, the ECB increasingly highlights geopolitical security rationales in its decision making. Especially in the case of the digital euro, the nexus of financial technology and geopolitics has been present from the very beginning. Increasingly, high-ranking representatives of the ECB, foremost its president, are more vocal about the implications of geopolitics for a range of policy areas, and they position themselves as geopolitical actors. This is not to say that central banking was apolitical before. On the contrary, scholarship in political economy and economic sociology has foregrounded in numerous ways how the ECB has long functioned as a political actor (Gabor, 2016; Wansleben, 2023; Wullweber, 2024). The debate on the digital euro, however, shows that the ECB increasingly positions itself as such.

The ECB not only links its rhetoric about European autonomy to the communication of the European Commission. An extensive, but independent report by the International Relations Committee work stream that is staffed by the ESCBs – 56 authors from various ECBs – analyze the 'EU's Open Strategic Autonomy from a central banking perspective' (Ioannou et al., 2023). While the report does not officially represent the views of the ECB or the ESCB, its findings are nevertheless noticeable:

> While OSA [Open Strategic Autonomy Agenda] is not a direct goal of the ESCB, it is directly relevant for the economic environment in which it operates. In some cases, it is also directly relevant for the primary mandate of the Eurosystem/ESCB, as well as for some of its key principles, such as economic openness (Article 119 of the Treaty on the Functioning of the European Union, TFEU) and its competences, such as payment systems and financial stability (Article 127 TFEU) (ibid., p. 17).

The explicit link to the mandate of the Eurosystem thus provides legitimacy for central bankers to engage with the agenda of strategic autonomy. The ESCB report provides a comprehensive account of the geopolitical situation and cites a number of think tanks that have published on the matter of international security, such as the Center for New American Security and the European Council on Foreign Relations.

In numerous speeches and interviews, ECB representatives not only describe rising geopolitical tensions, but also sketch out possible responses for the ECB and Europe as a whole. For example, Fabio Panetta, then Member of the Executive Board of the ECB, has spoken on multiple occasions about 'protecting the euro area economy from global shocks' and increasing European resilience (Panetta, 2022b). The main protagonist in this regard is Christine Lagarde, the President of the ECB, who addresses the topic of 'Central banks in a fragmenting world' and the 'new global map' in two speeches (several quotes that introduce sections of this article are taken from them). In presentations and panel discussions, she warns of Europe's vulnerabilities and emphasizes the profound changes occurring in global trade, and depicts 'shifts from dependence to diversification, from efficiency to security, and from globalisation to regionalisation' (Lagarde, 2022, 2023). While these are two highly prominent representatives, reports on a survey conducted among ECB staff indicate unease with these positions, pointing to the technocratic character of the central bank (Arnold, 2024).

Recent scholarship has shown that central banks increasingly take positions that sit uneasily with the self-perception of the community of central banking that likes to present itself as politically independent and technocratic. As Quaglia and Verdun (2023, p. 3) argue, central banks' role in financial sanctioning against the Central Bank of Russia's reserves has furthered their role in 'monetary and financial warfare'. For the ECB in particular, the situation has led to a 'rebalancing of the stated objectives of the ECB, which has focused less firmly on "price stability" (primary objective) and has favored a broader set of other objectives, including European integration and geopolitical goals.' Quaglia and Verdun (2023) find this development puzzling, as it could 'drag' the central bank into the realm of geopolitics which could be 'detrimental to its ability to meet its objectives' (price stability) and potentially impact the institution's perceived independence. My analysis of the ECB's position in the development of the digital euro and recent statements by some of its most prominent representatives lead to the conclusion that the ECB has not been 'dragged' into geopolitics, but instead positions itself as an actor in its own regard. Future scholarship will need to closely monitor these developments and assess how geopolitical developments impact central banking and the role central banks take on in this regard.

Conclusion

This article foregrounds the digital euro as a finance/security infrastructure in which European security ambitions manifest in a financial technology. The development of the financial infrastructure is conceptualized as a materialization of (in)security co-produced by discursive and material practices. European security rationales have led to greater determination to proceed with the digital euro and thus explicitly link geopolitical concerns with financial technology.

The development and planning of CBDCs involve several core themes of IPE, not to speak of their future issuance. Already in the phase of planning and deliberation, financial relations between citizens, financial institutions and the (supranational) state are re-negotiated. Seemingly technical questions of connectivity and interoperability are deeply political as they define the quality and character of these relations. Further attention needs to be directed to questions of data sharing and privacy in the evolving governance of these technologies. On the international level, several initiatives and pilots have been initiated which have the potential to redesign the international financial architecture (Bank for International Settlements [BIS], 2023).

The case of the digital euro also shows how financial and security rationales are entangled in the planning of financial infrastructure, and how they collide. While in the past, financial rationalities have been driving the development of new technologies, the plans for the digital euro indicate that this dominance is contested. The ECB and other European institutions mobilize ominous visions of the future and depict the new digital currency as part of European security efforts. Despite the challenges ahead, the ECB and the national central banks of the Eurosystem are committed to developing the digital euro. While it is still open whether the new CBDC will be a success, the fact that the ECB plans to provide a European infrastructure for European payments is in itself a practice of security. The digital euro is furthered and driven by European security rationales and at the same time advances them by contributing to the agenda of resilience and autonomy.

While the development of a new European financial infrastructure is the most important security implication of the digital euro, the provision of digital public money is its most important financial implication. The digital euro as a retail CBDC would allow individual citizens to hold public money in a non-cash form. Introducing public money in this way, however, brings potential challenges to banks and other financial actors that perceive their position within the established financial architecture as threatened. The case thus shows that financial and security mechanisms are not necessarily mutually reinforcing, but that security logics may challenge financial ones and vice versa.

The commitment of the ECB and the central banks of the Eurosystem to further pursue and develop the digital euro can be seen as a signal that they want to strengthen their role as public institutions that aim to protect European interests amid growing geopolitical tensions. Though the role of these central banks over the past 15 years has primarily been to manage financial and economic crises, these steps toward a digital euro indicate a geopolitization of central banking. While it is yet to be decided how the current geopolitical security claims are hardwired into the financial infrastructures that CBDCs present, their development has already led central bankers to exert themselves more explicitly than before as geopolitical actors in their own regard.

Notes

1. https://www.epicompany.eu/https://www.epicompany.eu/
2. This model applies if the provider only intends to provide a reduced front-end scope (no wallet service). Otherwise, these services would also be provided by payment providers.

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