AALBORG UNIVERSITET

Intelligent Documentation - Agentic Search in Service Design

Developing a Framework for Structured Knowledge Capture to Enable AI-Based Knowledge Retrieval

Paul Jacob Schlenzig, May 2025

Abstract Whiteboard-based tools such as Miro and FigJam are widely used by service designers to document their processes. While valued for their collaborative and visual strengths, these tools often result in fragmented, inconsistent, and difficult-to-retrieve documentation. This thesis investigates how documentation practices in service design might be improved by introducing intelligent, AI-powered retrieval systems.

The research sets out two objectives: (1) to enable service designers to document their work in a way that large language models (LLMs) can process effectively, and (2) to apply an LLM to support natural language querying of that documentation. Following a Research through Design approach, the study combines user research (survey, workshop, interview), scenario-based design, and trend analysis to understand current practices and explore future directions. These insights informed the development of a proof of concept framework, FLUID, which was evaluated through a limited user test.

Key findings highlight the fragmented and unsustainable nature of current documentation ecosystems, a strong recognition of pain points among designers, and a general openness to change. The test demonstrated the technical feasibility of AI-enhanced documentation but also revealed usability and onboarding challenges.

The thesis concludes that while structured input is essential for effective LLM-powered retrieval, tools like FLUID must align with designers' realities to gain traction. It also emphasizes the need for accessible onboarding and reflects on the trade-off between offering FLUID as a simplified service and using it to foster technical literacy among service designers. Ultimately, the work positions intelligent documentation not only as a technical upgrade but as an opportunity to empower designers in an AI-driven future.

Keywords: Service Design · Design Documentation · Structured Knowledge Capture · Knowledge Management · Large Language Models (LLMs) · AI-Based Knowledge Retrieval · Research through Design · Human-AI Interaction

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List of Abbreviations

AI Artificial Intelligence

CLT Cognitive Load Theory

DCT Dual Coding Theory

ECFR European Council on Foreign Relations

ETL Extract, Transform, Load

FLUID Framework for Living User-centered Information Documentation

GenAI Generative Artificial Intelligence

ISM Information Seeking Mantra

LLM Large Language Model

PoC Proof of Concept

PoLP Principle of Least Privilege

RAG Retrieval-Augmented Generation

SaaS Software as a Service

S3DK Service Design Digital Documentation Toolkit

UI User Interface

1 Introduction

During my Master's degree in Service Systems Design, I have had the opportunity to examine the research documentation of various design projects. These projects ranged from those led by professors and professional researchers of the private sector to those conducted by my peers and me. Despite the diversity in their nature, a commonality among them was the predominant use of whiteboard-based applications like Miro[1] or FigJam[2] for documenting research processes and findings.
With my background in computer science, I found the reliance on whiteboard-based tools for long-term information storage to be problematic, given the notable limitations these tools present:

- **Consistency of Information:** Maintaining a unified source of truth becomes challenging in collaborative projects with extensive research. It is often difficult to locate accurate information within a complex whiteboard setup. Additionally, some tools may not support file uploads, necessitating a secondary documentation method, which complicates the retrieval process.
- **Cost Implications:** The subscription costs for these services can be substantial, depending on the scope of documentation and the number of collaborators. This factor can affect the long-term sustainability of the documentation, as there may be a tendency to delete the whiteboard post-project to reduce costs.
- **Privacy Concerns:** Uploading sensitive information to third-party services can pose risks concerning compliance and legal standards. The data is stored on external servers, accessible only via the whiteboard application.
- **Data Retention:** Post-project, the challenge arises in how to preserve the documentation without an ongoing subscription. While exports in formats like PNG, SVG, or PDFs are possible, they are not practical for extensive projects. Any uploaded files are also not included in these exports.
- **Documentation Strategy:** Documentation within these tools is constrained by the initial organizational strategy chosen, be it domain-driven or chronological. Once set, it becomes impractical to switch strategies due to the sheer volume of accumulated information, locking the documentation into a single format.

Admittedly, some of these limitations might not be unique to whiteboard-based documentation and may apply to other digital systems as well. However, the convergence of these constraints in whiteboard tools prompted me to critically question their widespread use in design practice. At the same time, their popularity suggests they fulfill certain needs, perhaps due to their intuitive usability or the flexibility they offer, which may align well with the iterative and exploratory nature of design processes.
Consequently, this thesis begins by exploring the following aspects:

[1] https://miro.com
[2] https://www.figma.com/figjam/

- Investigating and comparing various documentation approaches and tools to better understand the strengths of whiteboard-based tools and to challenge my initial assumptions.
- Examining current trends to identify how they relate to and could shape documentation practices in the future.
- Gaining insight into what designers document, how they do so, and the challenges they encounter in the process.

Ultimately, this exploration aims to inform the development of a solution that improves how service designers interact with project documentation, enhancing both the accessibility and usability of the information, while accommodating the diverse needs and working styles of individual designers.
This thesis follows a design research methodology grounded in the Double Diamond framework, guiding the process through the phases Discover (Section 2), Define (Section 3), Develop (Section 6), and Deliver (Section 7). To strengthen the information foundation between the problem and solution spaces, two targeted excursions were conducted: one into the documentation practices of service designers (Section 4), and one into the technical landscape of Large Language Models (LLMs). The discussion in Section 8 includes an evaluation of the solution, an outlook on future work, and reflections on the process, followed by a concluding chapter in Section 9 that summarizes the thesis.
The overall approach is informed by Research Through Design, where the act of designing, in this case, the development of a knowledge management framework, serves as the primary method of inquiry (Zimmerman et al., 2007). Insights were generated through prototyping two system iterations, user-informed refinement, and critical reflection on both technical challenges and documentation practices encountered throughout the process.
The thesis also aligns with Constructive Design Research, particularly in its field mode, where a functional artifact is built to explore a real-world problem (Koskinen et al., 2012). This is complemented by a User-Centered Design mindset: user needs were investigated through a survey, workshop, and interview, informing both the problem framing and solution development (Stickdorn et al., 2018).
Scenario-Based Design was used to explore current and future states of documentation practice and evaluate design implications, while trend and foresight analysis helped contextualize the work within broader developments such as Generative Artificial Intelligence (GenAI) and open-source paradigms (Stickdorn et al., 2018). The prototyping phase involved the implementation of two working system versions, not as speculative mockups, but as usable systems tested with real documentation workflows.
Finally, the research is situated within a post-positivist qualitative paradigm, which values empirical insight while acknowledging the contextual nature of knowledge (Pickard, 2013). The thesis draws on qualitative data and critical reflection to develop a solution that is both technically grounded and situated in the realities of service design practice.

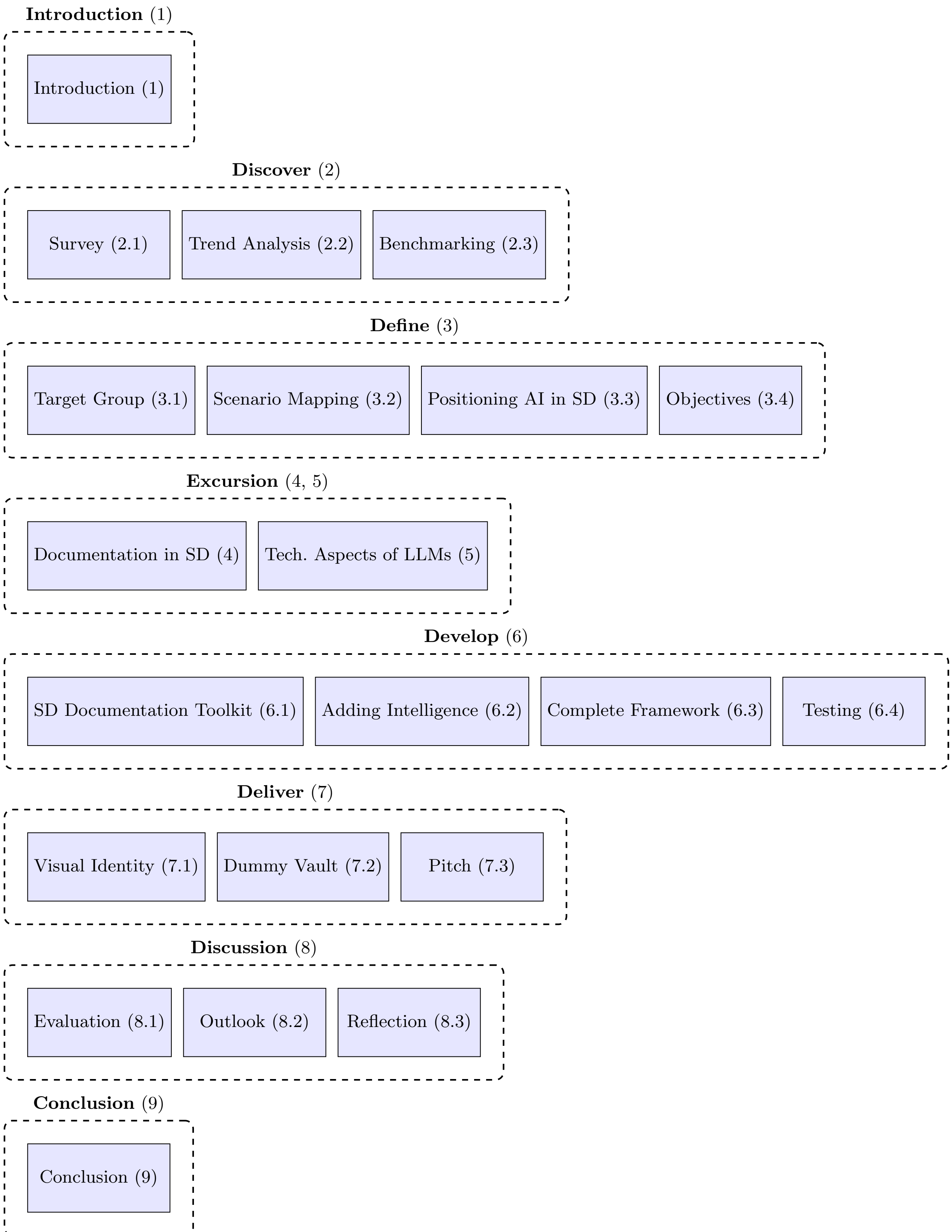


Figure 1: Interactive Overview of the Thesis Structure

2 Discover

Coming from the assumed limitations of whiteboard-based tools in supporting effective documentation, the process begins by seeking to validate these assumptions and build a broader understanding of general documentation practices. To do so, a survey serves as the first empirical step—designed not exclusively for service designers, but distributed to a diverse group of professionals. The goal is to explore how, why, and with what tools documentation is currently performed in practice, and to assess whether the perceived limitations hold true across contexts.

To complement the user-centered findings with a broader strategic perspective, a trend analysis identifies societal, technological, economic, and political developments that are likely to shape the future of documentation practices. This analysis expands the scope of inquiry beyond current user behaviour, providing a forward-looking lens to anticipate emerging needs, opportunities, and constraints in knowledge work.

Lastly, informed by insights from the survey, a taxonomy is developed comprising a set of questions designed to assess how well different tools support key aspects of documentation. This taxonomy is applied to a representative sample of tools, enabling a systematic benchmarking of features and gaps. The resulting analysis contributes to a clearer understanding of the current documentation landscape and the extent to which existing solutions address the identified needs.

Together, these activities reflect the purpose of the Discover phase within the Double Diamond framework: to investigate the problem space from multiple angles, surface unmet needs, and generate a rich foundation of insights to inform the subsequent design process.

2.1 Survey

As a first step in the research process, a survey was conducted to gain a broad overview of current documentation practices across various disciplines and age groups. By engaging a diverse audience, the survey aimed to understand which tools are commonly used, how effectively information is captured and retrieved, and what strengths and limitations users experience, particularly with regard to whiteboard-based tools.

In addition, the survey was designed to challenge and validate the early assumptions discussed in Section 1. By collecting empirical data from a wide range of respondents, the goal was to establish a grounded understanding of the documentation landscape that could support the direction and relevance of the project's next phases.

Section 2.1.1 introduces the theoretical background that informed the survey's questions. It provides conceptual grounding for understanding how individuals interact with information, particularly when documenting, retrieving, and making sense of knowledge. The section draws from several intersecting disciplines that offer complementary perspectives on cognitive processing, representation,

and information management - factors that shape how documentation tools are used and experienced.
While some theories presented are several decades old, they remain foundational and widely respected. Their continued relevance lies in their ability to explain patterns of information behavior across changing technological contexts. By revisiting these models, the thesis establishes a theoretical lens through which contemporary documentation practices, especially those involving visual and collaborative tools, can be critically examined.
Section 2.1.2 outlines the development, structure, and execution of the survey. It describes how theoretical insights and practical considerations were combined to shape the survey's content, details the types of questions used (both quantitative and qualitative), and explains the rationale behind the chosen format and distribution strategy.
Finally, Section 2.1.3 presents the analysis of the responses and synthesises the findings. Drawing from both quantitative and qualitative data, the insights are structured using a SWOT analysis, highlighting strengths, weaknesses, opportunities, and threats related to current documentation practices. These results lay the groundwork for the design exploration that follows.

2.1.1 Theoretical Background

Cognitive Load Theory

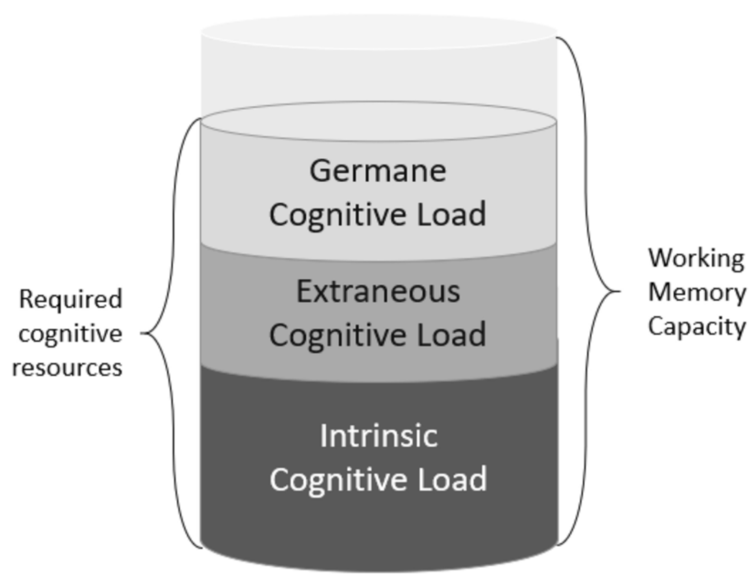


Figure 2: Illustration of Elements of Cognitive Load (Krieglstein et al., 2022)

Cognitive Load Theory (CLT) is a framework from educational psychology that elucidates how humans process and organize information cognitively. The theory is particularly relevant to the design of documentation and tools for knowledge retrieval, where understanding and managing cognitive load can significantly enhance the usability and effectiveness of information systems.
CLT identifies three types of cognitive load (see Figure 2) that play critical roles in how individuals interact with content:

- Intrinsic Cognitive Load: This is the inherent difficulty associated with the content itself. The level of intrinsic load is determined by the complexity of the material and the learner's prior knowledge. In contexts like documentation and knowledge retrieval, intrinsic load can vary widely depending on the user's familiarity with the terminology and concepts presented.
- Extraneous Cognitive Load: This load arises from the way information is presented to the user. In the context of documentation, extraneous load can be influenced by layout, accessibility of information, and the clarity of instructions. Minimizing extraneous load involves streamlining information presentation to avoid unnecessary complexity that does not directly contribute to learning or task completion.
- Germane Cognitive Load: Germane cognitive load refers to the cognitive effort directed toward the construction of schemas and meaningful learning. In documentation and knowledge retrieval systems, fostering germane load might involve organizing information in a way that aligns with user expectations and prior knowledge, thereby facilitating deeper understanding and efficient information processing.

The interplay between these loads is crucial, especially given the finite capacity of human working memory. High intrinsic loads necessitate the minimization of extraneous load to free cognitive resources for processing complex information. Conversely, when intrinsic load is low, the impact of extraneous load on overall cognitive capacity is less critical, though its reduction can still improve user experience and efficiency. An optimal balance allows users to maximize their cognitive resources for processing relevant information, thereby enhancing learning, understanding, and the application of knowledge in practical tasks.
Understanding and managing these interactions is key to designing effective documentation and knowledge retrieval systems that cater to the cognitive needs of users, facilitating ease of access, comprehension, and application of information. (Paas et al., 2003; Sweller et al., 1998)

Schema Theory

Schema Theory, as explored by Axelrod in 'Schema Theory: An Information Processing Model of Perception and Cognition', provides a framework for understanding how pre-existing cognitive frameworks, or schemas, facilitate the processing and interpretation of complex information. His work, published in the

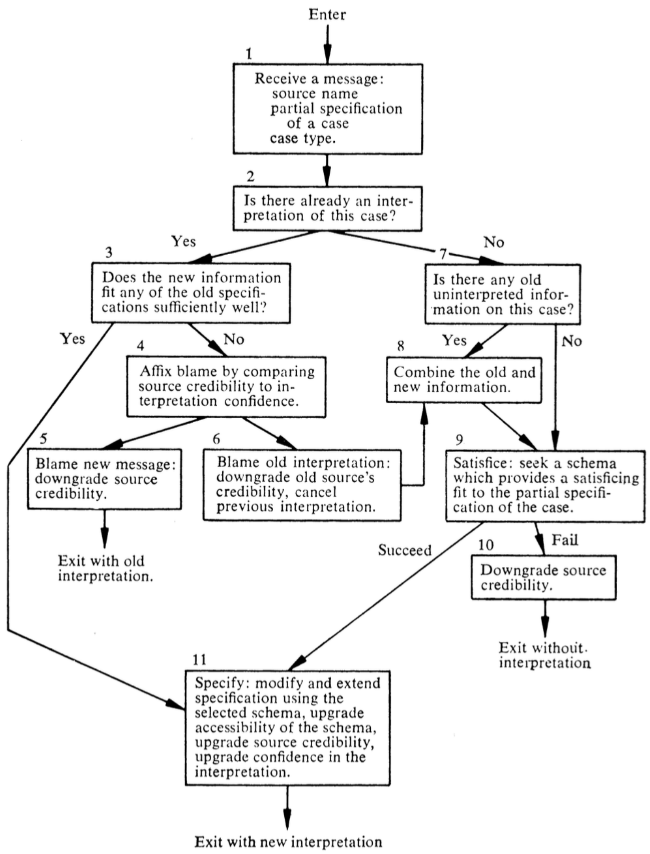


Figure 3: Process Model for Schema Theory (Axelrod, 1973)

American Political Science Review in 1973, explores the role of schemas in organizing and categorizing incoming data, thereby enhancing cognitive efficiency and reducing cognitive load.
Key Aspects of Schema Theory:

– Definition of a Schema: Schemas are cognitive structures that help in organizing and interpreting information, enabling the quick assimilation of complex data into familiar patterns. These structures streamline cognitive processes, making decision-making quicker and more efficient. Examples of common schemas include:
  – Hierarchical Schemas: Used in organizational charts to depict structures of authority and job roles, facilitating an understanding of company structure.
  – Process-Oriented Schemas: Seen in step-by-step guides or workflows, such as cooking recipes or assembly instructions, helping users perform tasks in a logical sequence.

  - Categorical Schemas: Used for classifying information into categories or types, such as sorting books into genres in a library or organisms in taxonomic classifications.
  - Timeline Schemas: Employed in creating timelines that order events chronologically, useful in history or project management to track progress over time.
  - Cause-and-Effect Schemas: Useful in scenarios like medical diagnostics where understanding the relationship between symptoms and diseases is crucial.
  - Visual Schemas: Include diagrams and infographics that help in understanding complex information through visual representation, such as flowcharts or organizational charts.
  - Relational Schemas: Used to show connections or relationships between entities, like in network diagrams or relational databases, facilitating the exploration of data relationships.
- Information Processing Model: Axelrod's model suggests that incoming information is evaluated based on its fit with existing schemas. A compatible fit reinforces or updates the schema, enhancing cognitive efficiency, while a poor fit might necessitate adjustments, underscoring the dynamic interaction between new information and existing knowledge.
- Integration with CLT: Schema Theory aligns closely with CLT, particularly in managing different types of cognitive loads. By organizing information into schemas, individuals can reduce extraneous cognitive load and enhance germane cognitive load, thereby facilitating deeper understanding and learning efficiency.

Axelrod's investigation into schemas provides deep insights into the cognitive mechanisms underpinning perception and cognition, highlighting the crucial role these structures play in managing the complexity of the information-rich environments individuals navigate daily.

Information Seeking Mantra

Shneiderman's Information Seeking Mantra (ISM), detailed in his publication 'The eyes have it: a task by data type taxonomy for information visualizations' introduces a framework for effective data interaction through graphical user interfaces. This approach aims to optimize user engagement with complex datasets by categorizing data types and recommending specific interaction tasks.
Shneiderman categorizes data into various types, each suited to different visualization and interaction strategies:

- One-dimensional Data: Includes linear data such as textual documents and lists, where each item is organized sequentially. Example: a chronological list of events.
- Two-dimensional Data: Covers planar data such as geographic maps and floor plans, where items occupy positions within a two-dimensional space. Example: architectural blueprints.

- Three-dimensional Data: Pertains to data with volume, like molecular models or CAD designs. Example: 3D architectural models of buildings.
- Temporal Data: Involves time-related information crucial for schedules or timelines. Example: project management timelines showing task durations.
- Multi-dimensional Data: Encompasses complex datasets with multiple attributes, typical in databases or statistical analyses. Example: customer data in a CRM system detailing attributes like demographics and purchase history.
- Tree Data: Represents hierarchical structures with parent-child relationships. Example: organizational charts or file system directories.
- Network Data: Consists of elements interconnected by various types of relationships. Example: social network graphs illustrating user connections.

Aligned with these data types, Shneiderman outlines essential tasks that facilitate systematic data exploration:

- Overview: Obtaining a broad understanding of the entire dataset.
- Zoom: Focusing in on specific elements or sections.
- Filter: Screening out less relevant data.
- Details-on-demand: Accessing more detailed information on specific items when needed.
- Relate: Understanding relationships between different data points.
- History: Keeping a log of interactions to facilitate navigation and understanding.
- Extract: Pulling specific subsets of data for further use or detailed analysis.

The ISM is particularly useful in managing large volumes of information, such as those found in digital libraries, archives, or large databases. It helps users navigate through extensive datasets efficiently, focus on the most relevant information, and retrieve detailed data as needed. This structured interaction not only supports effective documentation and knowledge retrieval but also enhances the overall process of data analysis and decision-making based on visualized information.

Dual Coding Theory

Developed by Paivio, Dual Coding Theory (DCT) provides a comprehensive framework for understanding how humans integrate verbal and non-verbal information. This theory suggests that cognitive processing involves two interconnected systems: the verbal system (logogens) and the non-verbal system (imagens), which enhance our cognitive abilities beyond what traditional intelligence tests typically measure.

- Logogens: Manage verbal information, processing language-based data.
- Imagens: Handle non-verbal information, such as sensory and perceptual inputs, facilitating mental visualization.

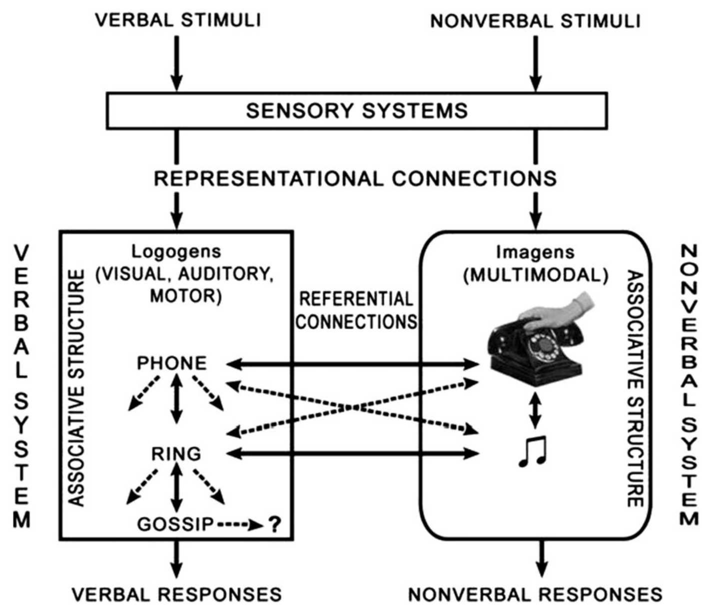


Figure 4: Dual Coding Theory Model Showing the Interaction Between Verbal and Non-Verbal Units and Their Connections (Paivio, 2014)

DCT is particularly beneficial for enhancing the effectiveness of documentation and knowledge management systems:

- Enhanced Information Retrieval: Information coded both verbally and non-verbally can be recalled more effectively, supporting quicker and more efficient retrieval systems.
- Improved Understanding and Learning: The integration of verbal descriptions with visual or other sensory representations can make educational materials and user manuals more comprehensible and memorable.
- Facilitated Knowledge Transfer: Supports the design of multimedia educational tools and collaborative platforms that leverage text and visuals, enhancing communication among diverse groups.

DCT challenges traditional intelligence assessments that focus predominantly on verbal and abstract reasoning skills. It underscores the importance of non-verbal processes, such as visualization and sensory interaction, which are crucial in practical tasks and creative endeavors. For instance, professions that rely heavily on spatial and visual skills, such as mechanics or architects, benefit significantly from the cognitive interplay between verbal instructions and non-verbal, visual understanding-capabilities that standard IQ tests may overlook but are vital for effective performance in various fields.

In systems design for documentation and knowledge sharing, DCT advises a holistic approach that accommodates both verbal and non-verbal elements. This approach not only enhances the accessibility and usability of information systems but also aligns with the cognitive processes involved in interpreting and utilizing complex information. (Paivio, 2014)

2.1.2 Content & Structure

Building on the theoretical foundations outlined earlier, the survey is structured into seven sections. The first section gathers demographic information, followed by a second section that addresses general practices and attitudes toward documentation. The subsequent four sections are directly informed by academic literature and focus on specific dimensions of user interaction with project documentation, each explored through targeted questions. The final section concludes the survey with an open-ended invitation for additional comments or feedback and a brief thank-you to participants.

Section 1: Demographic Information

This section of the survey collects detailed demographic information to analyze differences in how various age groups and professionals interact with and perceive project documentation. The questions are designed to identify age, educational background, employment status, industry sector, organizational role, and years of experience in the current field (see Appendix B.1). This detailed demographic profiling enables the identification of distinct patterns and needs across different groups, which is essential for tailoring solutions during the development phase. Moreover, understanding these demographic dimensions allows for the possibility of focusing on specific professions or age groups if particular needs or challenges emerge during data analysis. This approach ensures that solution development is deeply informed by a nuanced understanding of the user base.

Section 2: General Questions

This section of the survey explores general approaches to project documentation. It is designed to understand the frequency of documentation activities, the types of tools used and the overall satisfaction with these tools. Specifically, the survey aims to

- Assess the frequency with which professionals engage in documentation tasks, providing insights into the regularity and reliance on documentation in professional settings.
- Identify the range of tools used for documentation purposes, such as FigJam, Miro, Notion and others, to provide a snapshot of current technology preferences and trends in the industry.
- Evaluate user satisfaction with these tools, which is critical to identifying strengths and weaknesses in existing documentation systems and areas for improvement.

In addition, the survey aims to understand the importance of specific characteristics to users, including

- Privacy: Ensuring that documentation tools protect sensitive information.
- Ease of use: Improving the user experience to facilitate smoother documentation processes.
- Collaboration features: Supporting effective teamwork and information sharing through documentation tools.

The data collected will provide a general overview of the documentation tools in use, highlighting the characteristics users value most and their overall satisfaction with the tools' capabilities. Combined with demographic data, the analysis could reveal whether tool preferences vary based on age, profession, or education, providing essential insights for optimizing tool design and functionality to better meet the diverse needs of user groups. By focusing on these aspects, the survey will outline the documentation landscape, revealing user priorities and preferences across different demographic groups, which forms a solid basis for further research or development efforts. The exact questions are detailed in the Appendix, see Section B.2.

Section 3: Cognitive Load Theory

This section of the survey (see Appendix B.3), based on the principles of CLT (see Section 2.1.1), is designed to evaluate the cognitive loads involved in working with documentation. It aims to analyze how effectively the documentation is structured in relation to the cognitive loads.

- Intrinsic Cognitive Load The survey evaluates the inherent complexity of the documentation content. It focuses on understanding how the nature of the information itself may challenge comprehension, requiring cognitive effort to process and understand the material.
  When information in the documentation can only be understood in context, it indicates a high intrinsic cognitive load. In such cases, it becomes even more critical to consider the other cognitive loads during the documentation design process.
- Extraneous Cognitive Load The survey also examines how the information is presented. This evaluation considers whether the structure and design of the documentation unnecessarily increase cognitive effort, which could hinder efficient information processing and retrieval.
  The higher the intrinsic cognitive load, the more essential it is to minimize extraneous cognitive load, for example, by avoiding unnecessary details or overly complex layouts.
- Germane Cognitive Load Finally, the survey investigates the cognitive effort directed toward meaningful learning and schema construction. It evaluates whether the documentation facilitates intuitive understanding and easy retrieval of information, thereby supporting efficient learning and application.

A high germane cognitive load suggests that significant effort has been invested in structuring the information into commonly used schemas, making it easier and more pleasant to revisit the documentation. Conversely, if users find revisiting the documentation difficult or unpleasant, one potential reason could be that the information is not well-structured into familiar schemas, which complicates retrieval and decreases usability.

These assessments aim to determine whether CLT principles are effectively applied in the documentation. The results could reveal opportunities for improvement in documentation practices.

Section 4: Information Seeking Mantra

This section of the survey (see Appendix B.4), grounded in the research of Shneiderman (see Section 2.1.1), evaluates two critical aspects of documentation systems:

- The Types of Data Being Documented: The survey seeks to understand the frequency with which users interact with the different types of data categorized by Shneiderman. These data types each have unique needs for documentation and retrieval, and understanding their prevalence helps identify the specific requirements for effective documentation practices. Furthermore, by relating these data types to demographic data, such as profession, the survey can explore how different professional contexts influence the types of data that are documented and utilized.
- The Tasks Offered by the Documentation: The survey also examines how effectively documentation systems support core tasks outlined in the ISM. These tasks are crucial for efficient information retrieval, and the survey explores how well documentation systems facilitate them.

The questions in this section aim to identify gaps in current documentation systems in terms of their support for different data types and tasks, while also helping to understand what content, specifically data types, users need to document.

As different data types present unique documentation challenges, it may be valuable to relate the results of this section to demographic information. This approach can help narrow down specific issues or data types to focus on, providing more targeted insights.

By analysing whether the tasks outlined in the ISM are supported by documentation systems, this section highlights potential areas for improvement and customisation. Following the ISM can go a long way to reducing cognitive load. Tasks such as filtering and details-on-demand, for example, minimise extraneous cognitive load by eliminating irrelevant information and providing users with focused, contextual details only when needed. Streamlining the interaction process in this way prevents users from being overwhelmed by unnecessary data, making it easier to process and retrieve information. This ensures that documentation systems better match the cognitive capabilities of users, improving both usability and efficiency.

Section 5: Schema Theory

This section of the survey, informed by Schema Theory (see Section 2.1.1), evaluates how users interact with various organizational structures in documentation. It aims to assess users' familiarity with structures such as hierarchical arrangements, step-by-step workflows, visual representations, timelines, problem-solution formats, and relational models. Additionally, it investigates how frequently these structures are used, which ones are perceived as most effective, and the challenges encountered when applying them. The survey also seeks to uncover gaps in current practices and identify opportunities for improvement (see Appendix B.5).

Using familiar organizational structures can align with schemas from CLT, contributing to easier knowledge retrieval. For example, structures like hierarchical arrangements or workflows reduce cognitive effort by organizing information in ways that are intuitive and familiar to users. When these structures reflect established schemas, they enhance Germane Cognitive Load, allowing users to focus on understanding and applying the content rather than struggling with its organization.

The insights gained from this section will help determine how well current structures align with user needs and whether certain structures are underutilized or missing. By linking these findings to demographic data, the survey can reveal how preferences for organizational structures vary across different professional contexts, offering targeted recommendations for designing documentation systems that align with user expectations.

Section 6: Dual Coding Theory

This section of the survey, informed by DCT (see Section 2.1.1), examines how effectively text and visuals are integrated in documentation and whether this integration enhances understanding, recall, and usability. DCT emphasizes the cognitive benefits of combining verbal (text) and non-verbal (visual) elements, as information encoded in both systems is more easily processed and retained. The questions aim to assess the quality of this integration, determine whether transitioning between text and visuals is seamless, and identify if visuals are considered necessary or helpful compared to text-only documentation.

By evaluating the effectiveness and necessity of visual elements in documentation, this section seeks to identify gaps in current practices. Poor integration of visuals can hinder comprehension and usability, while well-designed visuals aligned with DCT principles can enhance information retrieval and cognitive processing. The exact questions are detailed in the Appendix, see Section B.6.

Section 7: End Card

The seventh section serves as an end card, thanking participants for their time and contributions. It provides space for optional comments or questions to gather any additional insights from participants. Additionally, my email address is included for any urgent questions or follow-up communication (see Appendix B.7).

Execution

The survey is conducted using Microsoft Forms[3], and the complete questionnaire is available in Appendix B.
In constructing the survey, I follow the guidance of Crawford et al., as outlined in their paper 'Web Surveys: Perceptions of Burden'. This work highlights several strategies for reducing participant burden in web-based surveys, aiming to increase response rates, minimize dropout, improve data quality, and enhance the overall user experience.
To reduce the burden on participants, the survey is designed with the following considerations:

- A progress bar at the bottom of the form indicates overall length.
- Access is simplified via a direct link, with no login or password required.
- The estimated completion time is explicitly stated as approximately 10 minutes.
- Open-ended questions are kept to a minimum and made optional.
- Nearly all remaining questions use single- or multi-select options to simplify response input.

Participants are recruited by sharing the survey link through my LinkedIn account and later via my Instagram story. While I acknowledge that this recruitment approach may introduce bias into the sample's diversity, the primary aim of the survey is to establish an initial understanding of documentation practices and to identify commonly experienced pain points.
The results of the survey analysis are presented in the following section and form a foundation for developing the problem statement.

2.1.3 Analysis

In the previous section, the structure of the survey, its underlying theories, and its execution were presented. Now, the focus shifts to analyzing participants' responses to gain insights into how interaction with project documentation can be improved. This analysis aims to assess the general validity of the challenges outlined in Section 1 and explore potential opportunities for enhancing documentation practices.
This section begins by outlining the approach used to analyze the survey responses. It then presents an overview of the key findings, organized using a SWOT analysis to categorize strengths, weaknesses, opportunities, and threats. Each finding is subsequently explored in detail, followed by a discussion of the analysis' limitations and concluding reflections on the results.

Approach

As described in Section 2.1.2, the survey was conducted using Microsoft Forms. The tool provides a high-level visual overview of the responses for each question, which can be found in Appendix C.

[3] https://forms.office.com

However, this overview did not support an in-depth analysis. To facilitate a more thorough examination, the survey responses were exported as an Excel file (survey-results.xlsx), which is included in the *digital-annex* of the thesis, as detailed in Appendix A.
To optimize the data for analysis, preprocessing was carried out, including the following steps:

- Splitting the responses into the sections of the survey
- Normalizing the data
- Importing it into a locally hosted MySQL database

Once the survey data was imported into the database, SQL queries were used to explore and analyze the responses. To facilitate numerical analysis, the five-point Likert scales were mapped to discrete numeric values, enabling the calculation of averages.
For example: *Strongly agree* = 5, *Agree* = 4, *Neutral* = 3, *Disagree* = 2, *Strongly disagree* = 1.
To ensure reproducibility, the *digital-annex* also includes:

- The SQL import statements required to load the survey data into the database (directory: sql-inserts)
- The SQL queries used for the analysis (directory: sql-statements)

Additionally, ChatGPT was occasionally utilized for correlation analysis, with visualizations generated to illustrate the identified relationships.
After completing the data analysis, the key findings were structured using a SWOT analysis to facilitate sense-making. The resulting clusters are presented in Section 2.1.3, with each of the four SWOT quadrants elaborated upon in the following sections.

Overview of All Insights

The insights derived from the survey were categorized using a SWOT analysis, the results of which are shown in Figure 5. The four quadrants are as follows:

- **Strengths** of Using Whiteboard Tools for Documentation (see Section 2.1.3)
- **Weaknesses** of Using Whiteboard Tools for Documentation (see Section 2.1.3)
- **Opportunities** for Documentation Tools (see Section 2.1.3)
- **Threats** for Documentation Tools (see Section 2.1.3)

To ensure clear identification, each insight was assigned a unique number within its respective category. Additionally, colours were used to match insights with the sections where the corresponding questions were asked.
The upcoming sections will first outline the analysis approach, followed by a detailed discussion of each quadrant and its insights.

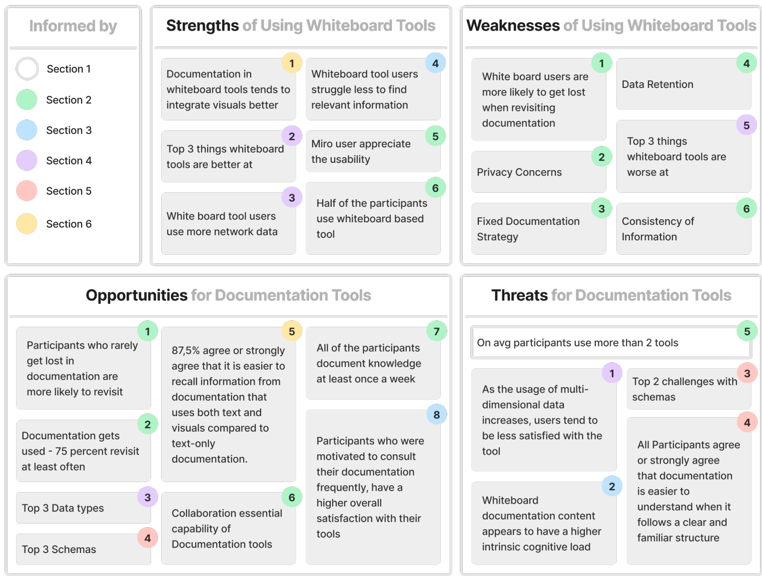


Figure 5: Survey Insights Clustered According to SWOT

Strengths of Using Whiteboard Tools for Documentation

This section presents the six insights illustrated in Figure 5 that highlight the benefits of using whiteboard-based tools for documentation.

Strength 1: Documentation in Whiteboard Tools Tends to Integrate Visuals Better

Based on Question 22 of the survey, which was informed by the DCT, participants who used whiteboard tools[4] provided higher average ratings in response to the statement compared to those who did not use whiteboard tools:

> Text and visuals are combined effectively to explain concepts in the documentation I use.

Furthermore, responses to the other two statements in the question suggest that users of whiteboard-based tools find it easier to recall information from documentation that combines text and visuals, compared to text-only documentation. Additionally, whiteboard tools appear to facilitate smoother transitions between text and visuals.

[4] Participants who selected at least one of the following: Miro, FigJam, Figma.

	Whiteboard	Not Whiteboard
avg_recall_information_uses_text_visuals	4.4634	4.2222
avg_text_visuals_combined_effectively	3.8293	3.6667
avg_transitioning_between_text_visuals	3.6585	3.3333

Table 1: Comparison of Responses for Question 22 Grouped by Category

Strength 2: Top 3 Things Whiteboard Tools Are Better At

In Question 15 of Section 4 of the survey, participants were asked to rate the effectiveness of various features (or tasks, as referred to in the ISM) provided by their tools.
The results suggest that certain tasks are performed more effectively using whiteboard-based tools compared to non-whiteboard tools. These tasks include:

1. Viewing relationships
2. Zooming
3. Obtaining an overview

This outcome aligns with expectations, as whiteboard tools are well-suited for brainstorming sessions and mind mapping, where visualizing relationships is crucial. Additionally, in the context of whiteboards, zooming and obtaining an overview are inherently interconnected, with each influencing the effectiveness of the other.

Whiteboard-Based	Average Score	Non-Whiteboard-Based	Average Score
avg_view_relationships	3.6098	avg_extraction	3.8889
avg_zoom	3.5854	avg_history	3.4444
avg_overview	3.1463	avg_filtering	3.0000
avg_details_on_demand	2.8293	avg_overview	2.9444
avg_extraction	2.8049	avg_view_relationships	2.9444
avg_history	2.7561	avg_details_on_demand	2.8889
avg_filtering	2.3171	avg_zoom	2.6667

Table 2: Comparison of Responses for Question 15

Strength 3: Whiteboard Tool Users Use More Network Data

In connection with Strength 2, responses to Question 14 of Section 4 suggest that participants using whiteboard-based tools tend to engage with network data more frequently. This aligns with the earlier hypothesis that whiteboard-based tools are commonly used for activities such as brainstorming and organizing interconnected ideas, where visualizing relationships is essential.

Whiteboard		Not Whiteboard	
avg_1_dimensional_data	3.7805	avg_1_dimensional_data	4.1111
avg_satisfied_with_tools	3.6585	avg_satisfied_with_tools	3.6667
avg_temporal_data	3.1707	avg_temporal_data	3.1667
avg_network_data	**3.0732**	**avg_network_data**	**2.6667**
avg_multi_dimensional_data	2.8780	avg_2_dimensional_data	2.5556
avg_2_dimensional_data	2.5366	avg_multi_dimensional_data	2.1667
avg_3_dimensional_data	1.5854	avg_3_dimensional_data	1.5556

Table 3: Comparison of Responses for Question 14 Grouped by Category

Strength 4: Whiteboard Tool Users Struggle Less to Find Relevant Information

Question 13 of Section 3 of the survey, informed by the CLT, suggests that participants using whiteboard-based tools struggle less to find relevant information in their documentation compared to non-whiteboard users.
This implies that whiteboard tool users may have an easier time locating information within their documentation than users of other tools. However, this finding contradicts the initial motivation outlined in Section 1. At the same time, there is also evidence supporting the opposite perspective, specifically Weakness 1, which will be further explored in Section 2.1.3.

Tool Category	Average Struggle to Find Information
Whiteboard-Based	3.0732
Non-Whiteboard-Based	2.8889

Table 4: Comparison of Responses for Question 13

Strength 5: Miro Users Appreciate the Usability

Question 11 of Section 2 of the survey provides insights into how participants rate the importance of usability among their documentation tools. The results indicate that Miro users, in particular, highly value usability. Among the 24 participants, 10 reported using Miro, assigning an average usability rating of 4.6, which is noticeably higher than the overall average of 4.2.

Interestingly, this trend is not observed among users of other whiteboard-based tools such as Figma or FigJam. However, due to the small sample size for these tools, it is difficult to draw definitive conclusions.
Comparatively, participants using more technically oriented tools, such as GitHub, rated importance of usability significantly lower, with an average score of 3.0.
These findings suggest that Miro stands out among documentation tools for its usability, particularly in contrast to more technical platforms. This reinforces the notion that whiteboard-based tools, and Miro specifically, offer a more intuitive and user-friendly experience for documentation.

Tool Name	**Average Usability**	**Count Tool users**
Are.na	4.0000	1
Company owned systems	4.0000	1
Confluence	4.8000	5
FigJam	3.6667	3
Figma	4.0000	1
GitHub	3.0000	2
Good Notes	2.0000	1
Goodnotes	4.0000	2
Google Drive	4.0625	16
Loop	5.0000	1
Miro	4.6000	10
Notion	4.4000	5
OneNote	4.3333	9
Teams	5.0000	1
Virtual Brain	5.0000	1

Table 5: Comparison of Responses for Question 11 by Tool

Strength 6: Half of the Participants Use Whiteboard-Based Tools

In Question 8 of Section 2 of the survey, participants were asked to select the tools they use for documentation. The question allowed multiple selections and provided an option to add tools not included in the predefined list.
Based on the responses, it can be inferred that 12 out of 24 participants use at least one whiteboard-based tool. Additionally, the five most commonly used documentation tools were identified as follows:

1. Google Drive
2. Miro
3. OneNote
4. Confluence
5. FigJam

Tool Name	Count of users
Google Drive	16
Miro	10
OneNote	9
Confluence	5
Notion	5
FigJam	3
GitHub	2
Goodnotes	2
Company owned systems	1
Figma	1
Loop	1
Teams	1
Virtual Brain	1
Are.na	1
Good Notes	1

Table 6: Comparison of Responses for Question 8

Weaknesses of Using Whiteboard Tools for Documentation

After highlighting the strengths of whiteboard based tools for documentation, this section will now examine the weaknesses identified in the survey.

Weakness 1: Whiteboard Users Are More Likely to Get Lost When Revisiting Documentation

In Section 2 of the survey, general information was collected. Question 12 examined how frequently participants feel lost when revisiting documentation. Contrary to Strength 4, the results indicate that participants using whiteboard tools experience this issue more often. This finding aligns with the limitations of whiteboard tools discussed in Section 1.

Tool Category	Average Lost When Revisiting
Whiteboard-Based	2.6667
Non-Whiteboard-Based	3.0833

Table 7: Comparison of Responses for Question 12.2

Weakness 2: Privacy Concerns

As part of the general information section, Question 9 allowed participants to specify features they felt were missing from their documentation tools.
One participant highlighted a limitation, stating:

> "[...] viewers can't write comments, but we don't want to give editor role for everyone who is reviewing a document."

This response underscores the need for granular permission settings that allow users to add comments without granting full editing rights. A flexible permission system is also essential for maintaining data privacy through fine-grained access control. However, the Principle of Least Privilege (PoLP) is often not well integrated into whiteboard-based tools.
The response was provided by a participant who uses Miro. However, the tool *Loop* was explicitly mentioned in their answer. Although *Loop* is not classified as a whiteboard-based tool, this feedback highlights a broader need for granular access control, that aligns with the PoLP principle. This need supports the privacy concerns discussed in Section 1.

Weakness 3: Fixed Documentation Strategy

Additional responses to Question 9 included feature requests for:

- Automatic templates
- Detection of duplicate content
- Proper sorting mechanisms
- Categorization features

As discussed in Section 1, a key limitation of whiteboard-based tools is the inability to switch between different views. Once a documentation strategy is chosen (e.g. a chronological approach), there is no option to display or filter the data by other dimensions, such as domain.
The ability to assign categories and apply filtering or sorting would enable multiple perspectives on the data. Additionally, such functionality could facilitate the identification of duplicate content. Implementing templates, depending on their implementation, could also contribute to a more structured data storage model (e.g. by defining properties for entities). Improved data organization would, in turn, support alternative views and enhance filtering and sorting capabilities.
Since whiteboard-based tools currently lack these features, this demand can be interpreted as a fundamental weakness of such tools, reinforcing the limitations initially outlined.

Weakness 4: Data Retention

Other feature requests from Question 9 include:

- Being able to use [the selected tools] all together/ transfer information easily
- Easier ways to digitise information

- Physical Features

Section 1 highlighted the issue of data retention when using whiteboard-based tools. Persisting or transferring stored information typically requires exporting it as an image-based file format, such as PNG, SVG, or PDF. While this may be sufficient for storing small projects, extensive documentation files can easily exceed one gigabyte in size, making them impractical to manage, transfer and use effectively. As a result, seamless information transfer between (whiteboard-based) tools is not feasible. This limitation is reinforced by one of the feature requests, further supporting the concerns outlined in Section 1.
Although motivated by different concerns, the other two feature requests can also be categorized under *Data Retention*. Unlike the first request, which addresses digital data transfer, these requests highlight the lack of functionality for capturing and preserving information from physical spaces. Based on my interpretation of these responses, participants expressed a need for features that enable the seamless digitization of physical content, such as post-it clusters.
While this perspective on *Data Retention* differs from the initial definition of the limitation, it introduces an interesting concept, enhancing information retention across both digital and physical mediums.

Weakness 5: Top 3 Things Whiteboard Tools Are Worse At

Section 4 of the survey, specifically Question 15, examined the tasks defined by the ISM. In Strength 2 of Section 2.1.3, the top three tasks where whiteboard tools outperform other tools were presented. However, there are also tasks where whiteboard-based tools underperformed in comparison to other documentation tools. These include:

- Data Extraction
- Filtering
- History

In line with concerns related to *Data Retention*, whiteboard-based tools perform significantly worse in effectively executing data extraction.
Additionally, as highlighted in Weakness 3, these tools offer limited filtering capabilities, making it difficult to locate specific information. This limitation may further support the likelihood of Weakness 1 being valid compared to Strength 4.
Finally, whiteboard-based tools are less effective at implementing features that enable historical traceability.
The supporting data for these findings was presented in Table 2.

Weakness 6: Consistency of Information

One of the limitations outlined in Section 1 was the issue of *Consistency of Information*. This critique encompasses several key aspects:

- Whiteboard tools require integration with cloud file storage, as they do not support uploads for all file types.

- Detecting specific information in extensive whiteboard documentation is cumbersome due to the lack of effective filtering or search functionality.
- Identifying duplicate information is challenging, as limited filtering options and a rigid documentation structure prevent the establishment of a single source of truth, potentially leading to ambiguity.

Feature requests from Question 9 reinforce this limitation. According to participant responses, the following functionalities are notably missing:

- A file system
- A unified solution for storing files and notes together
- A centralized space for project-relevant documentation
- Seamless integration between tools and easier information transfer

These requests highlight the limitation that whiteboard tools do not provide comprehensive file management capabilities.
Additionally, several participants expressed a need for:

- A smart search engine
- Improved search functionality
- AI support
- Reliable AI integration

These requests further support the critique that retrieving relevant information within whiteboard documentation is difficult and that duplicate content remains a persistent issue.

Opportunities for Documentation Tools

Building on the insights from the survey, this section explores eight key opportunities for improving documentation tools. These opportunities highlight areas where existing solutions can be enhanced to better support users' needs and address current limitations.

Opportunity 1: Participants Who Rarely Get Lost in Documentation Are More Likely To Revisit

In Question 12 of Section 2 of the survey, participants were asked to evaluate how often they revisit documentation and how frequently they feel lost when doing so.
An analysis of the average responses suggests a negative correlation between these two questions, as visualized in Figure 6.
This relationship can be interpreted in two ways:

- Participants who get lost more frequently may visit the documentation less often, or
- Participants who regularly revisit their documentation are less likely to feel lost.

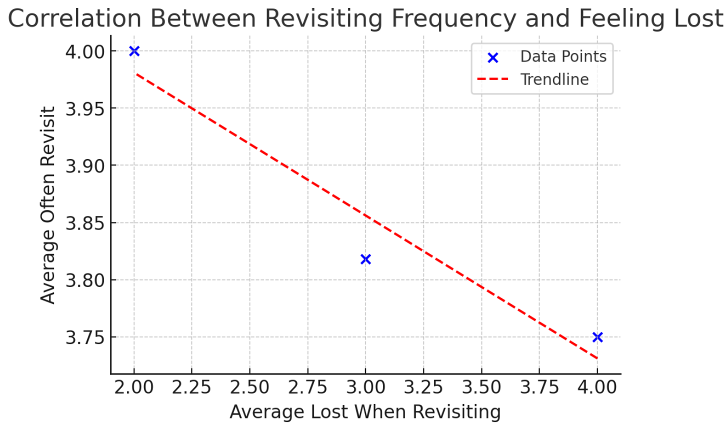


Figure 6: Correlation Between Revisiting Frequency and Feeling Lost

Regardless of the interpretation, this finding presents an opportunity for improving knowledge documentation tools. Implementing features that facilitate quick information retrieval - thus reducing the likelihood of getting lost - could encourage users to engage with the documentation more frequently, ultimately supporting more informed design decisions.
Additionally, the second interpretation reinforces the value of documentation itself. Regular interaction with documentation fosters familiarity with the knowledge base, making navigation more intuitive and decreasing the chances of getting lost over time.

Opportunity 2: Documentation Gets Used – 75 Percent Revisit at Least Often

Building on the insights from Question 12, the results show that 18 out of 24 participants revisit documentation often or always, while only 6 participants reported revisiting documentation occasionally.
This underscores the importance of documentation as a critical resource in workflows. With the majority of participants relying on documentation frequently, investing in features and best practices that improve knowledge capture and retrieval is not only valuable but also a strategic decision with long-term benefits.

Revisiting Frequency	Number of Participants
Always	2
Occasionally	6
Often	16

Table 8: Comparison of Responses for Question 12.1

Opportunity 3: Top 3 Data Types

The data types proposed by the ISM were assessed based on their frequency of usage in Question 14 of the survey. The results indicate that the following three data types are the most commonly used in documentation:

- One-dimensional data
- Temporal data
- Network data

Given their prevalence, it is crucial for documentation tools to support these data types to meet user requirements effectively. Tools that lack support for these fundamental data types may be overlooked, even if they offer advanced capabilities in other areas. Therefore, incorporating features that accommodate these data types could enhance a tool's appeal and usability for a broader user base.

Metrics	Values
avg_1_dimensional_data	3.8814
avg_temporal_data	3.1695
avg_network_data	2.9492
avg_multi_dimensional_data	2.6610
avg_2_dimensional_data	2.5424
avg_3_dimensional_data	1.5763

Table 9: Comparison of Responses for Question 14 Across Datatypes

Opportunity 4: Top 3 Schemas

In Section 5 of the survey, Questions 16 and 17 examined the use of schemas, focusing on both their frequency of usage and their effectiveness in making documentation clearer and easier to understand.
Based on participant responses, the three most commonly used schemas are:

1. Hierarchical structures

2. Visual representations
3. Step-by-step workflows

In terms of effectiveness, the same three schemas were ranked highest, but in a slightly different order:

1. Visual representations
2. Step-by-step workflows
3. Hierarchical structures

Similar to the findings in Opportunity 3, ensuring that documentation tools support these schemas can enhance their usability and make them more appealing to users.

Metrics	**Values**
avg_hierarchical_structures	4.3051
avg_visual_representations	4.2542
avg_step_by_step_workflows	3.9661
avg_timeline_formats	3.9492
avg_satisfied_with_tools	3.6610
avg_relational_models	3.5424
avg_problem_solution_structures	3.3898

Table 10: Comparison of Responses for Question 16

Opportunity 5: 87,5% Agree or Strongly Agree That It Is Easier To Recall Information From Documentation That Uses Both Text and Visuals Compared to Text-Only Documentation

In relation to the DCT, the survey results support the notion that combining text and visuals enhances information recall compared to text alone. Among the participants, 87.5% agreed or strongly agreed with this statement.
This underscores the importance of documentation tools being able to support both visual and textual content effectively.

Recall Information Uses Text and Visuals	Amount of particpants
Agree	6
Neutral	2
Strongly Agree	15
Strongly Disagree	1

Table 11: Comparison of Responses for Question 22

Opportunity 6: Collaboration Essential Capability of Documentation Tools

While collaboration is a particular strength of Miro, as shown in Strength 5, it is also recognized as an essential capability across all documentation tools.
Among the three factors - privacy, collaboration, and usability - collaboration was ranked the highest in Question 11. This highlights the necessity for documentation tools to provide robust collaboration features to serve as viable alternatives to whiteboard tools such as Miro.

capability	avg. rating
Privacy	3.8750
Collaboration	4.4583
Usability	4.2083

Table 12: Comparison of Responses for Question 11

Opportunity 7: All of the Participants Document Knowledge at Least Once a Week

While Opportunity 2 has shown that documentation is revisited regularly, the results from Question 7 provide additional evidence of its significance. All participants document knowledge at least once a week, with half doing so daily.
This reinforces the importance of investing in effective documentation practices, as it can lead to substantial resource savings over time.

frequently document	Amount of Participants
Daily	12
Weekly	12

Table 13: Comparison of Responses for Question 7

Opportunity 8: Participants Who Were Motivated To Consult Their Documentation Frequently, Have a Higher Overall Satisfaction With Their Tools

A combined analysis of Questions 10 and 13 suggests a moderate correlation between the motivation to consult documentation and overall satisfaction with the tool (as shown in Figure 7). However, this correlation is not statistically significant ($r = 0.46$, $p = 0.083$). The data indicates that participants who are more satisfied with their documentation tools tend to be more motivated to consult the documentation.

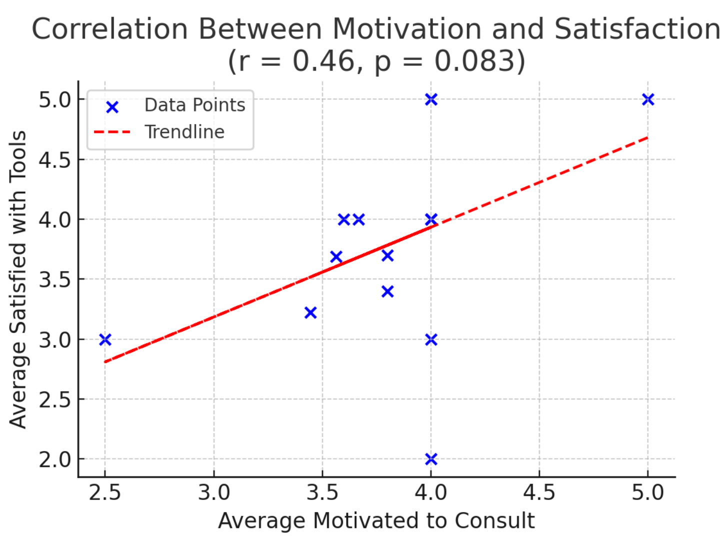


Figure 7: Correlation Between Motivation to Consult and Tool Satisfaction

This finding suggests that higher user satisfaction, potentially driven by the tool's ability to support schemas, data types, or collaboration, increases the likelihood of users actively engaging with the documentation.

Threats for Documentation Tools

This section presents the five insights illustrated in Figure 5 that highlight potential challenges and limitations of documentation tools. These threats were identified through the survey and address issues such as data complexity, schema inconsistencies, cognitive load, and tool fragmentation.

Threat 1: As the Usage of Multi-Dimensional Data Increases, Users Tend To Be Less Satisfied With the Tool

When combining the results from Questions 10 and 14, a moderate negative correlation appears between the frequency of multi-dimensional data usage and satisfaction with the selected tools.
This suggests that participants who work more frequently with multi-dimensional data are more likely to be dissatisfied with their documentation tools. However, due to the p-value, this relationship cannot be considered statistically significant with confidence (p = 0.141, r = -0.40).

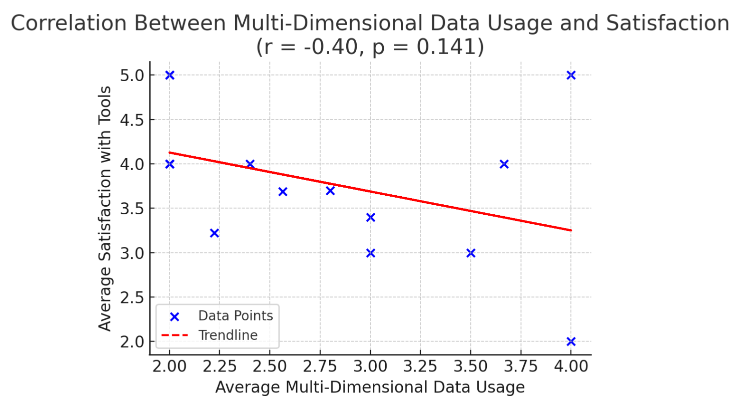


Figure 8: Correlation Between Multi-Dimensional Data Usage and Satisfaction

Nonetheless, this finding hints towards a broader challenge: as data complexity increases, documentation becomes more difficult. This difficulty could stem from the intrinsic complexity of multi-dimensional data or from insufficient tool support for handling such data effectively. The latter could indicate that inadequate support for complex data structures negatively impacts overall tool satisfaction, underlining the importance of user-centered documentation capabilities.

Threat 2: Whiteboard Documentation Content Appears To Have a Higher Intrinsic Cognitive Load

When discussing data complexity, Question 13 suggests that information stored in whiteboard-based tools is more likely to require contextual understanding.

As introduced in Section 2.1.1, the CLT states that information that can only be understood within a specific context has a higher intrinsic cognitive load.

Category	**avg_only_understood_in_context**
Whiteboard-Based	3.4146
Non-Whiteboard-Based	3.1667

Table 14: Comparison of Responses for Question 13 Grouped by Category

If the information documented in whiteboard tools inherently carries a higher intrinsic cognitive load, retrieving and effectively utilizing it becomes more challenging. This suggests that whiteboard-based documentation may require additional cognitive effort to interpret and recall, potentially impacting knowledge retention and usability.

Threat 3: Top 2 Challenges With Schemas

When dealing with high intrinsic cognitive load, utilizing appropriate schemas can help reduce the overall cognitive burden (see Sections 2.1.1 and 2.1.1).
However, as indicated by the responses to Question 9, fitting all information into a single schema can be challenging. 12 out of 24 participants identified this as a key challenge in schema usage.
Even when information is successfully fit into a schema, one-third of participants reported discrepancies in schema usage among collaborators as a significant issue. Improper schema application can undermine its intended benefits, limiting its effectiveness and potentially increasing cognitive load when retrieving information. This, in turn, may reduce the usability of the documentation, ultimately leading to lower engagement and adoption.

Threat 4: All Participants Agree or Strongly Agree That Documentation Is Easier To Understand When It Follows a Clear and Familiar Structure

In Question 8, participants were asked to rank their agreement with the statement that following a clear and familiar structure makes documentation easier to understand. All participants either agreed or strongly agreed with this statement. While this result is unsurprising, it is still valuable to have it confirmed by empirical evidence.
The statement in Question 22 can be expressed as an implication in the sense of propositional logic:

> If documentation follows a clear structure, then it is easy to understand.

By applying negation, the opposite can be inferred:

> If documentation is not easy to understand, then it does not follow a clear structure.

This leads to an interesting paradox: If participants recognize the benefits of structured documentation, why do 19 out of 24 participants still get lost at least occasionally when revisiting documentation? And why do only 5 out of 24 participants rarely get lost?
This suggests that, despite being aware that a clear structure improves comprehension, participants do not consistently apply this principle in practice. This discrepancy, known as the attitude-behavior gap, is likely difficult to address through documentation tools alone.

Threat 5: On Average Participants Use More Than 2 Tools

While Strength 6 highlighted that half of the participants use whiteboard-based tools, Question 8 further reveals that participants, on average, use 2.4583 tools to document their knowledge.
Using multiple tools simultaneously introduces the risk of losing a single point of truth. Once documentation is spread across multiple platforms, an additional system must be maintained and searched through. This issue is particularly relevant for whiteboard-based tools, which often require secondary storage solutions for files. As discussed in Section 1, this challenge was also addressed in Weakness 6.
From these findings, it can be concluded that most participants have developed a practice of using multiple tools concurrently. While this approach may offer flexibility, it also increases the risk of ambiguity and may compromise the quality and consistency of stored information.

Limitations

While the survey provided valuable user insights, several limitations must be acknowledged.
Firstly, the sample size of only 24 participants is too small to achieve statistical significance. As a result, all findings, particularly the correlation analyses, should be interpreted as hypotheses or tendencies, rather than definitive proof. Additionally, the participants were recruited from my LinkedIn and Instagram networks, which likely introduces a selection bias. The sample primarily consists of young, highly educated knowledge workers from diverse industries, occupying a variety of roles with moderate work experience. Further demographic details can be found in Appendix C (Questions 1–8).
Secondly, there seem to be some contradictions within the results of the survey. For example, while Strength 4 suggests that *Whiteboard Tool Users Struggle Less to Find Relevant Information*, Weakness 1 indicates that *Whiteboard Users Are More Likely to Get Lost When Revisiting Documentation.* This contradiction raises the question *How can whiteboard tool users struggle less to find information while also getting lost more frequently?* Potential explanations could include:

- The small sample size, making certain patterns appear inconsistently.

- Misinterpretations of survey questions by participants.
- Response reliability, although there is no additional evidence suggesting inconsistencies in responses.

Another notable limitation, which may also have led to inconsistencies, relates to the survey design itself, which became apparent during the analysis phase. Due to the multi-select format of Question 8 (which allowed participants to list multiple documentation tools), it is not possible to attribute responses to a specific tool when multiple were selected. For example, if a participant stated they use both Miro and Google Drive, their subsequent responses, such as being highly satisfied with their documentation tools, do not specify whether this satisfaction applies to Miro, Google Drive, or both. However, while this prevents tool-specific conclusions, it still allows for general insights regarding user satisfaction with their overall documentation setup. For example, if a participant indicated they use Miro and Google Drive, it is still possible to infer that this Miro user (who also uses Google Drive) is highly satisfied with their tool choices. However, this design inevitably dilutes the precision of the survey's insights, as it remains unclear which specific tool contributed to their satisfaction. Yet, the alternative, restricting Question 8 to a single-select format, would have resulted in the loss of valuable data on the number and combination of tools used, which is crucial for understanding documentation practices. Thus, while this limitation affects the granularity of the results, it was a necessary compromise to retain insights into multi-tool usage patterns.

Furthermore, while the SWOT analysis was helpful for structuring the findings into a coherent narrative, it did not apply equally well to all insights. This was particularly challenging for the Opportunities and Threats categories, as some findings could be interpreted from multiple perspectives, making it difficult to assign them to a single category. For example, Threat 5 could also be viewed as an opportunity rather than a threat. The fact that participants use more than two documentation tools on average could indicate that users are willing to adopt specialized tools for niche tasks, suggesting a potential opportunity for tool developers to refine and integrate their solutions more effectively.

Conclusion

Despite its limitations, the survey provided valuable insights into the role of documentation tools, helping to validate the challenges outlined in Section 1. While the small sample size prevents statistically significant conclusions, the findings still offer meaningful tendencies, particularly regarding the motivational barriers to maintaining structured documentation.

At the same time, the results highlight both the opportunities for improving documentation tools and the threats that must be considered. Whiteboard-based tools remain widely used due to their flexibility and ease of use, presenting an opportunity to integrate these strengths into more structured documentation solutions. However, challenges such as cognitive load, schema inconsistencies,

and the fragmentation of documentation across multiple tools must be addressed to ensure usability without sacrificing information quality.
Beyond evaluating existing practices, this analysis could also serve as a starting point for assessing the final solution proposed in this work. By understanding both the strengths and weaknesses of current documentation practices, there is an opportunity to refine documentation strategies that strike a balance between structure and usability, ultimately improving knowledge management and accessibility.

2.2 Trend Analysis

In the rapidly evolving macro-environment characterized by complexity, uncertainty, and volatility, it becomes imperative for organizations to adopt foresight in their strategic planning to ensure that their service offerings remain relevant and competitive in the future (Buhring & Liedtka, 2018). Foresight in service design serves as a critical tool in understanding and preparing for future needs and contexts, thus enhancing the design's effectiveness and sustainability (Kulsbjerg Løgager et al., 2021).

It is crucial to recognize that both service design and foresight are inherently future-oriented; they strategics around innovations that have yet to be realized. While foresight provides long-term, future-gazing views, service design typically focuses on the more immediate, near-future applications of services. Integrating these two approaches provides designers with a comprehensive understanding of user needs and broader contextual shifts across social, cultural, economic, technological, and environmental spheres (Ojasalo & Ojasalo, 2018). This integration deepens the strategic foundation from which services are designed.

In this context, I employed trend analysis as a foresight method to inform the service design process. Trend analysis involves assessing trends which are significant forces that influence society but do not solely determine future developments; they are moderated by counter-trends, thus providing a balanced view of future possibilities (Cramer et al., 2016). Incorporating trend analysis into service design not only enhances the depth and breadth of the design process but also ensures that the services are strategically positioned to remain relevant and effective as future conditions evolve.

Despite its significant benefits, the use of foresight methods, including trend analysis, has been limited in service design projects, often restricted to the initial phases of design such as preliminary research or early ideation. This limited use suggests a gap in the integration of these methods throughout the design process. To address this, there is a potential to expand the use of foresight to more phases of the service design process (Kulsbjerg Løgager et al., 2021). For instance, scenario planning could be utilized in later stages, particularly in the define phase, to ensure that the insights from trend analysis translate into narratives that are closely aligned with the design brief and contextual needs (Nekkers, 2016).

Kimbell suggests that for a more strategic approach, service designers should consider various drivers of change - political, environmental, socio-cultural, technological, legal/regulatory, and economic - that could impact services over different future periods, ranging from three to over ten years (Kimbell, 2014).

However, as noted by Kulsbjerg Løgager et al., there exists a danger in conducting trend analysis that is too broad, potentially complicating the innovation process within service design (Kulsbjerg Løgager et al., 2021). To address this, I opted to focus on the following five specific trends:

- Sovereignty of Europe
- Demographic Change

– Open Source
– Artificial Intelligence
– Lifelong Learning

These five trends encompass four of the proposed perspectives: Political, socio-cultural, technological, and economic. While the trend analysis does not cover the legal aspects, the environmental considerations are inherently integrated within the analysis of these trends, ensuring a more comprehensive approach.

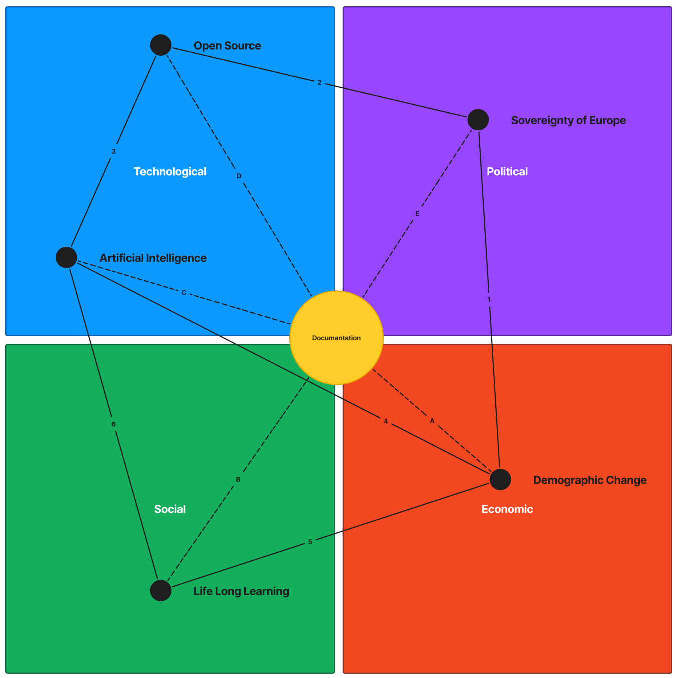


Figure 9: Interrelations of Trends Relevant for Documentation by Category

In Figure 9, all trends, their relevant relationships, and their relevance to documentation are visualized. The solid edges represent the relations among the trends and are numbered, while the dashed line represents the relations of trends and the intentianally kept brought realm of documentation. The trends relate to each other as shown in Table 15.

ID	Trends	Relation	Section
1	Sovereignty of Europe - Demographic Change	Threatens economic stability	2.2.2
2	Sovereignty of Europe - Open Source	Promotes technological independence	2.2.4
3	Artificial Intelligence - Open Source	Democratizes access by commoditizing, Enables data control, Potential to reduce footprint	2.2.4
4	Artificial Intelligence - Demographic Change	Mitigates workforce shortages, Enhancing productivity	2.2.2
5	Lifelong Learning - Demographic Change	Counters workforce ageing with skill renewal	2.2.5
6	Lifelong Learning - Artificial Intelligence	Essential for maintaining employability	2.2.5

Table 15: Annotation of Inter-Trend Relations

In the following, we will explore each trend and how they relate to each other in more detail. We will wrap up this chapter by discussing how these trends are important for documentation, which you can find at the end of this chapter (see Section 2.2.6).

2.2.1 Sovereignty of Europe

The intensifying rivalry between the United States and China has reshaped global trade dynamics, leading to increased trade fragmentation and the realignment of economic relationships (Eugenio Cerutti et al., 2019; Gita, 2024). This evolving landscape poses significant challenges for Europe, which maintains substantial ties with both superpowers. The increased fragmentation and realignment of global trade relationships not only challenge the existing structures of globalization but also threaten the geopolitical and economic stability of regions caught between major powers.
For Europe, the necessity to forge its path towards greater self-dependence has never been more critical. As the pressures from external superpowers mount, the continent faces the risk of being overshadowed or coerced into alignment with one of the dominant global players. This precarious position jeopardizes Europe's autonomy, making the pursuit of strategic sovereignty imperative.
Recognizing these challenges, the European Council on Foreign Relations (ECFR) articulates its vision for Europe's future:

> European countries are increasingly vulnerable to external pressure that prevents them from exercising their sovereignty. This vulnerability threatens the European Union's security, economic health, and diplomatic freedom of action, allowing other powers to impose their preferences on it. To prosper and maintain their independence in a world of geopolitical competition, Europeans must address the interlinked security and economic

> challenges other powerful states present - without withdrawing their support for a rules-based order and the transatlantic alliance. This means creating a new idea of "strategic sovereignty", as well as establishing institutions and empowering individuals that see strategic sovereignty as part of their identity and in their own interest. Most fundamentally, the EU needs to learn to think like a geopolitical power. (European Council on Foreign Relations, 2020)

The concept of *strategic sovereignty* suggested by the Council not only emphasizes the necessity for an autonomous stance in foreign policy and economic practices but also highlights the urgent need for Europe to redefine its role on the global stage. By fostering institutions and cultivating a mindset aligned with geopolitical assertiveness, Europe might be able to secure its place as a resilient and sovereign entity in a rapidly changing world order.

2.2.2 Demographic Change

One significant societal challenge to establishing *strategic sovereignty* is demographic change. This refers to shifts in the population's structure over time, such as aging, variations in birth and death rates, and migration patterns. Such changes demand substantial adaptations in healthcare, welfare, and employment sectors to support sustainable development and maintain social cohesion.
The aging population leads to a shrinking workforce, which poses risks to economic prosperity by potentially reducing the GDPs of Europe's member states. The *European Commission Report on the Impact of Demographic Change* highlights that without strategic interventions, a diminishing labor force could slow economic growth and lessen competitiveness (European Commission, 2023).
However, this challenge can be mitigated by enhancing productivity. According to McKinsey, "Productivity measures the amount of value created for each hour that is worked in a society" (McKinsey, 2024). The integration of digitization and AI technologies is seen as a pivotal strategy for boosting productivity levels in developed economies, thus compensating for the reduced workforce (McKinsey, 2024).

2.2.3 Artificial Intelligence

In the realm of geopolitical dynamics, ECFR underscores the importance of digital sovereignty. Identified as one of five essential dimensions to achieve *strategic sovereignty*, this aspect is crucial for Europe's strategic future. The ECFR points out that Europe has lagged in the initial wave of digital innovations, which were primarily developed outside its borders (Hobbs, Carla, 2020).
The council also stresses the need for the EU to evolve beyond its regulatory role to establish itself as a leader in technological innovation. As emphasized, "[t]he EU cannot continue to rely on its regulatory power but must become a tech superpower in its own right. Referees do not win the game" (Hobbs, Carla, 2020).

AI is highlighted as a key area of technology that Europe must actively engage with to assert its digital sovereignty and leverage potential competitive advantages.
According to Stryker, Cole and Kavlakoglu, Eda from IBM AI, "[...] is technology that enables computers and machines to simulate human learning, comprehension, problem solving, decision making, creativity and autonomy." (Stryker, Cole & Kavlakoglu, Eda, 2024) Since the release of OpenAI's ChatGPT in 2022, a subset of AI known as GenAI has risen to prominence.

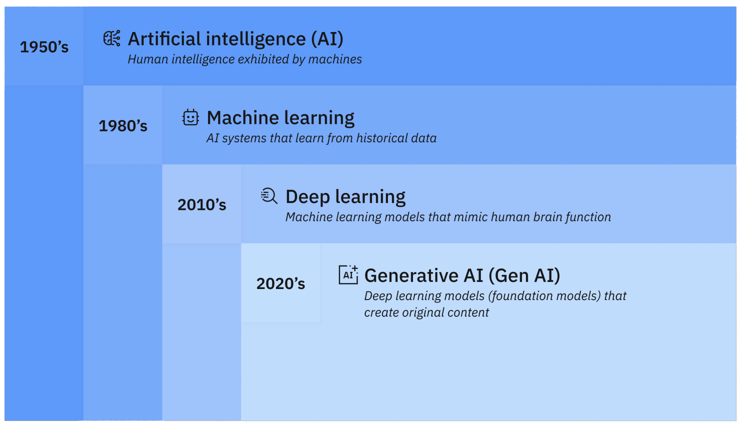


Figure 10: Concepts and Evolution of AI (Stryker, Cole & Kavlakoglu, Eda, 2024)

Though Jaffri, Afraz from Gartner suggests the hype around GenAI has peaked, the technology's relevance continues as it "[...] has potential to be a transformational technology with profound business impacts on content discovery, creation, authenticity and regulation, automation of human work, and customer and employee experiences" (Jaffri, Afraz, 2024).
Accenture also emphasizes the significant potential of GenAI, noting that "Generative AI presents a huge opportunity to accelerate reinvention, offering the potential to reshape every facet of an organization. Our recent research indicates that technology is the top lever for reinvention for 98% of organizations, with generative AI now seen as one of the main levers for 82% of those organizations. This underscores the growing recognition of its transformative potential among businesses across various industries" (accenture, 2024).

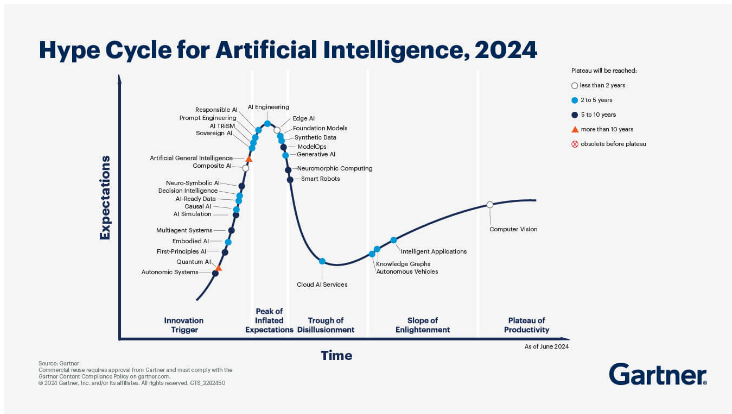


Figure 11: Hype Cycle for AI 2024 (Jaffri, Afraz, 2024)

Assistive Search

One trend for AI identified by Google Cloud for 2025 is the evolution of assistive search, which leverages AI to improve the efficiency and accuracy of retrieving information. Assistive Search is designed to streamline complex query handling by providing contextualized, personalized, and relevant results. It integrates GenAI capabilities to enhance user interactions by offering predictive suggestions, summarizing information, and answering follow-up queries dynamically. This approach significantly reduces the effort required to sift through vast datasets, allowing users to focus on decision-making and creativity. As businesses and organizations adopt this technology, they can achieve better insights and operational efficiency by tailoring search outcomes to specific needs and contexts. (Google Cloud, 2025)

AI Agents

Another AI specific trend mentioned by Google Cloud for 2025 is the growing adoption of AI agents, which are autonomous software systems designed to perform tasks, make decisions, and interact with users or other systems. These agents leverage advanced machine learning models to analyze complex datasets, automate repetitive processes, and provide tailored recommendations. AI agents excel in dynamic environments, where their ability to learn and adapt enables them to address diverse use cases, from customer support to enterprise operations. By integrating seamlessly into workflows, they enhance productivity and decision-making, allowing organizations to operate with greater agility and precision. This trend underscores the increasing reliance on AI to drive innovation and efficiency across industries. (Google Cloud, 2025)

Energy Consumption

One significant downside of AI is the rapid increase in energy consumption, particularly among LLMs. Since 2012, the energy use of AI systems has grown by an estimated 300,000 times, driven largely by the escalating complexity and scale of models such as deep neural networks, which require massive computational power for both training and inference (Hidalgo et al., 2023). Training state-of-the-art models demands sustained operation of high-performance hardware, with computational requirements doubling approximately every 3.4 months (Verdecchia et al., 2022). As a result, data centers supporting these systems now account for 5 to 9% of global electricity consumption and contribute around 2% of global CO2 emissions (Hidalgo et al., 2023). Efforts to mitigate these impacts include "Green AI" initiatives, which focus on optimizing model architectures and utilizing energy-efficient hardware (Tabbakh et al., 2024). Striking a balance between innovation and sustainability is crucial to addressing the long-term effects of AI's energy footprint.

2.2.4 Open Source

Open source refers to open source software, where the software code is made publicly accessible, allowing anyone to view, modify, and distribute it. This approach not only facilitates decentralized, collaborative development but also enhances security due to its transparency. Community involvement in open source software leads to cost-effective, flexible solutions that typically offer greater longevity than proprietary software. Beyond software, the open source concept has grown into a movement that applies its principles to solve broader community and industry challenges through a decentralized production model. (Red Hat, 2019)

In the realm of AI, the open source approach has significantly shaped developments. LLMs, for example, are increasingly seen as commodities and broadly available. (Larissa Holzki, 2025; Stephen M. Walker II, 2024)

Companies like SAP have strategically chosen not to expend enormous resources on developing proprietary LLMs. Instead, they leverage existing open-source models, integrating them into their systems to save on the substantial energy and resources required for training such models from scratch. This strategic decision not only conserves resources but also allows for rapid scalability and flexibility in AI applications. (Larissa Holzki, 2025; YatseaLi, 2024)

Mark Zuckerberg of Meta advocates for the open sourcing of AI, suggesting it promotes safety, prosperity, and equitable access, preventing the concentration of power within a few hands. He posits that governments will likely support open-source initiatives as they lead to a more prosperous and secure world. (Isaac, 2024; Mark Zuckerberg, 2024)

Open-source LLMs enable companies and individuals to run their own instances of the model, be it locally or in the cloud, allowing for fine-tuning with proprietary data without the need to share it with external AI providers. This control over data aligns with the zero-trust principle and enhances data security.

Europe stands to benefit significantly from this shift towards open-source LLMs, seizing the opportunity to develop unique use cases on freely available, customizable models.

2.2.5 Lifelong Learning

Lifelong learning is defined as the continuous, voluntary pursuit of knowledge for personal or professional reasons. It enhances social inclusion, active citizenship, and personal development, as well as competitiveness and employability. The concept emphasizes that learning occurs throughout an individual's life in various settings - formal, non-formal, and informal - encompassing both education and practical application of skills in real-world contexts. (Valle, 2024)
Lifelong learning is highly relevant for individuals as it enables them to adapt to rapid changes in their environments, technologies, and economies. It supports personal and professional growth, helping individuals to meet challenges, capitalize on opportunities, and participate fully in all aspects of life. (Valle, 2024)
As demographic shifts intensify the competition for skilled labor, organizations face significant challenges in maintaining steady performance and managing changes in operations. The aging population and evolving job markets require a strong emphasis on lifelong learning to keep the workforce productive and innovative. Gajanova, Lubica points out that the shortage of skilled workers leads to fierce competition for talent, forcing companies to quickly adjust their strategies to attract and retain essential personnel. This local shortage has prompted companies to adopt remote work and flexible talent models, allowing them to tap into a global talent pool and mitigate the impact of local demographic changes (Gajanova, Lubica, 2021; Ozimek & Stanton, 2022). This situation highlights the crucial role of lifelong learning programs that not only help individuals adapt to new roles and technologies but also assist companies in addressing the challenges posed by skill shortages. By prioritizing lifelong learning, organizations can develop a workforce that is well-prepared to navigate the demands of a rapidly changing economic environment, thus enhancing both corporate performance and employee satisfaction. (Valle, 2024)
Relating lifelong learning to technological changes, particularly the rise of AI and digital transformation, it's evident that continuous learning is essential to stay abreast of technological advancements. As AI and automation reshape industries, workers need to continuously update their skills to work effectively with new technologies and maintain their employability in a changing labor market. Lifelong learning facilitates the transition by providing individuals with the necessary skills to adapt and thrive in a technologically advanced workplace.

2.2.6 Relevance for Documentation

As illustrated in Figure 9, each trend discussed either influences or is influenced by documentation practices. Currently, we are in the process of identifying relevant inputs to enhance documentation, and no concrete concept has been

developed yet. Consequently, the central circle in Figure 9, labeled "documentation" and connected to various trends, remains conceptual.
For the purposes of the subsequent discussion, documentation is defined as:

> ...the systematic process of capturing, organizing, and sharing knowledge that facilitates effective communication and decision-making across various disciplines. It encompasses the creation of structured repositories that are tailored to the needs of users, thereby enhancing knowledge management and retrieval.

Moving forward, we will explore how these emerging trends relate to documentation to determine how they could inform and improve the design process, making it more robust and future-proof.

A: Documentation - Demographic Change: Crucial for Preserving Expertise

In Section 2.2.2, the discussion focuses on the demographic changes occurring across Europe, particularly the retirement of a substantial number of skilled workers. These workers have played a critical role in driving prosperity through their accumulated expertise over recent decades. To mitigate the loss of this invaluable knowledge, robust documentation practices are crucial. Effective documentation not only helps in preserving this knowledge but also facilitates a smoother transition and continuity as the workforce evolves.

B: Documentation - Lifelong Learning: Enhancing Skill Acquisition

Related to the demographic change is the concept of Lifelong Learning explained in Section 2.2.5. For effective learning well structured documentation is helpful. In Section 2.1.1 theories and frameworks how to do so have been presented. As an example, organizing information in a way that does not cognitively exhaust the user is essential for learning. Including non verbal information improves Information Retrieval, Understanding and Learning. Such strategies not only aid in learning but also make the process more engaging and accessible.

C: Documentation - Artificial Intelligence: Accelerates Evidence-Based Decision Making

The potential integration of AI (see Section 2.2.3), particularly GenAI, could revolutionize documentation processes by enabling more interactive and intuitive systems. These advanced AI technologies might enhance user experience by allowing individuals to interact with documentation in a natural, verbal manner, which could significantly simplify the search and retrieval process. Currently, on average, an employee spends approximately 19 percent of their working hours trying to discover information needed to complete tasks (McKinsey & Company, 2012). With the integration of AI in documentation systems, this time could be significantly reduced, as AI might streamline the ability to quickly locate specific information and integrate insights across various data silos. Furthermore, AI could support sophisticated analysis and synthesis of disparate data sets, providing a unified view that enhances decision-making.

D: Documentation - Open Source: Potential Enabling Technology

As discussed in Section 2.2.4, open-source AI models, particularly LLMs, could provide Europe with an opportunity to close the technological gap with the United States and China. By identifying relevant use cases and fine-tuning AI models, Europe can potentially develop innovative business models that can be monetized and exported globally. This strategy not only strengthens Europe's technological stature but also creates new economic opportunities on the international stage. One such use case could be the application of AI in documentation, as previously demonstrated.

E: Documentation - Sovereignty of Europe: Think Big - Documentation as European Counterweight to US Tech Dominance

Imagine a scenario where the application of open-sourced AI to documentation has led to the development of a revolutionary tool. This tool transforms how professionals interact with documentation, prioritizing data protection and energy efficiency. Suppose further that, due to its unique selling proposition, this tool gains widespread recognition and becomes the leading documentation resource globally - a rare European digital counterweight to United States tech dominance.
Admittedly, this scenario is hypothetical. Yet, it embodies the digital and entrepreneurial spirit that is seams to be scarce in Europe, especially in comparison to the United States. According to McKinsey & Company, there is a significant gap in market capitalization at IPO for tech companies, with the US market being 11.6 times larger than that of the EU (McKinsey & Company, 2024).
If Europe aims to maintain its prosperity and stay relevant in the coming century, it is time to innovate - digitally.

2.3 Benchmarking

As part of the survey conducted, efforts were made to gain insights into the general approaches to project documentation among participants. This involved identifying the tools currently in use and evaluating participants' satisfaction with these tools (see Section 2.1.2).
Given the varied characteristics of these tools, a taxonomy has been developed to facilitate comparisons. This taxonomy not only categorizes tools based on distinct attributes but also highlights their strengths and weaknesses. By weighting these categories according to individual preferences, it becomes possible to identify the most suitable tools for different practices.
In total the taxonomy consists of six criteria, each contributing up to 10 points based on specific yes/no questions. These questions are deliberately designed to be straightforward, allowing for objective answers and reducing ambiguity in the evaluation process. The sum of all criteria points provides a composite score, with a maximum of 60 points achievable across all categories. This approach ensures a standardized evaluation of tools, highlighting their strengths and weaknesses in distinct functional areas. The questions of each category as well as their evaluations are detail in Section D.1 of the Appendix

Tool Evaluation

After establishing the taxonomy, it was applied to evaluate the most commonly used documentation tools. The survey revealed that the top five tools used by participants were

1. Google Drive[5]
2. Miro[6]
3. OneNote[7]
4. Notion[8]
5. Confluence[9]

In addition, Obsidian[10] has been gaining traction, especially within the tech community, prompting its inclusion in this analysis to compare its performance against the other tools (Hawkesford, 2024; Newman, 2023).
Each tool was scored against the criteria of the taxonomy, with the scores added together to provide a comprehensive overview. The unweighted results are presented in the table 16. The questions in the taxonomy are designed to be straightforward and as objective as possible to facilitate the assessment. Nevertheless, the assessments were made personally, based on publicly available

[5] https://workspace.google.com/products/drive/
[6] https://miro.com
[7] https://www.onenote.com/
[8] https://www.notion.com
[9] https://www.atlassian.com/software/confluence
[10] https://obsidian.md

information and my own experience with the tools. Consequently, evaluations by different individuals could vary.
Given the effort required to evaluate all six tools and the need to manage resources efficiently, I opted not to involve additional participants to avoid potential fatigue, such as in a workshop setting. Instead, I validated the findings through an independent evaluation and a comparison with ChatGPT-generated results. The final assessment, detailed in Appendix D, represents a synthesis of these three sources.
Conducting the evaluation myself ensured a consistent and controlled application of the criteria, minimizing variability that can arise with multiple evaluators. While the method relies on my familiarity with the tools, it is grounded in a rigorous analysis of publicly available information, including user reviews, feature lists, and official documentation. This comprehensive approach helps ensure the evaluation remains both informed and balanced, mitigating personal bias where possible.
In addition, the results for each question are detailed in a more extensive table in the Appendix (see Appendix D). The decision to carry out the assessment individually reflects a practical consideration of available resources and a cost-benefit analysis. At this initial stage, given the exploratory nature of evaluating different tools simply to discover their capabilities, I considered it prudent not to expend excessive resources or risk fatiguing potential survey or workshop participants.

Category	Google Drive	Miro	OneNote	Notion	Confluence	Obsidian
Collaboration	10	10	7	10	10	7
Control over Data	6	4	8	4	6	10
Ease of Use	8	6	10	4	6	6
Support of Data Types	10	4	4	10	10	10
Tasks	9	6	6	9	7	10
Cost and Scalability	6	6	6	4	6	10
SUM	49	36	41	41	45	53

Table 16: Evaluation of Tools Using the Taxonomy

Findings

The questions were often not as straightforward to answer as I had hoped. In such cases, ranking the tools from best to worst helped identify the threshold. Occasionally, it was necessary to make assumptions, such as about the structure of the setup or the process, to answer certain questions. While this approach has some limitations, the overall methodology is effective and can be used to compare tools based on their suitability for documentation purposes.

From the results shown in Table 16, it is indicated that Obsidian and Google Drive are the most suitable for documentation, while Miro falls short in some categories, ranking last among the compared tools. This result aligns with the limitations discussed in Section 1 and raises the question of why whiteboard-based tools are still commonly used for documentation despite these shortcomings.
One possible explanation lies in the personal preferences and requirements of users. Less tech-savvy users might value a low learning curve, while others might prioritize having greater control over their data.
To better account for user-specific needs, the taxonomy categories will be weighted to reflect the priorities and preferences of different user profiles. In Section 3.1.1, Lisa, a persona of a Service Designer, is introduced, and her perspective is applied to the taxonomy. This adjustment highlights how personal preferences can shift the importance of certain categories, ultimately influencing the ranking of documentation tools (see Section 3.1.3).

3 Define

In Section 1, the motivation for this thesis was presented, highlighting my personal experiences with documenting service design projects, which usually rely on whiteboard-based tools. To validate my reservations with these tools in regard to documentation, a survey was conducted and analysed, confirming the issues initially assumed (see Section 2.1.3).

As introduced in Section 1, the primary target group of this thesis are service designers. While the survey offered valuable insights into general documentation practices, the diversity of professional roles among participants, and the relatively limited sample size, means that no definitive conclusions can be drawn about the specific habits of service designers as a subgroup. In particular, whether whiteboard-based tools are the preferred method for documentation among service designers remains an unverified assumption.

Nevertheless, based on this working assumption, a speculative persona of the target group is developed in Section 3.1, accompanied by a set of present and future documentation scenarios mapped out in Section 3.2. These artefacts aim to clarify the characteristics of the target group, surface their pain points related to documentation, and outline potential pathways forward. Both the persona and the scenarios are later validated as realistic representations by service designers during a workshop (see Section 4.1).

Additionally, this section includes a deliberate deviation from the conventional structure of the Define phase. As discussed in the trend analysis of Section 2.2.3, the potential influence of AI on future documentation practices is already apparent (compare Scenario 4 in Section 3.2). In light of this, it is considered relevant to first explore the current role of AI within the broader discipline of Service Design in Section 3.3 before this section concludes by narrowing the problem space into two concrete objectives. These objectives define the scope for the development work that follows and help ensure that any proposed direction is aligned with emerging technological trajectories.

3.1 Target Group

This section introduces Lisa, a persona representing typical documentation behaviours and needs observed among service designers. Based on both professional experience and workshop validation (see Section 4.1), Lisa serves as a reference point for understanding the target group throughout this thesis.

Her profile captures relevant attitudes toward tools, collaboration, and emerging technologies such as AI, highlighting both enthusiasm for analogue methods and scepticism about digital complexity. To contextualize Lisa's role further, a stakeholder map is included. Finally, the taxonomy from Section 2.3 is revisited from her perspective, resulting in a reweighted evaluation of documentation tools that better reflects her priorities and constraints.

Figure 12: AI-Generated Illustration of Lisa

3.1.1 Persona Building: Meet Lisa

Basic Information

- **Name:** Lisa
- **Age:** 33
- **Generation:** Millennial
- **Profession:** Graphic Designer, transitioned into Service Design
- **Workplace:** Mid-cap design agency
- **Team Structure:** Interdisciplinary team, working under a Team Lead responsible for sales
- **Tech-Savviness:** Moderate - willing to try new tools but avoids complex setups
- **Current AI Use:** Minimal - has not yet found AI particularly useful

Mindset and Work Habits

– Loves working analog through sketching, whiteboarding, and using physical post-its
– Recognizes the advantages of digital tools but uses them as a means to an end
– Willing to try new tools if they are intuitive but avoids investing time in complex setups
– Prefers collaboration-focused tools over technically advanced features
– Prioritizes research insights over the technical capabilities of tools

Documentation and AI Behavior

– Struggles with documentation - often loses track of files, insights, and meeting notes
– Uses a mix of analog and digital methods - handwritten notes digitized when necessary
– Skeptical of AI in design - perceives it as hype rather than a useful addition
– Concerned about privacy but demonstrates contradictory behavior on social platforms
– Environmentally conscious - concerned about AI's energy consumption

Tool Preferences and Workflow

– Uses Miro, FigJam, or Google Drive inconsistently
– Prefers tools that are intuitive and require minimal configuration
– Dislikes fragmented documentation but unintentionally contributes to it
– Needs better retrieval mechanisms but avoids learning complex structuring systems

Pain Points

– Frequently loses important information due to scattered documentation
– Finds extensive setup processes in digital tools frustrating
– Overwhelmed by the number of tools; prefers simpler options
– Spends too much time searching for past insights
– Skeptical of AI's impact on design work and concerned about ethical and sustainable implications

Needs and Goals

– A tool that structures documentation automatically, with minimal manual effort
– An AI assistant focused on retrieving insights without taking over decision-making
– Minimal onboarding and setup requirements for new tools
– Seamless collaboration tools that allow for frictionless teamwork
– A balance between analog and digital workflows

Key Quotes

> "I love sketching out ideas and brainstorming - it's where I feel most creative. But turning those ideas into structured documentation? That's where I always get lost."

> "AI sounds cool, but I don't see how it actually helps my workflow."

> "I'll try new tools, but if I have to spend an hour setting them up, I'd rather not."

> "I know AI consumes a lot of energy, and that's a problem. I'm not sure if I want to use it unless it's really worth it."

3.1.2 Stakeholder Map: Lisa's Context

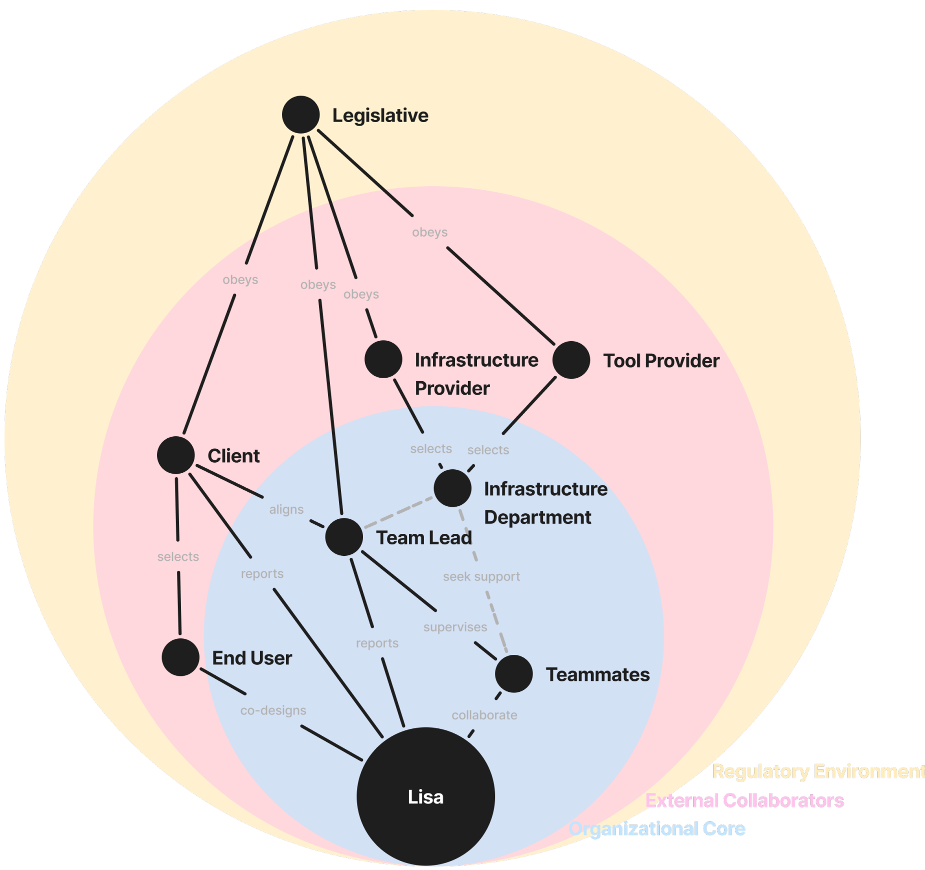


Figure 13: Stakeholder Map

To better understand the stakeholders who influence or are influenced by the way Lisa engages with documentation, a stakeholder map has been created (see Figure 13). This map highlights all the relevant actors involved in Lisa's work, particularly in relation to documentation practices.

Lisa works at a mid-cap design agency as part of an interdisciplinary team that includes other service designers, UI designers, and developers. While collaboration is central to her daily work, each discipline brings different needs and expectations regarding documentation.

With fellow service designers, she typically works in more flexible, exploratory formats that support synthesis and iteration. In contrast, collaboration with UI designers and developers often requires more structured outputs that translate research insights into clear, actionable information.

As a result, Lisa continuously adapts how she documents and shares information to ensure it remains accessible and useful across roles. The effectiveness of their teamwork often hinges on how well the documentation supports both creative exploration and practical implementation.

Another crucial aspect of Lisa's work revolves around the end users for whom she designs solutions. These users are typically selected by the client who hires her agency, sometimes internal staff, other times external customers. The client usually facilitates access to these users, enabling Lisa and her team to gather insights and co-create user-centered solutions.

Lisa prefers working in analog formats, especially during collaborative workshops where she and participants sketch ideas, move post-its around, and iterate directly on paper or whiteboards. She values the spontaneity and shared ownership that physical materials enable. Digital tools are used primarily to document or share outcomes when needed, such as scanning workshop results or digitizing sketches for remote collaboration. Her workflow reflects a balance: analog methods support ideation and co-creation, while digital platforms serve as a practical means of communication and archiving.

End users occasionally gain limited access to this documentation, particularly when collaboration extends across time or space, such as in remote or asynchronous projects.

Recently, clients have also requested access to the documentation to increase transparency throughout the project. As a result, client-side managers now occasionally review the documentation to monitor progress or prepare for update meetings. These update meetings are a regular part of the project workflow and are facilitated by Lisa's manager, who oversees the entire project. As the team lead, the manager holds responsibility for both project progress and client communication. During these meetings, Lisa and her teammates present their latest developments and provide status updates.

In her daily work, Lisa relies on several tools to support her activities. She uses Miro for conducting workshops, sharing project progress, and fostering collaboration. Google Drive serves as the primary platform for storing and organizing documents, while Slack facilitates quick internal alignments and occasional doc-

ument exchanges. Despite the availability of these tools, keeping track of all the scattered information remains a challenge (see Section 3.2, Scenarios 1 and 2).
Fortunately, Lisa doesn't need to manage the administrative aspects of these tools herself. The agency's infrastructure department handles the IT landscape, selecting appropriate tools, managing licenses, and determining hosting arrangements or data storage locations. This department also ensures the smooth functioning of the technical infrastructure that supports Lisa's documentation ecosystem.
Recently, Lisa had to install an authenticator app on her smartphone, introducing two-factor authentication for accessing the company's cloud storage. According to the infrastructure department, this security measure was introduced to enhance data protection and comply with the latest legal requirements. Additionally, her manager advocated for the changes, as some clients requested ISO certification for continued collaboration. While Lisa finds the extra authentication step mildly inconvenient, she accepts it as a necessary adjustment, as long as it doesn't interfere with her day-to-day work.

3.1.3 Personalised Taxonomy: Lisa's Perspective

In Section 2.3, a taxonomy for comparing documentation tools was introduced, with the potential for personalization through the prioritization of specific categories. Now, with a clearer understanding of Lisa's context and the factors that influence her documentation practices, we can explore how adjusting these priorities affects the evaluation of different tools.
By incorporating Lisa's perspective as a representative Service Designer, the taxonomy is weighted to better reflect her individual needs and preferences, as discussed in Section 3.1.1. This adjustment allows us to assess how subjective priorities can shift the ranking of documentation tools to align more closely with her workflow and values.
The following process outlines how the categories are reweighted to reflect Lisa's preferences:

1. **Prioritizing Categories:** The taxonomy categories are prioritized based on Lisa's preferences, reflecting her personal workflow, needs, and pain points. A total of 6 points is available for distribution across all categories.
2. **Assigning and Weighting Points:** Instead of distributing points equally, Lisa allocates the 6 available points based on the importance of each category. Categories that matter more receive a higher number of points, increasing their influence on the final evaluation, while less relevant categories may receive fewer or even zero points.
3. **Adjusting Tool Evaluations:** In the original taxonomy, each tool was evaluated based on its performance within each category, with scores ranging from 0 to 10. To incorporate Lisa's perspective, the original score of each tool in a given category is multiplied by the number of points assigned to that category. Categories with 0 points are excluded from the evaluation.

4. **Calculating Final Scores:** The final score for each tool is determined by summing the adjusted scores across all categories. Since each category can contribute a maximum of 10 points, the highest possible total score remains 60 points. The tools are then ranked based on these adjusted scores, reflecting Lisa's specific preferences and needs more accurately.

This method strikes a balance between simplicity and fairness by directly assigning points to categories based on their relative importance, as determined by Lisa's preferences (see Table 17). By allowing some categories to carry more weight while others may be excluded altogether, the evaluation reflects Lisa's personal priorities more accurately. Multiplying the original evaluation scores by the assigned points ensures that categories relevant to Lisa's workflow have a proportionally stronger influence on the final ranking. The calculations can be found in the Appendix under D.3 or in the *digital-annex.zip* as taxonomy.
As a result, the adjusted evaluation better aligns with Lisa's practical needs as a Service Designer, leading to a tool ranking that reflects her expectations and working style. This approach also increases transparency in understanding why certain tools, such as whiteboard-based platforms like Miro, have gained popularity for documentation.
This weighting shows that adjusting the evaluation criteria based on individual preferences, such as those of Lisa, can significantly alter the ranking of documentation tools. Tools like Miro, which initially ranked last under equal weighting, rise substantially when collaboration and ease of use are prioritized, reflecting Lisa's actual needs as a Service Designer. Conversely, tools like Obsidian, which excel in features less relevant to her workflow, drop in the rankings.
The personalized taxonomy highlights why designers might prioritize tools like Miro, which, despite their limitations for structured documentation, offer significant advantages in terms of collaboration and ease of use. These preferences often make such tools attractive, even if they are not the most effective for thorough knowledge documentation. However, this subjective ranking alone may not be enough to justify the continued use of these tools for documentation purposes, suggesting that better practices for managing knowledge could be explored. Rather than prescribing specific solutions, the taxonomy offers a transparent framework for understanding how subjective preferences influence decision-making around tool selection.

Category	Points	Explanation
Ease of Use	2	Lisa's main frustration lies in the complexity of setting up tools. Her pragmatic approach means that if a tool requires significant effort to configure, she's unlikely to use it. The survey results also highlight that Miro users, in particular, highly value usability (see Strength 5).
Collaboration	3	Lisa's workflow involves frequent teamwork, and she prefers tools that facilitate smooth collaboration across interdisciplinary teams. The survey results emphasize the importance of collaboration as an essential capability of documentation tools (see Opportunity 6).
Tasks	0.5	Lisa struggles with scattered documentation and difficulties in retrieving past insights. Tools that streamline tasks such as filtering, organizing, or searching for content could help improve her efficiency. However, this remains a secondary concern, as she is hesitant to invest time in learning how to use these features effectively.
Control over Data	0	Lisa has some awareness of privacy and organizational concerns, but these factors do not directly influence her daily workflow. Therefore, they hold little relevance in her evaluation of documentation tools.
Support of Data Types	0.5	Lisa frequently works with visuals and PDFs. While not her highest priority, supporting a variety of data types is beneficial for her documentation needs.
Cost and Scalability	0	These factors are of minimal concern for Lisa, as she works within an agency where cost and scalability considerations are typically handled at the organizational level rather than by individual designers.

Table 17: Assigned Points and Explanations for Each Category Based on Lisa's Updated Perspective

Rank	Equal Weights	Lisa's Preferences
1	Obsidian	Google Drive
2	Google Drive	Confluence
3	Confluence	Miro
4	OneNote	Notion
4	Notion	OneNote
6	Miro	Obsidian

Table 18: Comparison of Tool Rankings: Equal Weights vs. Lisa's Preferences

3.2 Scenario Mapping

This paper began by highlighting the limitations of existing design research documentation. In Section 2.1.3, insights from the survey assessing real-world knowledge documentation practices was presented, confirming the initially identified challenges. Subsequently, in Section 2.2, trends that can be related to documentation were explored, while Section 2.3 introduced a taxonomy to systematically evaluate documentation tools, enhancing transparency. Now, it is time to synthesize these insights to determine the further direction of this work. To achieve this, different scenarios will be developed based on the findings thus far, broadening awareness of potential pathways.

> A scenario is a story that describes a possible future end state in a horizon year, that also contains an interpretation of the events and developments in the present and their propagation into the future and that, finally, offers an internally consistent account of how a future world unfolds. (Wright & Goodwin, 2009)

Usually, scenarios, as defined by Wright and Goodwin, describe possible future end states. For the purpose of this paper, however, the scenario mapping, while future-oriented, remains unusually close to the present. Some scenarios may already be unfolding, while others represent near-term futures.
This *Scenario Mapping*, deliberately not referred to as scenario planning due to its nontraditional approach, aims to make different documentation practices more tangible by illustrating their nuances'. By highlighting these differences, the mapping clarifies the relationships between the scenarios and outlines potential pathways toward more preferred documentation practices.
To construct these scenarios, the *2x2 Matrix* method is applied. The *2x2 Matrix* is a scenario planning methodology inspired by the Shell approach and later popularized by the consulting firm Global Business Network, co-founded by Peter Schwartz. This method follows a deductive approach and aligns with the intuitive logics school of thought. (Alex Fergnani, 2020)
Although some scenarios may already be materializing in the present, the next step involves evaluating them using the *Futures Cone*. By incorporating elements of the *Theory of Change*, this evaluation assesses potential futures, their likelihoods, and actionable steps for the present. (van Gaalen, 2016)
While the *Futures Cone* is traditionally used for long-term foresight, it is applied here to near-term scenarios, some of which may already be unfolding. This adaptation helps narrate the transitions described in the *Theory of Change*, illustrating how different documentation practices evolve over time and how pathways toward preferred futures emerge.

3.2.1 Identifying Factors

To be able to construct the 2x2 Matrix it is necessary to discover two *Factors* that form the axis of the matrix (Fergnani, 2023). Those Factors, also referred to as *Critical Uncertainties*, for the sake of this work, will be based on the discovers

made thus far and represent characteristics of documentation tools or practises. To identify relevant factors, a brainstorming session was conducted assessing different ideas and trying out different combinations of factors.
The brainstorming included suggestions for factors such as:

- Satisfaction with the used tool
- Ease of use of the tool
- Consistency of information in the documentation
- Control over data offered by the tool
- Support for various data types
- Privacy of the data
- Level of collaboration offered
- Energy Consumption / Computing power necessary
- Availability as Open source

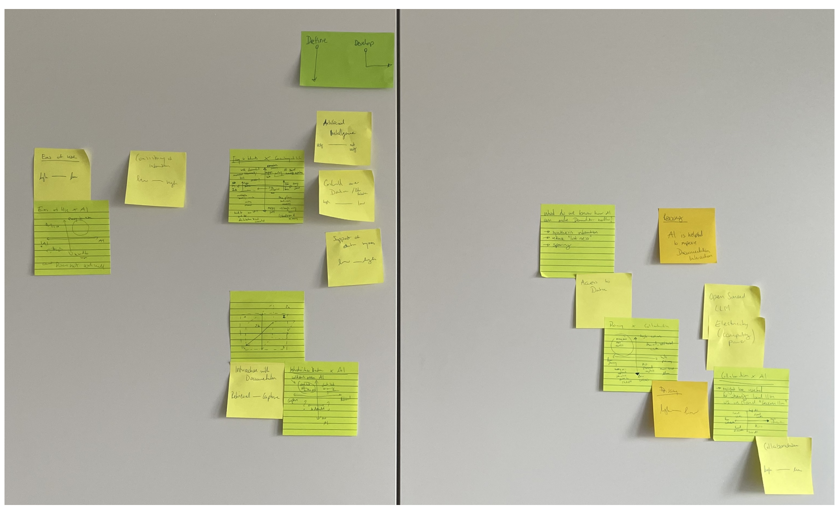


Figure 14: Result of Brainstorming for Identifying Factors of the 2x2 Matrix

After the brainstorming activity, all but two were ruled out, due to mainly two reasons: either the suggestions were not mutually exclusive, meaning that they effect each other or the factors are too solution oriented and more suited for the second part of this thesis.
The first factor identified to form the 2x2 Matrix was *Consistency of Information*. This factor was first mentioned as a limitation of whiteboard tools in Section 1 and later confirmed and elaborated on in Section 2.1.3 as Weakness 6.
The second factor *Ease of Use* was first introduced during the creation of the survey in Section 2.1.2. Due to its significance for tools choice, it was included as one category of the taxonomy in Section 2.3.

3.2.2 2x2 Matrix: Consistency of Information vs. Ease of Use

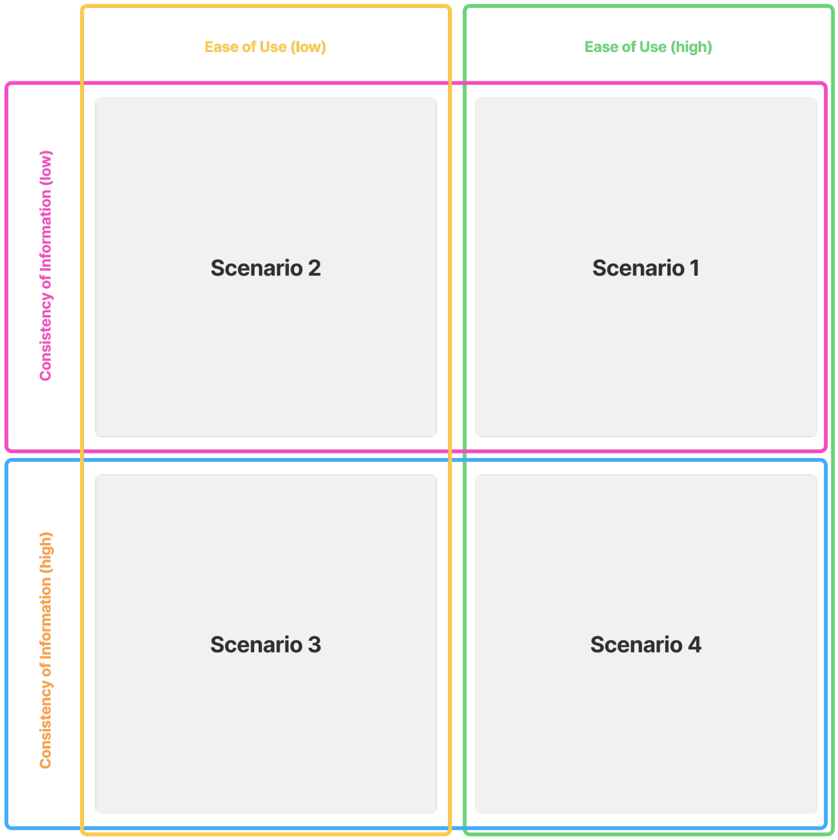


Figure 15: 2x2 Matrix: Consistency of Information vs. Ease of Use

As depicted in Figure 15, the two selected factors form the axes of the matrix, shaping the characteristics of the resulting scenarios. From this framework, four distinct scenarios are derived.

Scenario 1: The Sticky Note Jungle - Easy to Use, Hard to Navigate

This scenario is defined by a high ease of use but low consistency of information. In this context, the documentation system is user-friendly and simple to interact with. However, it presents a risk of fragmented and inconsistent information. The absence of a centralized single source of truth may lead to scattered related content across the documentation, making it difficult to locate specific information efficiently.

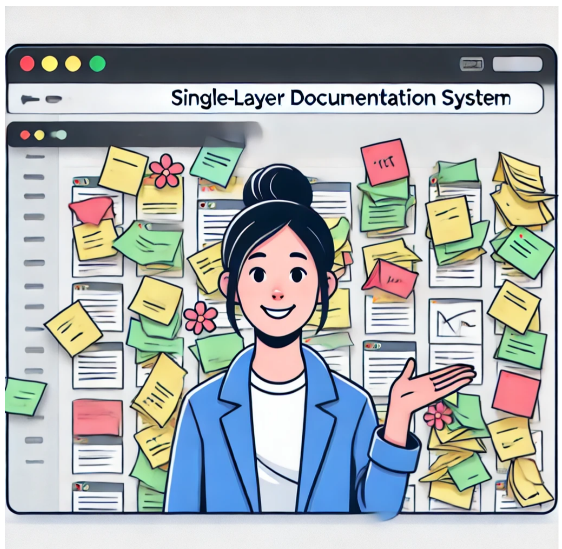


Figure 16: Illustration of Scenario 1

Lisa and her team are working on a design project and decide to use Miro as their primary documentation tool. At first, it feels intuitive - adding sticky notes, drawing connections, and capturing ideas is seamless. Everyone contributes, and collaboration flows effortlessly. However, as the project progresses and the volume of information grows, challenges start to emerge. Finding the latest insights becomes a daunting task. Was that crucial feedback added in last week's brainstorming session, or was it buried under layers of new additions? There is no clear single source of truth - information is scattered, duplicated, or outdated. As the team struggles to locate the most relevant details, they begin to question if their documentation approach can scale effectively.

Scenario 2: Lost in Layers - When Too Many Tools Create Chaos

This scenario is characterized by both low ease of use and low consistency of information. The documentation system relies on complex tools that may require specialized expertise, making it difficult for users to interact with and navigate the system efficiently. Additionally, the lack of a structured, single source of truth results in fragmented and inconsistent information. Users may struggle to locate relevant content due to scattered documentation, further increasing the cognitive load and reducing accessibility.

Figure 17: Illustration of Scenario 2

Lisa's team quickly realizes that relying solely on Miro is insufficient. To store audio files from interviews, they set up a shared cloud drive. Then, as more people contribute, some prefer storing PDFs in Miro, while others upload them to Google Drive. Without clear guidelines or structure, the documentation becomes increasingly fragmented.
To make matters worse, some information is confidential, meaning not everyone should have access. Instead of a structured permission system, restricted documents are shared via Slack messages or even emailed between permitted colleagues. Over time, duplicates pile up - documents like *client-sla-version1-12-02-25-draft.pdf* exist across different folders and personal desktops. Now, retrieving the right version of a file requires sifting through multiple tools, asking colleagues, or hoping to stumble upon the correct document. What started as an attempt to improve documentation has resulted in a complex, inefficient mess.

Scenario 3: Order in Complexity - Structured but Hard to Master

This scenario is defined by low ease of use but high consistency of information. The documentation system ensures a structured and centralized single source of truth, reducing redundancy and fragmentation. However, accessing and managing this information requires interaction with complex tools that demand specialized expertise. While the documentation remains reliable and well-organized, the steep learning curve and technical barriers may hinder usability, making it less accessible to non-experts.

Figure 18: Illustration of Scenario 3

> Having learned from previous projects, Lisa's team, now under the direction of a new team lead with a management background, takes a more structured approach to documentation. Concerned about recurring issues with scattered files, unclear ownership, and security risks, the team lead initiates a collaboration with an external IT consulting firm to establish a more reliable and organized documentation setup.
> Anticipating the need for cloud storage, the team consults an IT specialist to properly configure the company's documentation environment with defined access permissions. Sensitive files are now stored securely, ensuring that only the appropriate team members can access them.
> In parallel, the team transitions to using the knowledge management tool Obsidian as the central repository for documentation. This change is intended to reduce reliance on Miro, which is now reserved exclusively

for collaborative activities like brainstorming and workshops. The new approach promises greater transparency and long-term efficiency.
However, the decision to adopt Obsidian was implemented top-down, without any formal onboarding or training. Team members were expected to self-learn the system while continuing their regular work. This uneven adaptation process creates friction within the team.
Regina Resistant, a longtime team member, struggles with the shift. She finds Obsidian's interface unintuitive and misses the ease of adding content in Miro. In workshops, she prefers working with physical materials - post-its, sketches, whiteboards - and finds the new documentation workflow overly rigid. Despite recognizing some of the system's benefits, she often reverts to old habits, resulting in inconsistencies and duplicated efforts that undermine the team's alignment.

Scenario 4: The AI-Powered Knowledge Hub - Smart, Structured, and Effortless

Figure 19: Illustration of Scenario 4

This scenario is characterized by high consistency of information while also ensuring high ease of use. The documentation system maintains a well-structured and centralized single source of truth, ensuring reliability and reducing fragmentation. Unlike the previous scenario, however, the complexity of interacting with the system is mitigated through AI-powered support. Intelligent assistants facilitate navigation, automate information retrieval, and streamline documentation processes, making the system more accessible even for non-experts. As a result, users can efficiently engage with the documentation without being overwhelmed by the underlying complexity of the tools.

> Despite some resistance, Pia Persistent, the team lead, sees the long-term value of the new documentation system and is determined to make it work for everyone. Recognizing the challenges faced by team members like Regina, she reaches out to Byte & Mortar, a digital service design consultancy, to help refine their documentation process.
> The consultants praise the team's progress, their documentation is already structured in a way that makes it machine-readable, setting the stage for integrating an AI-powered research assistant.
> Before launch, Byte & Mortar conducts an onboarding workshop to ensure that all team members feel equipped to interact with the assistant. Through hands-on activities and guided examples, they learn how to phrase questions, steer the assistant's output, and understand its limitations. This shared introduction helps align expectations and lowers the barrier for those less confident with new technology, ensuring no one is left behind.
> When the AI assistant is introduced, Regina Resistant experiences a turning point. Previously, she struggled to locate workshop insights from earlier projects, especially information buried in Miro boards from four months ago that had never been properly summarized. Now, instead of digging through fragmented files, she can ask the assistant directly. It retrieves relevant insights in seconds and even links them to findings from other projects, surfacing patterns and relationships she hadn't noticed before. Her skepticism begins to fade as she starts to rediscover knowledge she thought was lost.
> Six months later, a second iteration of the assistant is introduced. This version integrates seamlessly into the team's workflow, not only supporting information retrieval, but actively assisting in logging, categorizing, linking, and summarizing new insights as they emerge. What once felt like a rigid and tedious part of the process now feels more natural, almost like being interviewed while working. The assistant helps turn fleeting observations into reusable knowledge, without interrupting the flow of collaboration.
> Still, not all questions are resolved. While the assistant reduces friction and uncovers valuable connections, it also introduces a layer of automation that not everyone fully understands. Some team members wonder what content might be overlooked or filtered out. Others raise concerns about transparency, how insights are surfaced, and whether the system's logic can be trusted.
> As the team continues to use the assistant, they begin learning by doing. They gradually come to understand not just the potential of AI, but also its limits, what it sees, what it misses, and how to steer around blind spots. They experiment, adjust, and develop a shared sense of how

to collaborate critically and responsibly with the system. The assistant becomes not just a tool, but a catalyst for evolving their documentation culture.

3.2.3 Mapping Pathways to the Future: Positioning Scenarios in the Futures Cone

All presented scenarios represent possible short-term futures, some of which may already be unfolding. To better understand the spectrum of potential developments and proactively steer towards preferred outcomes, these scenarios can be mapped within the framework of the Futures Cone. When combined with the Theory of Change, this approach helps in structuring the necessary steps to transition from the current state to a more desirable future.
By defining long-term goals, stakeholders can outline concrete actions to shift these futures from the realm of the possible or plausible into the probable, ultimately making the envisioned outcomes more attainable. (van Gaalen, 2016)

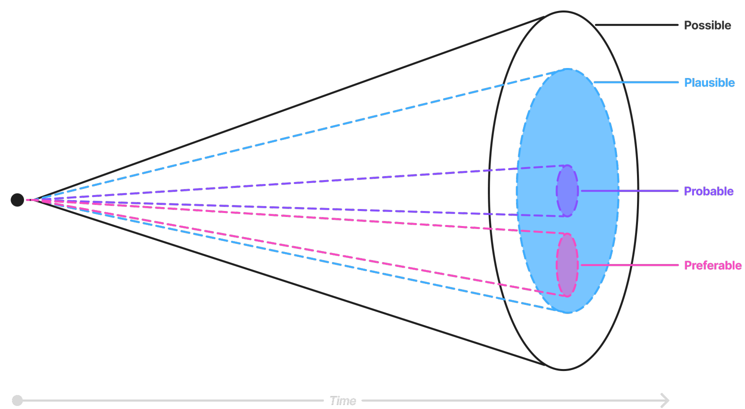


Figure 20: Illustration of the Futures Cone (van Gaalen, 2016)

The Futures Cone categorizes different types of futures based on their likelihood and desirability:

- **Possible Futures**: All futures that could conceivably occur, given the laws of physics and current knowledge.
- **Plausible Futures**: Futures that could reasonably emerge based on existing trends and understanding.
- **Probable Futures**: Futures that are likely to materialize if current trajectories remain unchanged.
- **Preferred Futures**: Futures that are intentionally shaped and pursued as ideal outcomes.

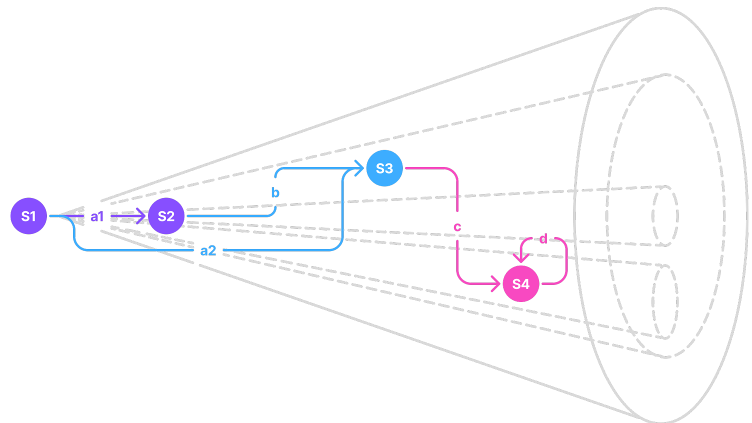


Figure 21: Pathways Through Scenarios Toward the Preferred Future

Categorizing the scenarios based on their likelihood and desirability, we can conclude that all scenarios fall within the realm of Possible Futures, and even Plausible Futures, as demonstrated in Section 2.2.3 and 2.1.3.
Like the persona Lisa introduced in Section 3.1, the scenarios were also included in the workshop conducted with service designers to better understand their documentation practices (see Section 4.1). A preliminary version of the scenarios was reviewed during the session, and participant feedback was used to enhance their ethnographic quality. The critique gathered in the workshop informed several refinements, resulting in the improved versions presented here.
While participants identified most closely with Scenarios 1 and 2 based on their current professional realities, there was consensus during the workshop that Scenario 4 represents the most desirable direction forward. It was seen as the preferred future - not necessarily the most likely one at present, but the one they would most like to work toward.
It is therefore reasonable to state that Scenario 4 represents the Preferred Future, as it embodies a promising application of AI to documentation processes. This also aligns with explicit requests made by survey participants, as highlighted in Section 2.1.3, Weakness 6.
But how does one get from Scenario 1 to Scenario 4? The scenarios presented are not isolated - they build on each other and reflect a gradual progression. To better understand this trajectory, let's revisit Scenario 1 and explore how it can evolve into more structured, collaborative, and intelligent documentation practices.
If you have ever worked on a (design) research project where Miro was used as the primary documentation tool, then Scenario 1 is already your reality. You have likely experienced the advantages of using an intuitive and collaborative tool. At the same time, you may have encountered its downsides, where documentation becomes fragmented and messy, with related information scattered across the board. Let's say the documentation is structured chronologically rather than

thematically, finding information on a specific topic often requires manually scanning through the entire documentation, as there is no simple way to filter or navigate by subject. If this scenario resonates with you, then Scenario 1 is not only a Probable Future - it is already happening.

Now, let's assume Scenario 1 applies to you. Over time, you might realize that Miro's capabilities for file storage are limited. Perhaps, in your last project, storing PDFs in Miro sufficed. But what happens when you need to store audio recordings or videos? To manage these effectively, you would need an additional cloud storage solution. Without sufficient technical expertise and clear documentation guidelines, your documentation could become even more fragmented: Welcome to Scenario 2 (see Figure 21 *a1*). Since Scenario 2 naturally follows Scenario 1, it can be categorized as a Probable Future.

As mentioned earlier, Scenarios 1 and 2 reflect the most common situations related to design documentation among the service designers consulted. To reflect their defining characteristics, including tool touchpoints and patterns of team collaboration, their core elements have been synthesized into an exemplary documentation journey faced by collaborative design team, illustrated in Figure 22. This journey is not intended to cover all possible tools or workflows, but rather to illustrate a typical progression based on recurring patterns observed during the research.

Phase	1. Quick Start	2. Organic Growth	3. Cracks in the System	4. Tool Fragmentation	5. Retrieval Frustration
Description	The team begins a new project and sets up a Miro board. It's fast to launch, easy to use, and requires no training. Everyone jumps in, and collaboration feels effortless.	As ideas flow in, sticky notes multiply and boards expand. Information is added freely, often without structure. Eventually, the volume becomes overwhelming.	The team starts hitting Miro's limitations—audio and video files can't be embedded effectively, and file types or notes become buried. Documentation becomes uneven.	To compensate, additional tools are introduced ad hoc: shared drives, Slack, email. Team members store files wherever it's convenient, each following their own approach.	When trying to find key insights—like feedback from a past workshop—the team must search across platforms or ask around. Trust in the documentation system declines.
Tools Involved	Miro	Miro	Miro, Google Drive, Email (ad hoc expansion)	Multiple, loosely coordinated tools (divergent practices)	All tools in parallel (full tool sprawl)
Collaborat ion Impact	High collaboration, shared energy, everyone contributing in real time	Collaboration slows as people struggle to find past work; small misunderstandings begin	Collaboration slows as people struggle to find past work; small misunderstandings begin	Collaboration splinters; effort is duplicated, and trust in shared documentation erodes	Collaboration becomes inefficient and stressful; people revert to personal systems
Emotional State	✨ Motivated and aligned	😅 Slightly overwhelmed	😩 Frustrated and blocked	😤 Disconnected and confused	😠 Defeated and disillusioned
Pain Points	None initially — the tool is intuitive, collaborative, and lowers the barrier to documentation.	No structure leads to clutter. It becomes hard to navigate or retrieve older content.	Tool limitations emerge. Team members start improvising without alignment, leading to inconsistency.	Fragmentation increases. No shared structure, file naming, or permissions. Sensitive data becomes hard to manage.	High cognitive load. Time is wasted. Duplicates and outdated info undermine collaboration.

Figure 22: Collaborative Design Documentation Journey Synthesizing Patterns from Scenario 1 and 2

However, some may find themselves in a more structured environment. Perhaps your organization has a clearly defined framework for file storage, access controls, and a standardized tool stack. While this setup improves the structure and retrievability of documentation, it introduces technical overhead. The system might feel overengineered or overly complex, especially for those without a technical background. Scenario 3, although less common, remains a probable outcome following Scenario 2 (see Figure 21 *a2*) - or, in some cases, even directly from Scenario 1 (see Figure 21 *b*). Yet, from the perspective of most designers, it is unlikely to be the Preferred Future.
Despite its limitations, Scenario 3 plays a critical role in the transition toward Scenario 4. For AI-powered documentation systems to function effectively, structured and accessible data is essential. As outlined in Section 2.1.3, Weakness 4, whiteboard tools often present data retention challenges. Without proper access to stored data, the full potential of AI cannot be realized. Thus, ensuring a structured, well-maintained documentation environment, as presented in Scenario 3, is a prerequisite for making Scenario 4 a Probable Future (see Figure 21 *c*).
When Scenario 4 was described in the previous section, an iteration was mentioned. In the first version, the AI assistant could respond to queries by retrieving information from the documentation. However, the iteration was required to enable the assistant to actively capture knowledge. This iteration is indicated in Figure 21 by the edge annotated *d* and is necessary because the AI initially lacks sufficient data to learn how to capture information within the domain of Service Design. This challenge is known as the *Cold Start Problem* (Lika et al., 2014). To highlight the differences between the two iterations and to establish a consistent vocabulary for the subsequent discussion, Figure 23 illustrates the distinct information flows in a documentation system supported by a LLM.

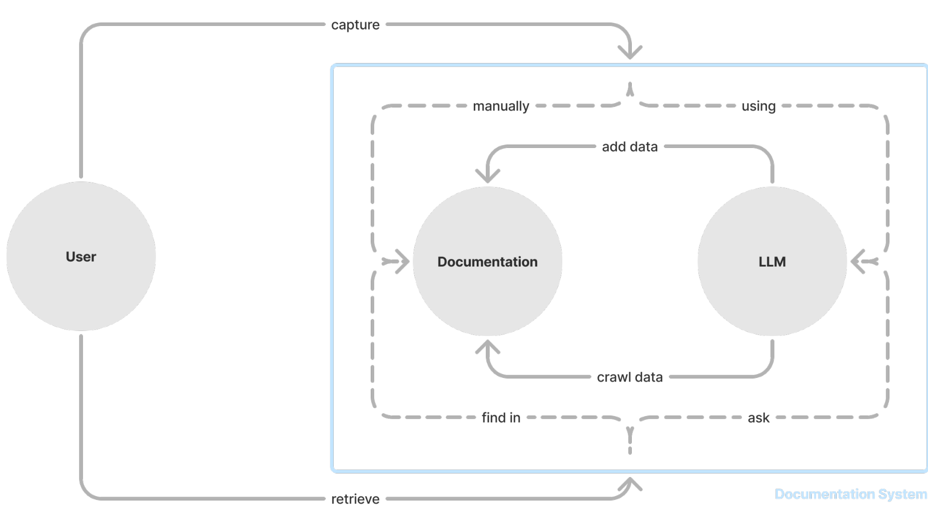


Figure 23: High-Level Illustration of Information Flow in Documentation

3.3 Positioning AI in the Service Design Context

Section 3 began by defining the target group of this thesis, focusing on Service Designers. Next, four scenarios were presented, outlining sequential steps toward achieving an AI-enabled documentation approach. The scenario mapping and narration were informed by the findings of Section 2, particularly the Trend Analysis (Section 2.2.3) and the survey results (Section C).
Building on this prior work, the thesis will examine how Service Designers can leverage LLMs to enhance their interaction with documentation. A precise and detailed description of the objectives for the proposed solution will be provided at the end of the Define phase in Section 3.4.
To gain a broader understanding of AI‘s impact and its current applications in Service Design, this section will take a research excursion.
First, we will explore the *Touchpoint Journal*, a service design magazine where practitioners publish insights from their work. Volume 15, published in 2024 and thus relatively recent, presents several articles discussing AI in Service Design. These articles will be clustered based on common themes.
Second, the identified themes will be examined in the context of academic research. A literature search will assess whether topics relevant in practice are also discussed in academia, allowing for a comparison between academic perspectives and professional application of AI in Service Design.
Finally, insights from two conversations with professional Service Designers will be presented.

3.3.1 Practitioners' Perspective: Identifying Themes in the Touchpoint Journal

To understand how AI is currently discussed in professional Service Design practice, this section examines Volume 15 of the *Touchpoint Journal*, titled *Service Design at the Dawn of AI*. The articles in this volume explore various aspects of AI in Service Design and can be grouped into three main categories.

1. AI as a Co-Designer:
   This category includes articles where AI is used as a tool to support Service Designers in their work. AI assists in blueprinting, research synthesis, prototyping, and automating aspects of the design process. The focus is on enhancing design efficiency while keeping human creativity central.
2. AI as a Service Provider:
   This category covers cases where AI is integrated into the service itself, functioning as a touchpoint, agent, or decision-maker. Rather than supporting the design process, AI interacts with users, influencing their experiences and shaping the overall service offering.
3. AI and Ethics: Designing Responsible AI:
   This category examines the ethical, societal, and inclusivity challenges associated with AI in Service Design. The articles discuss topics such as bias, accountability, transparency, and the role of Service Designers in ensuring fair and responsible AI implementation.

Table 19 presents an overview of the articles from *Touchpoint Journal* Volume 15, categorized according to these three groups.

AI Influence in Service Design	**Articles**
AI as a Co-Designer	Sorokin, 2024 Aslam and Bogers, 2024 Besplemennova, 2024 Jackson and Morales, 2024 Hormeß and Bailey, 2024 Veen et al., 2024 Bobde, 2024
AI as a Service Provider	Staszowski et al., 2024 Zvirgzdina et al., 2024 Ress and Edwards, 2024 Martins, 2024 Shine and Peiffer, 2024
AI and Ethics: Designing Responsible AI	Alapartanen, 2024 Raijmakers and Barnard, 2024 Chakraborty et al., 2024 Willis et al., 2024 Carman et al., 2024

Table 19: Categorization of Articles in *Touchpoint Vol 15* Based on AI's Influence in Service Design

This categorization not only highlights the breadth of AI applications in Service Design but also helped clarify the conceptual framing of this thesis. The aim here is to leverage AI to improve documentation practices within design processes. Due to the tight coupling between documentation and the design process itself, the articles in Category AI as a Co-Designer are particularly relevant. One article in particular 'Elevating Design Work: Design and AI in the Coming Era', strongly resonated with the direction of this work, as it addresses the role of AI in improving access to design documentation and knowledge within organizations. The relevance of this article is further explored in Section 3.3.4, which introduces an interview conducted with one of its authors. The conversation offered additional practitioner insights that informed the further development.

3.3.2 Academic Perspectives on Practitioners' Themes

The analysis of *Touchpoint Journal* articles identified three key themes in how practitioners engage with AI in service design: AI as a Co-Designer, AI as a Service Provider, and AI and Ethics: Designing Responsible AI,.
To assess whether these themes are also reflected in academic discourse, a structured literature review was conducted. The search targeted peer-reviewed journal

articles, conference proceedings, and reputable institutional reports, ensuring that all sources met formal academic standards. To capture state-of-the-art developments in AI and service design, only sources published in 2021 or later were considered. The selection process prioritized sources that explicitly addressed the intersection of AI and service design.

Research on AI as a Co-Designer examines how AI supports designers in service ideation, prototyping, and decision-making. Studies propose structured collaboration models, such as human-AI co-creation frameworks and heuristic guidelines for integrating AI into design workflows. Scholars emphasize that while AI enhances efficiency and iteration speed, human designers remain critical for ensuring interpretability, emotional intelligence, and contextual sensitivity. These findings align with practitioner accounts that describe AI as a tool for augmenting creative processes rather than replacing human designers.

In examining AI as a Service Provider, academic studies investigate how AI is embedded in service interactions, automating decision-making and optimizing service quality. Research highlights frameworks for designing AI-driven customer interactions, decision-support systems, and adaptive service personalization. These studies parallel practitioner concerns about balancing automation with human intervention, reinforcing the importance of designing AI-enabled services that are transparent, adaptive, and user-centered.

The ethical implications of AI in service design are also a focus of academic research, addressing issues such as accountability, bias mitigation, and user autonomy. Scholars explore frameworks for meaningful human control, ethical co-design practices, and strategies for increasing public trust in AI-driven systems. This research complements practitioner discussions on fairness, transparency, and the need to align AI-powered services with ethical standards. Across both practice and academia, there is a shared emphasis on ensuring that AI remains a tool for human benefit rather than an opaque decision-making system.

Among the reviewed sources Zheng et al., 2023, proved particularly relevant to this thesis. The paper demonstrates how LLMs can be embedded into team-based design workflows and proposes 23 heuristics for productive human-AI collaboration, insights that align well with this thesis's focus on collaborative documentation practices.

While the remaining literature does not directly address the integration of AI (particularly LLMs) into design documentation processes, it nonetheless helped to position this work within the broader discourse on AI in service design. In this way, the literature review clarified the boundaries of existing work, highlighted a potential research gap, and contributed to framing the direction of the proposed solution.

Theme	Academic Sources
AI as a Co-Designer	Guo et al., 2023 Zheng et al., 2023 Zhong et al., 2024
AI as a Service Provider	Li and Lu, 2021 Yu and Guo, 2024 Tan and Lee, 2023 Rjsé et al., 2023 Hamid and Suoheimo, 2023 Subramonyam et al., 2021
AI and Ethics: Designing Responsible AI	Giaccardi and Bendor, 2024 Patil et al., 2024 Siebert et al., 2022 Nicenboim et al., 2023 Aranda-Muñoz et al., 2022

Table 20: Academic Research Aligned with Themes from Touchpoint Journal

3.3.3 Conversation with Clara Bonde

To explore how AI is currently applied in service design practice and to gain deeper insights into potential pitfalls, I conducted an interview with Clara Bonde. Clara was selected because she has directly experimented with integrating AI into a real-world service design project - making her perspective especially relevant to this thesis.

Clara graduated in 2023 from Aalborg University's Master's program in Service Systems Design and is currently working as a Service Designer at SimCorp. Her thesis, co-authored with peers, examined the use of a customized ChatGPT instance named Lexi as an additional "team member" in the design process 'Enhancing Service Design Processes Through Generative AI: An Explorative Case Study on an Onboarding Service at Ørsted'. Lexi was tested in a real project setting and supported tasks such as data synthesis, persona development, and concept ideation. This work aligns with Category AI as a Co-Designer outlined in Section 3.3.1, where AI is used to augment human designers.

The goal of the conversation was to go beyond the scope of the thesis and understand what challenges emerged during their experiment, how they approached the integration of AI, and what lessons were learned. I was particularly interested in Clara's reflections on the limitations of their approach, her perspective after one year of professional practice with occasional AI touchpoints, and how she sees the direction of my thesis in light of her own experience.

The conversation lasted one hour and was conducted at a high level, given time constraints and the fact that neither of us are technical AI specialists. A recording is available in the *digital annex* under interview-clara-bonde.

In the following, I will present the four main challenges that emerged from my conversation with Clara. These challenges highlight key limitations and considerations when applying LLMs to the context of service design.

Customization and Data Structuring Challenges

One of the primary challenges in applying LLMs to service design was managing and structuring data effectively. Initially, the team attempted to upload raw documents directly into the model but encountered limitations in retrieving specific information. To address this, they implemented a structured approach by curating and organizing content into categorized "feed sheets" before feeding it into the system. This highlights the importance of preparing and structuring input data in a way that aligns with how the LLM processes information.

Contextual Understanding and Alignment Issues

Ensuring that the LLM correctly interpreted and aligned with human designers' intentions proved to be another challenge. Differences in how individual researchers documented information led to inconsistencies in AI-generated outputs. As a result, the team had to iteratively validate the AI‘s responses to ensure its outputs reflected human understanding. This underscores the need for a systematic approach to input standardization and validation when integrating LLMs into service design workflows.

Limitations in Visual and Complex Data Interpretation

While the LLM demonstrated strengths in processing text-based data, its ability to interpret complex visual documentation, such as service blueprints and user journey maps, remained limited. Without accompanying descriptive text, the AI struggled to extract meaningful insights from visual artifacts. This limitation suggests that, in its current form, LLM-assisted service design remains predominantly text-driven, requiring additional tools or structured inputs to bridge the gap between textual and visual design elements.

Hallucination and Trustworthiness of AI Outputs

A significant challenge when using LLMs in service design was their tendency to generate overly confident yet potentially inaccurate outputs. Unlike human collaborators, AI models do not convey uncertainty, making it difficult to gauge the reliability of their responses. The team implemented validation strategies, such as cross-checking AI-generated insights with original documentation, but ensuring transparency and trust in AI-generated information remains an ongoing challenge.

Despite these challenges, Lexi proved useful in synthesizing large amounts of qualitative data, identifying recurring themes, and retrieving relevant insights efficiently. This suggests that LLMs can serve as valuable assistants in handling information-heavy aspects of service design, provided that their outputs are critically evaluated and integrated into a structured design process. (Bonde et al., 2024)

3.3.4 Conversation with Mary Jackson

Following the conversation with Clara Bonde, I turned to a source that closely aligned with the central focus of this thesis: the use of AI to improve access to and interaction with design documentation. One of the most relevant articles from the *Touchpoint Journal*, 'Elevating Design Work: Design and AI in the Coming Era', explored this topic in depth, making it a natural starting point for further inquiry. I was fortunate to speak with one of its co-authors, Mary Jackson, a lead service designer at Futurice.

The article investigates how AI can enhance knowledge retrieval in service design by reducing friction in accessing, searching, and synthesizing research documentation. It presents a case study from Futurice, a digitalization consultancy, where AI was integrated into internal knowledge management processes to improve the discoverability of past case studies and proposals. This directly addresses a common organizational challenge: the difficulty of efficiently locating relevant information within large and growing repositories of documentation.

To tackle this, the company deployed a generative AI-powered tool, Futucortex, designed to streamline knowledge retrieval. Instead of relying on manual searches, employees could interact with the system using natural language queries, allowing them to quickly access summaries of relevant materials, identify previous projects, and locate subject-matter experts within the company. By leveraging AI, Futurice significantly reduced the time spent searching for information, improving both workflow efficiency and decision-making.

This work is particularly relevant to this thesis because it provides a concrete example of how AI can transform documentation from a passive archive into an interactive, accessible knowledge base.

The interview, attached in the *digital-annex* as interview-mary-jackson, offered valuable perspectives on the role of designers in AI development and the importance of interdisciplinary collaboration. The following paragraphs summarize the main insights from our conversation:

Risks of Excluding Designers from AI Development

Excluding designers from AI projects can lead to:

- **Misaligned solutions**: Focusing on technical capabilities without addressing user needs.
- **Poor workflow integration**: Developing tools that complicate user processes instead of simplifying them.

Designers help ensure that AI solutions serve their intended purpose effectively and remain user-friendly.

Multidisciplinary Collaboration in AI Development

The development of AI solutions, as demonstrated by the Futucortex project, relies on collaboration between designers, developers, data scientists, and business leads. Designers play a vital role by:

– **Mapping user flows** to ensure intuitive interactions with the AI system.
– **Identifying user problems** to focus the AI solution on real needs.
– **Ensuring usability** by creating accessible and intuitive tools.

Rapid prototyping and iterative testing, often starting with a Proof of Concept (PoC) model, help align technical solutions with user needs throughout development.

Balancing Technical Feasibility with User-Centered Design

A core challenge in AI projects is balancing what is technically feasible with what is valuable to users. Designers help:

– **Set realistic boundaries** for AI performance in collaboration with technical experts.
– **Prioritize user needs** to ensure practical, user-friendly technical solutions.

This balance ensures that AI tools meet both technical requirements and user expectations.

Building Trust Through Transparency

Trust is essential for successful AI adoption. Futucortex fosters trust through:

– **Clear communication of system limitations**: Providing prompts and guidance to help users understand what the AI can and cannot do.
– **Transparency in data sources**: Allowing users to verify the reliability of AI-generated outputs.

These practices increase user confidence in the system's reliability.

Sustainability and Privacy Considerations

Although not a primary focus of Futucortex, the interview highlighted the growing importance of:

– **Energy efficiency**: Reducing the environmental impact of AI solutions.
– **Privacy measures**: Implementing self-hosted LLM instances to ensure sensitive data remains protected from external platforms.

These factors are essential for responsible AI development.

3.4 Objectives

This thesis has systematically explored several facets of documentation practices, particularly focusing on the use of whiteboard-based tools. The initial analysis revealed the reasons why users favor these tools for documentation purposes (see Section 2.1.3). However, it also highlighted their inherent limitations and explained why they might not be the most effective solutions for documentation needs (see Section 2.1.3).

Building on this foundation, the opportunities that could emerge from a well-designed documentation system were explored (see Section 2.1.3) and addressed the potential risks associated with inefficient documentation practices (see Section 2.1.3).

To facilitate a more objective comparison of commonly used documentation tools, a taxonomy was developed (see Section 2.3). Applying this framework in conjunction with user preferences made it clear why whiteboard-based tools remain popular, despite their limitations (see Section 3.1.3).

A broader perspective was introduced through a trend analysis, which examined the Political, Economic, Technological, and Social dimensions shaping the future of documentation (see Section 2.2). Special attention was given to the rapid advancements in AI, particularly in GenAI and LLMs, as well as the growing importance of open-source models (see Section 2.2.3).

In addition, the target audience was defined, focusing on service designers. This was illustrated through the introduction of the persona “Lisa” and her work context, visualized via a stakeholder map (see Section 3.1).

Driven by the potential of assistive search and the contextual framework provided by Lisa’s persona, various scenarios were mapped out to envision how documentation practices might evolve in the near future (see Section 3.2). These scenarios outline a path from current practices toward a future where the application of AI enhances the efficiency and effectiveness of documentation processes within service design.

Finally, an exploration was conducted to assess the current role of AI in service design. This involved analyzing reports from both practitioners and academics, which were then categorized into common themes (see Section 3.3.1). Complementing this analysis, two interviews were conducted with professional service designers experienced in integrating AI into their workflows, offering further insights into the practical applications and challenges of AI in service design.

Building on these insights, it is now time to define the objectives that the solution to be developed should fulfill. The overarching goal is to work toward achieving Scenario 4:

> HMW enable service designers to use LLM for knowledge retrieval from documentation while keeping privacy high and energy consumption low?

This HMW statement can be broken down into the following specific objectives:

- Objective 1: Enable service designers to document their knowledge in a way that LLMs can effectively process and interpret.

– Objective 2: Apply an LLM to the documentation, allowing service designers to retrieve knowledge from their documentation using natural language queries.

Objective 1 serves as a prerequisite for achieving Objective 2, as effective knowledge retrieval depends on well-structured, machine-readable documentation. With respect to Objective 2, the focus of the PoC will be limited to knowledge retrieval (see Figure 23). While knowledge capture is equally important, it lies beyond the scope of this research and may be considered in future work.
The development of the PoC will be guided by the following principles:

– Principle 1: Integrate privacy-preserving measures into the system's design.
– Principle 2: Reduce energy consumption during the operation of the LLM.

Although Principle 1 and Principle 2 are essential for promoting ethical and sustainable system design, they are treated as guiding principles rather than core requirements for this PoC. They will be considered throughout development, but will not constitute the primary focus.

4 Excursion: Exploring Documentation Practices of Service Designers

Having defined the objectives for the proposed solution in Section 3.4 and clarified its intended target group in Section 3.1, the direction for further development has been established. However, to ensure a robust foundation for this development, it is necessary to validate key assumptions, such as the persona Lisa (Section 3.1.1) and the scenarios from Section 3.2, regarding the documentation practices of service designers.
To examine these practices in greater depth, a workshop, an interview, and a literature review were conducted. The following section outlines the methodology and key findings of these activities, including participant details and limitations where relevant.

4.1 Workshop

Figure 24: Photograph of the Workshop Setup

To validate the persona and scenarios introduced earlier and to deepen the understanding of service designers' documentation practices, a workshop was conducted. Beyond testing initial assumptions, the session aimed to uncover how service designers approach documentation in practice, including the methods and tools they use, the types of data they work with, and the challenges they encounter.

The following subsections present the methodology of the workshop, introduce the participants, and detail the key insights gathered in two parts. The section concludes with reflections, limitations, and a discussion of how these findings inform the further development of the solution.

Methodology

The workshop was conducted in person with six participants and facilitated by me. The participants were recruited from my Master's program, meaning all were Master's students in *Service Systems Design*.

The workshop consisted of two main parts:

1. Setting the stage - establishing a common understanding of the direction of the thesis.
2. Understanding documentation practices - exploring how participants document their knowledge.

To gather background information about the participants, a demographic survey was conducted prior to the workshop. Initially, the workshop was planned for five participants and estimated to last approximately one hour.

Demographic Information

To save time during the workshop, all demographic information was collected beforehand using a Typeform[11] survey. Depending on the participant's responses, the survey contained between four and nine questions:

- What's your first name?
- What's the highest level of education you've completed?
- Are you currently studying?
  - What are you studying?
  - Are you currently writing your thesis?
    - Are you working on it with other students?
- Are you currently working?
  - What's your job title?
  - Does your employer decide which tools you use for documentation?

The survey was not anonymous, so that, in theory, responses could be mapped to the participants' contributions during the workshop. To facilitate this, each participant was assigned a unique color of post-it notes.

The motivation behind this approach was to assess whether factors such as employment status or collaborative thesis work had any influence on the responses given during the workshop.

[11] https://www.typeform.com

Setting the Stage

This part of the workshop was designed to help participants quickly grasp the workshop's purpose without requiring an extensive introduction. To achieve this, each participant was provided with study materials, which included:

- The persona *Lisa* (see Section 3.1.1)
- The stakeholder map and its description (see Section 3.1.2)
- The four scenarios (see Section 3.2)

The workshop materials are included as workshop-material in the *digital annex*. After a short icebreaker, participants were asked to review the persona and stakeholder map. They were encouraged to highlight aspects they disagreed with, found missing, or wanted to emphasize. After 10 minutes of individual study, they shared and discussed their thoughts.
Next, the participants repeated the process with the four scenarios. They had 7 minutes to review and take notes, followed by a discussion to share their insights. Using the previously defined persona, stakeholder map, and scenarios enabled participants to onboard to the topic of documentation as a service designer while also allowing me to validate the initial hypotheses.

Section	**Task**	**Planned Duration**
Icebreaker	Think of a time when you needed to find a specific piece of information but couldn't locate it easily. What was it? Where did you look? How long did it take? Did you ever find it?	5 min
Meet Lisa and Work Environment	Participants study the persona and stakeholder map, highlighting aspects they disagree with, find missing, or want to emphasize.	10 min
	Discuss thoughts	10min
Scenarios	Participants study the scenarios, highlighting aspects they disagree with, find missing, or want to emphasize.	7 min
	Discuss thoughts: Which would you consider yourself in?	5 min

Table 21: Agenda of Part 1

Documentation Practices

After a 5-minute break, the second part of the workshop began. The objective of this part was to understand the documentation practices of service designers. Participants were given 10 minutes to reflect on and answer the following three questions:

1. What do you document?
2. What methods do you use?
3. What tools do you use?

Afterward, each participant presented their responses by sticking post-it notes onto a blackboard, already beginning to cluster their findings. Once everyone was finished, the final step was to assign file types to the documented methods. This was done through color-coding from a predefined selection of file types (see Table 22).

File Type	**Examples**	**Color**
Text Documents	PDFs, Markdown (`.md`), Word Docs (`.docx`), raw notes, transcripts	blue
Images & Graphics	JPG, PNG, SVG, scanned notes, sketches	orange
Structured Data	CSV, JSON, Excel (`.xlsx`), Google Sheets	green
Media Files	MP4, MP3, WAV (video & audio recordings)	red

Table 22: Colour Coding of File Types

Section	**Task**	**Planned Duration**
Documentation Reflection	Participants reflect on and answer the three questions	10 min
Presentation and Clustering	Each participant presents their responses	10 min
File Type Assignment	Participants assign file types to documented methods	10 min

Table 23: Agenda of Part 2

Background of the Participants

The primary objective of the workshop was to gain insights into the documentation practices of service designers. To ensure a relevant participant pool, I leveraged my network and invited fellow Master's students to take part. To better understand their professional backgrounds and interdisciplinary educational experiences, a demographic survey was conducted prior to the workshop.
Individuals working in a design team or collaborating on their thesis might have different documentation needs and experiences compared to those who do not.

Therefore, gathering this contextual information was crucial for interpreting the findings.
The following presents an overview of the participants' backgrounds, with the raw survey responses included in demography-survey-responses.csv in the *digital annex*.

General Demographics

All six participants were female and enrolled in the *M.Sc. Service Systems Design* program. Their educational backgrounds varied, reflecting a diverse mix of disciplines:

- B.E./ B.Sc. Industrial Design
- B.Sc. Communication Design
- B.A. Graphic Design
- B.Sc. Digital Concept Development
- B.A. Sociology and English Literature

Thesis Collaboration

Half of the participants were writing their thesis individually, while the other half were collaborating. However, none of the participants who were collaborating were working with someone from within the workshop group.

Employment Status

Four out of six participants were employed alongside their studies, holding positions in service design and user experience research roles, such as:

- Service Design and Research Intern
- Service Design Student Helper
- User Experience Researcher Student Assistant
- UX Designer - Student Assistant

Among those employed, three out of four stated that their employer dictated which tools were used for documentation, providing the necessary tooling infrastructure. The commonly used tools included:

- Microsoft Office
- Miro
- Google Drive
- Figma
- Google Forms
- EnjoyHQ
- SharePoint
- Condens

Only one participant neither worked nor collaborated on their thesis, offering a different perspective that, while valuable, may be less representative of the typical documentation challenges faced in professional or collaborative settings.

Findings of Part 1

The purpose of the first part of the workshop, as described earlier, was twofold: First, to set the stage for the participants, so they could grasp the workshop's context, and second, to critically examine the artifacts created.
By allowing participants to study the persona, stakeholder map, and scenarios, I was able to validate my hypothesis. Overall, all participants agreed that Lisa represents a realistic depiction of a service designer. Furthermore, the other artifacts were also considered plausible and realistic within a professional work environment.
However, some minor critiques and questions emerged from the discussions surrounding the artifacts.

Suggested Improvements for the Persona

Most suggested improvements for the persona stemmed from unclear wording and a lack of detail.
For the statement "Spends too much time searching for past insights" one participant suggested specifying how Lisa currently searches for insights to provide more clarity.
Another example is the statement "Concerned about privacy but demonstrates contradictory behavior on social platforms". Participants raised questions regarding whose privacy Lisa is concerned about - her own or that of her clients. Additionally, they suggested providing more context on what is meant by "contradictory behavior on social platforms".
The term "Mid-cap design agency" also caused some confusion. Normally, midcap refers to company size in a financial context. Considering the target audience, it may be more appropriate to use a different term to describe the company's size.
Other suggestions included logical refinements of certain statements.
For instance, the sentence "Needs better retrieval mechanisms but avoids learning complex structuring systems" was flagged as an assumption rather than a fact. It implies that there are only two types of tools: those that are easy to learn but lack advanced retrieval mechanisms, and those that provide sophisticated retrieval mechanisms but are difficult to learn. However, this assumption may not hold true, as tools may exist that are both user-friendly and offer strong retrieval capabilities.
Similarly, the mindset statement "Collaboration-Focused - Prefers tools that facilitate teamwork over those with advanced technical features" presents a similar issue. It suggests that tools with advanced technical features do not support teamwork, which is a hypothesis that is likely to be disproven.
Lastly, one participant suggested extending Lisa's concern for energy consumption beyond just her attitude towards AI. They recommended including this concern under her Needs & Goals to emphasize her commitment to sustainable behaviors.

Suggested Improvements for Stakeholder Map

In addition to evaluating the persona, participants provided feedback on the stakeholder map and its description. While the overall structure was deemed useful, certain aspects required clarification or refinement.

One of the key points raised was centered around the legislative aspect of the stakeholder map and its relevance to Lisa's work. Some participants questioned whether this connection was too distant and suggested reconsidering its placement or providing additional context to clarify the relationship.

Regarding the section "Working with End Users and Clients" participants questioned how Lisa's preference for analog tools is reflected in her work. They suggested further elaboration on this aspect to ensure alignment between her working style and the stakeholder interactions described.

The description of Lisa as part of an interdisciplinary team prompted discussion about the nature of collaboration in her role. Participants suggested elaborating on interdisciplinarity, emphasizing that different roles require different forms of collaboration. They noted that collaboration may occur primarily among service designers or extend across other disciplines, such as development teams. The nature of these interactions can vary based on the specific insights required for each role, and this distinction should be clarified in the description.

Suggested Improvements for the Scenarios

The scenarios were generally considered clear and realistic. Participants were asked to indicate which scenario best reflected their documentation practices: 50 percent identified with Scenario 1, while the other half found themselves represented in Scenario 2.

Nonetheless, there were some minor suggestions for improvement.

For Scenario 3, questions were raised about the adaptation process, suggesting that it should be further defined. Additionally, the reference to Obsidian was unclear, indicating that additional context may be necessary to make the scenario more accessible.

For Scenario 4, the sentence "Instead of struggling to find information, she can now interact with the assistant" led to questions about the nature of this interaction. Participants emphasized the need for more details on how the interaction occurs, particularly regarding the appearance of the interface and how users engage with it. Additionally, the scenario was perceived as possibly too positive. Participants suggested presenting a more critical perspective by questioning whether information gets lost, how transparent the system is, and to what extent the outputs can be trusted. There were also concerns about whether the system provides unfiltered results and whether this might pose any risks.

Findings of Part 2

Figure 25: Photograph of Two Workshop Participants Preparing to Present Their Documentation Practices

Figure 26: Photograph of a Workshop Participant Presenting Their Documentation Practices

The second part of the workshop was designed to explore the documentation practices of service designers. As previously described, participants were tasked with answering three key questions: what they document, how they document, and with what tools. The findings were clustered on a blackboard using post-it notes. Finally, file types in use were assigned to the corresponding documentation methods.

Due to time constraints, the clustering of post-it notes during the workshop was not conducted with full precision. As a result, post-processing was necessary, not only to refine the clustering but also to digitize the findings. The post-processing involved the following steps:

Figure 27: Analogue Post-Processing of the Workshop Findings

1. After the workshop, the post-it notes were collected and archived according to their category.

2. In the next step, I revisited the post-its and refined the clustering more thoroughly. Instead of organizing them in columns, they were now arranged in nested circles (see Figure 27). To reduce visual clutter, clusters were consolidated into single representative post-its. Additionally, some notes were reassigned between the first two questions, as the distinction between them had proven too ambiguous. More on this is discussed in Section 4.1.

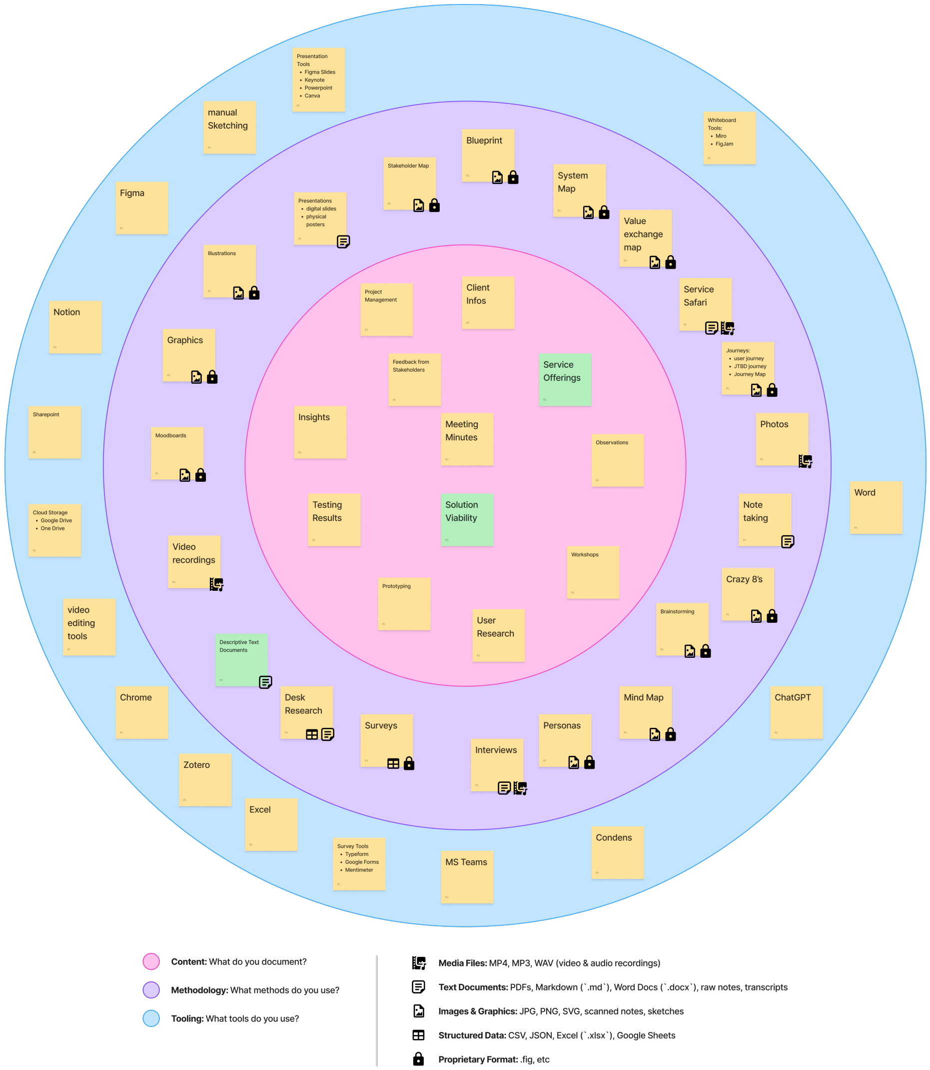


Figure 28: Digital Representation of the Workshop Findings

3. Finally, the post-its were digitized using FigJam (see Figure 28). During the transfer, the findings were slightly summarized while ensuring the core insights remained intact. Two additional items were introduced under content, namely *Solution Viability* and *Service Offerings*, which were derived from mentioned methods such as *(technical) interviews* and *blueprints*. Additionally, one new entry was added under methodology: *Descriptive Text Documents*, based on the use of Word as a documentation tool. All post-its added during post-processing are shown in green.

Reflections & Limitations

Limitations Regarding Participants

The participant pool consisted exclusively of fellow master students, all of whom were female and had limited professional experience as service designers. As digital natives, their documentation habits may differ from those of more experienced or older service designers, who might rely less on digital tools.

Limitations in the Execution

The workshop exceeded the planned duration of 60 minutes, lasting approximately 80 minutes. This was partly due to an unexpected participant change at the start, which required additional time for adjustment. One participant who arrived late was replaced by another fellow student for the first part of the workshop. Fortunately, she was able to join for the second part.
Furthermore, the workshop was initially planned for five participants, but six were invited as a precaution in case someone did not attend. In the end, all six participated, which extended certain parts of the workshop beyond the planned timeframe.
Towards the end, time constraints resulted in a slightly rushed pace, leading to participant fatigue and reduced engagement in the final part of the session.
The mapping of data types also presented some challenges. Data types representing physical artifacts were not included, nor were proprietary formats such as Figma files. To my surprise, participants mapped the majority of methods exclusively to Figma, indicating that some artifacts are never exported elsewhere and exist only within the Figma environment.

Structural Deficits

In the first part of the workshop, participants took notes directly on the provided materials. However, the brief was not clearly stated, resulting in handwritten notes in various languages, which complicated post-processing and limited the ability to extract insights systematically.
Additionally, the distinction between *what* is documented and *how* documentation is performed was not always clear. During post-processing, it became evident that some responses to the first question were actually methods, while some answers to the second question were more about content. If more time had been available, it might have been possible to refine the clustering process further, which was somewhat chaotic due to the large volume of data produced by participants and the time limit.

Post-Processing Reflections

Debriefing and structuring the collected data required substantial effort. Conducting the clustering digitally from the start could have facilitated this process. This could have been achieved through collaboration on a shared digital whiteboard. However, since all participants were physically present in the same space, I opted for an analog approach. Furthermore, the data types mapping had to be extended to better reflect the significant role of Figma in documentation practices.

What Went Well

The workshop setup worked as expected, requiring no additional introduction and successfully setting the stage. The hypothetical artifacts were validated, confirming my assumptions. The findings from the second part of the workshop reinforced the dominance of FigJam in documentation workflows, highlighting its widespread use among participants. Additionally, the workshop provided valuable insights into general documentation practices, contributing to a deeper understanding of how service designers capture and organize information.

Word of Appreciation

I sincerely appreciate the time and initiative of my classmates, who not only participated in the workshop but also contributed to capturing valuable glimpses into the documentation process.

4.2 Interview

To gain additional insights into how service designers document information, a one-on-one interview was conducted with *Susanna*. More details about her background are provided in Section 4.2, following an explanation of the interview methodology. Finally, the findings of the interview are presented, followed by a reflection and a discussion of potential limitations.

Methodology

The interview took place in an informal setting at a café and lasted approximately one hour. A rough outline of topics had been prepared in advance. However, due to the conversational nature of the interview, the structure remained flexible, allowing for a natural flow of discussion while staying within the scope of documentation practices in service design.
The following outline served as a guiding framework for the interview, providing inspiration rather than a rigid structure:

- **Introduction to the Thesis** (15 minutes)
  - Motivation for the research
  - Topics explored so far, with a particular focus on the workshop
  - Potential directions for the thesis outcome
- **Co-creation Session: User Journey Mapping** (30 minutes)
  - Understanding documentation practices among service designers
  - Exploring how Susanna interacts with her documentation
    - What types of information are documented?
    - At what stages is documentation created?
    - Which tools are used for documentation?
    - How often is past documentation revisited?
    - What challenges are encountered in documentation practices?
    - How does collaboration around documentation take place?

Background of the Participant

The participant, *Susanna*, is also enrolled in the *M.Sc. Service Systems Design* program and has an academic background in both design and psychology. She works as a service designer and is employed part-time at Mayone, where her work focuses on researching signals and trends within the field of Future Studies.
For her thesis, she is collaborating with another student from the same master's program. Her professional experience is particularly relevant to this research, as she works for a well-known strategic design consultancy, offering a more industry-driven perspective.
Her documentation workflow is shaped by the tooling infrastructure provided by her employer. More details on the specific tools she uses and their influence on her documentation practices are discussed in the following section.

Findings

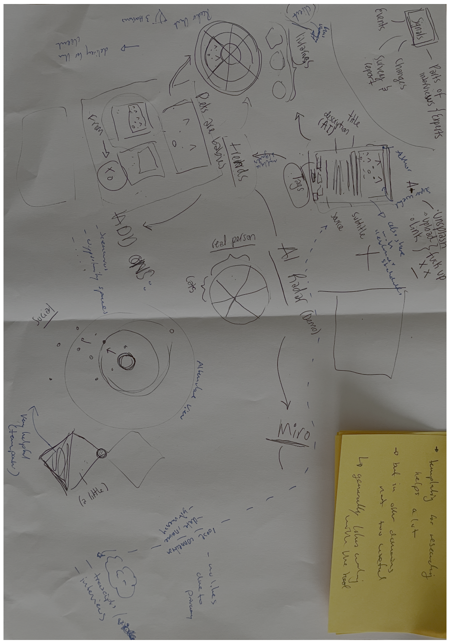


Figure 29: Visual Note-Taking of Documentation Practices

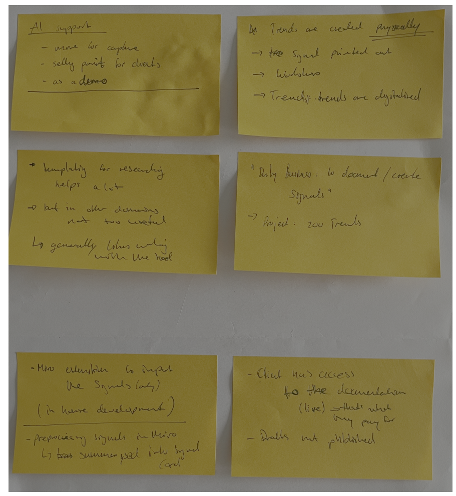


Figure 30: Supplementary Notes for Visual Note-Taking

After setting the stage and introducing the topic, the conversation focused on Susanna's documentation practices. During the discussion, she mapped out her workflow on paper, while I captured additional notes on post-its to document relevant insights. Due to ambient noise in the café and privacy considerations, the interview was not audio-recorded.

Custom Documentation Tool

At the core of the company's documentation process lies a custom-built tool, addressing many shortcomings of generic whiteboard-based solutions. This tool provides:

– *Structured documentation* through templates tailored for capturing signals and trends.
– *Filtering and searchability*, offering different views to navigate the stored data.
– *Persistent and exportable data*, ensuring long-term accessibility.
– *Granular access control*, allowing selective visibility for internal and external stakeholders.

Template-Based Documentation Approach

The tool relies heavily on predefined templates to structure information. Signals, which represent early indicators of change, are documented with specific attributes, including:

- Title, author, and source
- Subtitle and description
- Tags for categorization
- Cover images, aiding in trend identification

Signals are aggregated into broader trends, which serve as a foundation for strategic analysis. Trends are organized into projects, forming libraries that can contain up to 100 trends per client. The documentation tool also functions as a client interface, granting controlled access to work-in-progress materials while ensuring unpublished artifacts remain internal.

Integration with Other Tools

Although the primary documentation occurs within the custom tool, additional tools support the process:

- *Miro*: Used for structuring research before transferring it into the documentation system. A custom-built plugin enables signal import but is not used for long-term storage.
- *Cloud Storage (Google Drive)*: Stores supplementary materials such as interview transcripts. While loosely connected to documented signals, these files remain separate for privacy reasons, occasionally leading to fragmented information management.
- *Physical Workshops*: Printed signals are utilized in collaborative workshops to identify and refine trends before being formalized in the digital system.

AI Integration

AI is used within the company's workflow, though its application focuses on content generation rather than retrieval. Specifically:

- AI assists in generating *demo versions* of trends for client presentations.
- No AI-powered search or retrieval mechanisms are currently in place to extract insights from the documentation.

Trend Representation and Delivery

The final output of the documentation process is structured within a radar chart visualization, categorizing trends according to the DESTEP[12] framework and three strategic time horizons. More advanced offerings extend beyond documentation into scenario planning and opportunity identification.

[12] Demographic, Economic, Social, Technological, Ecological, Political

Summary

The company's documentation approach emphasizes structured and templated knowledge capture, facilitating both internal workflow efficiency and external client communication. The system supports predictable documentation processes, enabling efficient signal and trend tracking. However, its effectiveness is domain-specific, making it particularly well-suited for the discovery phase of projects rather than generalized documentation needs.

Reflections & Limitations

While the interview provided valuable insights into structured documentation practices, certain limitations must be considered. As a junior professional, the participant's experience, though relevant, remains limited compared to more senior practitioners. Additionally, like the workshop participants, she is female and enrolled in the *M.Sc. Service Systems Design* program, which, while beneficial for comparative analysis, restricts diversity in perspectives.

Methodologically, while the interview aimed to develop a user journey, the resulting visualization functioned more as visual note-taking rather than a structured mapping of interactions (see Figure 29). This suggests that in loosely structured discussions, journey mapping may lead to organic rather than systematic representations.

Despite these limitations, the setting allowed for a more detailed and personal discussion, with greater flexibility to explore emerging themes. Compared to the workshop, the interview provided a more relaxed environment, allowing for a less structured, exploratory conversation. This format enabled more detailed and personal insights, giving room to steer the discussion toward emerging themes.

Notably, it revealed a contrasting viewpoint regarding structured documentation. The participant's experience demonstrated how a strictly templated system facilitates not only internal knowledge management but also serves as a deliverable for external stakeholders by altering its visualization. This reinforces the idea that documentation structure is often shaped by organizational needs, and how structured documentation can transition into a service offering by adapting its form of visualization, demonstrating the potential for documentation to extend beyond internal knowledge management.

Beyond structured documentation, the interview also shed light on the role of AI within the participant's organization. While integrated into their workflow, AI is currently limited to generating demo materials, not supporting information retrieval. Their system—built on templates, metadata, and permissions—would suit a retrieval-based AI assistant, yet such functionality hasn't been prioritized. This raises the question of whether structured documentation reduces the perceived need for retrieval tools, or if their absence reflects organizational choices. Future research could explore whether AI-driven retrieval adds value in such environments or if existing systems suffice.

4.3 Literature Review

To complement the exploratory activities on service design practises, a review of relevant academic literature was conducted to understand how knowledge is documented within the field of service design. This step aimed to identify existing research that addresses the practices, challenges, and systems associated with capturing, structuring, and reusing design knowledge.
The literature search was performed using Google Scholar[13], based on the following search strings:

```
"service design" AND "documentation"
service design practices
service design information systems
service design knowledge
```

From the resulting publications, five papers were identified as particularly relevant to the research questions of this thesis. These were selected based on their focus on documentation practices, knowledge management, or conceptual frameworks that inform the design of knowledge systems in service design:

- *This Is Service Design Doing: Applying Service Design Thinking in the Real World* by Stickdorn et al.
- 'A knowledge management framework to support product-service systems design' by Baxter et al.
- 'An exploration of knowledge management activities in multidisciplinary service design organizations' by Mirafzal et al.
- 'Building up a framework for Service Design research' by Sangiorgi
- 'Reusing design information: an investigation of the document creation process in service design projects' by Lin

This Is Service Design Doing: Applying Service Design Thinking in the Real World is a foundational book in the field, widely used by practitioners and educators alike. It offers a practical, method-based guide to applying service design in real-world contexts, with tools and activities organized across the phases of a typical design process. For this thesis, it serves as a key reference for identifying the methods commonly used in service design, providing a grounded basis for exploring how these activities might be documented and made accessible for AI-supported retrieval. (Stickdorn et al., 2018)
Although Baxter et al. present a knowledge management framework rooted in technical Product-Service Systems within manufacturing contexts, their work offers transferable insights for the design of structured documentation in service design. While the framework does not engage with the human-centered or iterative nature of service design, its focus on modular representation, contextual relevance, and systemic feedback aligns well with the needs of AI-enabled knowledge retrieval.
Key principles relevant to this work include:

[13] https://scholar.google.com

1. Granular and linked knowledge units:
   Structuring information into small, reusable modules that can be interlinked (e.g. connecting requirements to design decisions or test procedures) enhances both retrieval and traceability.
2. Context-aware filtering:
   Associating knowledge with specific tasks or roles enables more relevant and efficient access during design processes.
3. Feedback integration:
   Enabling structured input from later lifecycle stages supports iterative improvement and learning.
4. Shared knowledge structures:
   Ontology-based modeling offers a scalable backbone for organizing and navigating complex, interconnected information. (Baxter et al., 2009)

This paper 'An exploration of knowledge management activities in multidisciplinary service design organizations' explores how multidisciplinary service design consultancies manage, share, and store knowledge, offering direct relevance to this thesis on structuring service design documentation. The authors highlight the challenges of managing tacit knowledge in fast-paced, expertise-driven environments, where consultants often favor informal, peer-to-peer exchanges over formal knowledge management systems. A key contribution is the proposed *knowledge leveling* model, which classifies knowledge into three types - global, semi-detailed, and detailed - based on specificity and reuse potential, and maps each type to appropriate documentation tools and formats. For example, general methods or foundational concepts are best shared via trainings or wikis; task-specific guidance (e.g. how to run a co-creation workshop) fits well in searchable repositories; and context-rich, experience-based insights (e.g. client-specific reactions or workaround hacks) are better suited for forums or chat apps.
The paper provides a valuable framework for tailoring documentation to human retrieval needs and offers principles that can inform how structured knowledge might be adapted for machine-assisted access. It underscores the importance of designing multiple documentation formats, aligned with the type and context of knowledge, and avoiding a one-size-fits-all approach - insights that are critical for building AI-ready documentation systems in service design practice. (Mirafzal et al., 2023)
This paper by Sangiorgi offers a foundational reflection on the evolution of service design, tracing its roots in interaction design and proposing three future research directions: designing for interactions, managing complexity, and enabling transformation. Rather than focusing on practical outputs, the paper frames service design as a systemic, participatory, and transformative practice, where designers must align diverse perspectives and work across organizational and community boundaries.
While it does not address documentation directly, the paper provides valuable conceptual grounding for this thesis. It emphasizes the need for shared representations - such as mapping tools and visual artifacts - as essential tools for cross-disciplinary understanding, acting as boundary objects that externalize

and align knowledge. It also positions service designers as enablers of learning and change, highlighting the importance of capturing not just outcomes, but also rationale, reflections, and evolving insights. These ideas support the view that service design documentation should be modular, visual, and adaptable - not only to facilitate LLM-based retrieval, but to foster collaboration, knowledge transfer, and long-term transformation. (Sangiorgi, 2009)

Lin's paper investigates how service designers create and interact with project documentation, with a specific focus on how this affects the reuse of design information and rationale across projects. Drawing on interviews with practitioners and field observations in a logistics company, the study identifies six core types of design documents, ranging from research protocols to wireframes, and shows that their value often depends more on social context and authorship than on their informational content. The paper highlights how documents created collaboratively or with clients are often treated as political or consensus artifacts, not reusable assets. Attempts to structure rationale using templates rarely succeed across projects due to interpretation barriers and insufficient granularity.

For this thesis, the paper offers key insights into the limits of documentation as a static artifact and underscores the importance of contextualization, group sense making, and document provenance. It finds that detailed research reports, which are less shaped by client-specific judgments, are more likely to be reused than summary insights or templated formats. These findings support the need for modular, richly contextual documentation structures that can bridge human understanding and AI-based retrieval - capturing not just what was designed, but why, how, and with whom. (Lin, 2021)

Although Mirafzal et al. describe service design organizations as "[...] knowledge seller by nature [...]" and refer to them as "[...] knowledge-intensive organizations" (Mirafzal et al., 2023), there appears to be surprisingly little contemporary research - particularly regarding the use of digital practices and technology to support knowledge management. To the best of current knowledge, this indicates a research gap in the systematic capture and reuse of knowledge within service design. Nonetheless, the reviewed literature provides valuable insights - though in some cases conflicting (e.g., the role of templating) - which, together with the findings from the workshop (see Section 4.1) and interview (see Section 4.2), will inform the design decisions behind the solution developed in Section 6.

5 Excursion: Exploring Technical Aspects of LLMs

With the objectives of the solution defined (see Section 3.4) and LLMs identified as its technological core, it became necessary to explore the technical foundations of such systems. Although this thesis is grounded in the field of Service Design, the nature of technological approach required a basic understanding of the underlying technology to make informed design decisions and ensure feasibility.
This chapter provides a high-level exploration of the landscape of LLMs, prioritizing breadth over depth to remain accessible and relevant for a design-oriented audience.
It begins by defining what is meant by "customizing a LLM" within the scope of this thesis. Several customization approaches are then outlined based on desk research. The most promising approach is selected for closer examination, followed by a discussion of its mechanisms. Finally, an interview with a machine learning expert assesses the feasibility and robustness of the selected direction.

5.1 How to Customize LLMs

Definition of Customization

Customizing a LLM involves transforming a general-purpose model into a powerful tool tailored to specific business needs (Yiyou_Lin, 2024). While pre-trained LLMs offer broad knowledge, they often fail to meet industry-specific demands due to limitations in domain expertise, specialized terminology, or real-time adaptability (Anjali Shah & Chintan Patel, 2023).

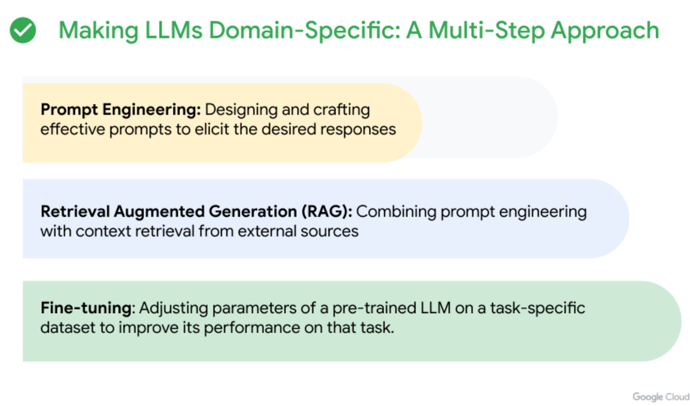


Figure 31: Overview Customisation Approaches (Arsalan Mosenia, 2024)

A customized LLM is designed to:

– Enhance precision and expertise by grounding responses in domain-specific datasets, ensuring relevance (Arsalan Mosenia, 2024).
– Improve reliability and safety by minimizing irrelevant outputs and integrating safeguards for high-stakes applications (Anjali Shah & Chintan Patel, 2023).
– Optimize efficiency by fine-tuning smaller models with targeted knowledge, reducing computational costs while improving accuracy (Arsalan Mosenia, 2024).
– Create a better user experience by ensuring interactions align with industry jargon and organizational context (Yiyou_Lin, 2024).

Customization can be achieved through three primary approaches: Prompting, Retrieval-Augmented Generation (RAG), and Fine-Tuning. These methods enable businesses to bridge the gap between general knowledge and specialized expertise, making AI solutions more effective, accurate, and context-aware (Anjali Shah & Chintan Patel, 2023; Arsalan Mosenia, 2024; Yiyou_Lin, 2024).
While other techniques, such as System Prompting, Parameter-Efficient Fine-Tuning, and Prompt Learning, exist, they are more niche. To keep the discussion focused and avoid excessive technical depth, this work prioritizes the three main approaches that provide the most impact in adapting LLMs to specific business needs.

Why Not Train Our Own LLM?

Training an LLM from scratch is largely infeasible for small to medium-sized teams due to the immense requirements for data, compute power, and expertise (Gong, 2025). Even large enterprises hesitate to train their own models because of the high costs and complexity involved. For instance, SAP, a major global corporation, has opted to use pre-trained models rather than developing its own, as AI is increasingly treated as a commodity (see Section 2.2.4).
Key challenges:

– **Data Requirements**: Requires vast amounts of high-quality, domain-specific data.
– **Compute Costs**: Training state-of-the-art models requires expensive hardware or cloud resources.
– **Time-Intensive**: Developing and refining a competitive LLM takes months or even years.
– **Scalability Issues**: Adapting a model across multiple tasks is difficult without significant resources. (B, 2024; Gong, 2025)

Renting A100 GPUs on AWS costs $3 per hour, placing GPT-4's training cost at approximately $180M. Similarly, LLaMA 3 was trained on 24,000 H100 GPUs, with estimated GPU training costs reaching $720M. These figures highlight that compute power alone makes training an LLM prohibitively expensive for most organizations (B, 2024).

Given these challenges, leveraging pre-trained models with RAG or fine-tuning is a far more cost-effective and practical approach for most organizations (B, 2024).

Prompting

Prompt engineering is the practice of designing structured inputs to guide an LLM's responses toward a desired outcome. It does not modify the model's parameters and is an efficient, cost-effective approach to aligning model behavior with specific objectives (Yiyou_Lin, 2024).
Common prompting techniques:

- **Zero-Shot and One-Shot Prompting**: Minimal context is provided, relying entirely on the model's pretrained knowledge (Gong, 2025).
- **Few-Shot Learning**: The model is given a few examples within the prompt to help it generalize and generate more accurate responses (Buzdugan, 2024; Gong, 2025).
- **Chain-of-Thought (CoT) Prompting**: Encourages step-by-step reasoning, improving logical accuracy, particularly in complex problem-solving scenarios (Arsalan Mosenia, 2024).
- There are other prompting techniques, but these are among the most widely used.

Prompt engineering offers several benefits but also comes with inherent limitations:

- **Immediate Results**: No additional training is required.
- **Cost-Effective**: Avoids the computational expense of fine-tuning.
- **Flexible**: Easily adapts to different tasks and domains.
- **Limited Knowledge Control**: Cannot improve the model's domain-specific expertise.
- **Dependent on Prompt Quality**: Poorly designed prompts lead to inconsistent outputs. (Buzdugan, 2024; Gong, 2025; Yiyou_Lin, 2024)

> Prompting is like giving a student a set of instructions before a test - they can tailor their answers based on guidance, but their underlying knowledge remains unchanged (Arsalan Mosenia, 2024).

RAG

Retrieval-Augmented Generation enhances LLM responses by retrieving relevant, real-time information from an external knowledge base before generating an answer. By combining retrieval-based methods (which select pre-existing responses) and generative models (which create responses from learned patterns), RAG balances accuracy, flexibility, and contextual relevance (Arsalan Mosenia, 2024; Buzdugan, 2024; Gong, 2025; Vittorio Haardt, n.d.; Yiyou_Lin, 2024).
Traditional retrieval-based approaches return stored answers from a database, making them reliable but inflexible. Generative models create responses from

scratch, offering creativity but risking inaccuracies. RAG integrates both, using a retriever to find relevant documents and a language model to generate responses based on retrieved information (Buzdugan, 2024; Gong, 2025).
RAG offers several advantages but also introduces complexities:

- **Dynamic Knowledge**: Accesses up-to-date, context-specific information without retraining.
- **Reduced Model Size**: No need to encode all knowledge within the model itself.
- **Increased Accuracy**: Reduces hallucinations by grounding responses in retrieved data.
- **Flexibility**: Easily updates the knowledge base without altering model parameters.
- **Requires a Retrieval System**: Performance depends on the quality and structure of stored information.
- **Complexity**: Integrating retrieval mechanisms requires additional system design. (Buzdugan, 2024; Gong, 2025; Vittorio Haardt, n.d.; Yiyou_Lin, 2024)

> RAG is like an open-book exam - instead of memorizing everything, the model retrieves relevant information from external sources to ensure accuracy and completeness (Arsalan Mosenia, 2024).

Fine-Tuning

Fine-tuning involves customizing a pre-trained LLM by updating its parameters with additional, domain-specific training data. Unlike prompt engineering or RAG, fine-tuning permanently modifies the model's internal knowledge, making it more accurate for specialized tasks (Arsalan Mosenia, 2024; Buzdugan, 2024; Gong, 2025; Yiyou_Lin, 2024).
Fine-tuning updates an LLM's weights through backpropagation, requiring high-quality labeled datasets. This process allows the model to:

- **Improve performance in specific industries**: Fine-tuning enhances accuracy in domains such as legal, healthcare, and finance (Buzdugan, 2024; Gong, 2025).
- **Reduce costs**: Shortens prompts or improves the efficiency of smaller models (Yiyou_Lin, 2024).
- **Retain learned knowledge for long-term adaptation**: Unlike RAG, which retrieves data dynamically, fine-tuned models store knowledge permanently (Arsalan Mosenia, 2024; Buzdugan, 2024).

Fine-tuning provides significant benefits but comes with notable trade-offs:

- **Higher Accuracy**: Improves domain-specific performance.
- **Permanent Learning**: Retains specialized knowledge for future tasks.
- **Custom Styling**: Adjusts tone, writing style, and output structure.

– **High Computational Cost**: Requires significant processing power and memory.
– **Catastrophic Forgetting**: May reduce general capabilities when overfitting to new data.
– **Data-Intensive**: Needs large, high-quality labeled datasets to be effective. (Buzdugan, 2024; Gong, 2025; Yiyou_Lin, 2024)

Fine-tuning is like preparing for a closed-book exam - a student studies a specialized textbook and internalizes knowledge, but once the test starts, they cannot consult external sources (Arsalan Mosenia, 2024).

Conclusion: Why RAG?

For customizing an LLM to retrieve and process project documentation effectively, RAG stands out as the best solution. Unlike prompting, which requires all knowledge to be pre-embedded in the prompt, and fine-tuning, which is expensive and relies on static datasets, RAG dynamically fetches relevant, up-to-date information from external sources in real time (Arsalan Mosenia, 2024; Gong, 2025; Yiyou_Lin, 2024).

	Prompt Engineering	RAG	Fine-tuning
Key benefit	Rapid adaptability and prototyping	Incorporation of real-time or external data for factual answers	High specialization and tailored responses.
Training requirement	No	No	Yes
External Data	No	Needs a corpus	Task-specific dataset
Computation	No overhead	Overhead for retrieval	Intensive for training, no overhead for inference
Quality Improvement	Iterative refinement	Update/expand corpus	Periodic retraining
Potential Costs	Human labor for crafting prompts	Training, storing corpus, computational overhead	Dataset, training compute, evaluation
Technical Complexity	Low technical	Moderate to high – management of corpus can be complex	Moderate – requires expertise in neural networks & dataset biases
Extra Inference Latency	No	Yes – needed for retrieval	No

Figure 32: Comparison of Customisation Approaches (Arsalan Mosenia, 2024)

Why RAG is the best fit:

– **Real-Time Knowledge Access**: No need for costly retraining; new information is integrated instantly.
– **Eliminates Complex Prompting**: Avoids reliance on manually crafted, knowledge-heavy prompts.
– **Domain-Specific Accuracy**: Retrieves and applies relevant information dynamically without modifying model parameters.
– **Scalability & Long-Term Relevance**: Ensures the model remains useful over time without expensive updates.

– **Reduces Hallucinations**: Provides factually grounded responses by referencing external sources. (Arsalan Mosenia, 2024; Gong, 2025; Yiyou_Lin, 2024)

While RAG introduces additional system complexity, this trade-off is outweighed by its flexibility, reliability, and ability to maintain domain relevance over time. Since the focus is on maintaining and retrieving accurate project documentation, RAG offers the best balance of efficiency, adaptability, and cost-effectiveness. Prompting lacks adaptability since missing information cannot be embedded, while fine-tuning struggles with outdated knowledge and high data quality demands. RAG enables scalable, on-demand knowledge retrieval, making it the most effective approach for our use case.

5.2 How to Build RAG

As established in the previous section, RAG provides a promising approach to customizing an LLM with domain-specific knowledge, outperforming other methods in adaptability and real-time information access. While the fundamental workings of RAG have been introduced, building a functional system requires a deeper understanding of its key components and architecture. The simplest form of RAG, referred to as naive RAG, consists of the following components:

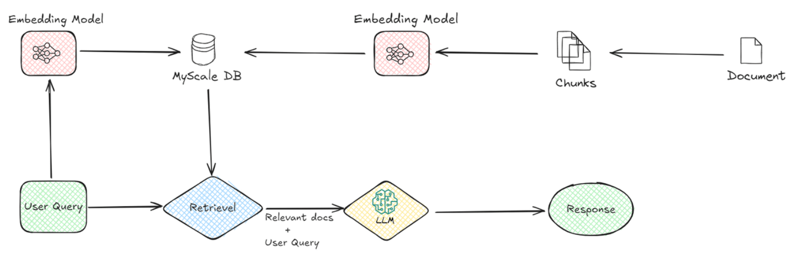


Figure 33: Architectural Diagram of a Naive RAG System (MYSCALE, 2024)

Document Chunking

Before any information can be retrieved, large documents must be broken into smaller, meaningful segments. This process, known as chunking, ensures that each section remains contextually coherent while still being small enough to be efficiently searched. Typically, documents are split into paragraphs, sentences, or fixed-length token chunks, making retrieval more precise and manageable.

Embedding

Once the documents are chunked, each segment is converted into a vector representation using an embedding model. These numerical vectors capture the semantic meaning of the text, allowing for similarity-based comparisons. The same embedding model is later used to process user queries, ensuring that document chunks and search inputs are represented in the same way.

Vector Database Storage

To facilitate fast and efficient retrieval, the generated embeddings are stored in a vector database. Unlike traditional databases that rely on keyword searches, a vector database allows for semantic search, meaning it can find relevant text even if it doesn't contain the exact words from the query. These embeddings are indexed using specialized algorithms to enable quick retrieval of the most relevant information.

Query Processing

When a user submits a question, the system first converts the query into a vector embedding using the same model that was applied to the document chunks. This step ensures that the query and the stored document vectors exist in the same embedding space, making it possible to compare their semantic similarities.

Retrieval

Once the query has been embedded, the system searches the vector database to find the most relevant document chunks. Using nearest-neighbor search, the system identifies the top-k chunks that have the highest similarity scores to the query. These retrieved chunks will serve as context for the final response generation.

Context Augmentation

To provide the language model with useful context, the retrieved document chunks are combined with the original user query. This augmented input ensures that the LLM has access to relevant, real-world information before generating a response. Without this step, the model would rely solely on its pre-trained knowledge, which may be outdated or incomplete.

Response Generation

Finally, the augmented input, containing both the user query and the retrieved document chunks, is sent to the LLM. The model generates a response based on the provided context, ensuring that its answer is not only fluent but also grounded in factual information. This approach significantly reduces hallucinations and improves accuracy by leveraging external knowledge sources. (bycloud, 2024; ILIN, 2024; MYSCALE, 2024)

The approach outlined above represents the most basic implementation of RAG. Its overall effectiveness hinges on the quality of the retrieval process. If the system retrieves irrelevant or low-quality data, the generated responses may become misleading or inaccurate. To mitigate this, the retrieval system must employ robust search mechanisms to ensure only the most relevant and reliable information is retrieved. (ILIN, 2024; Kaz Sato & Guangsha Shi, 2024)
Given the critical role of retrieval quality, research into improving RAG techniques has become its own field. The article 'Advanced RAG Techniques' by ILIN provides an overview of various RAG methodologies. However, exploring these techniques in depth falls outside the scope of this thesis, as it would require a highly technical discussion. For the purposes of this work, understanding the foundational principles of a naive RAG setup should suffice. Additional explanations, if needed, will be provided in Section 6.2 when the architecture of the final solution is discussed.
While RAG offers significant advantages, it also introduces additional complexity. Even in its naive form, a RAG system comprises multiple components, each of which presents opportunities for optimization, whether through parameter tuning, alternative approaches, or the use of different technologies.

5.3 Challenging Assumptions & Suggestions for Implementation: Expert Insights on RAG Implementation

After conducting initial research into the technical feasibility and various approaches to customizing a LLM, I concluded that using RAG appears to be the most promising direction for this solution. To validate this assumption and refine my ideas, I conducted an expert interview.
The interviewee, Nathan Ayalon, is an AI Engineer at Planday with several years of experience in developing technical solutions involving different forms of AI.
The interview was conducted over Microsoft Teams in two one-hour sessions. Recordings of both sessions are available in the *digital annex* under conversation-nathan-ayalon-1.m4a and conversation-nathan-ayalon-2.m4a.
The main objectives of the conversation were to:

- validate the assumptions made so far,
- clarify open questions, such as:
  - where to host?
  - which model to choose?
  - how to test?
- collect tips for development.

The following section presents the key findings from the interview, laying the groundwork for the technical prototyping described in Section 6.2.

Is RAG the Best Approach? Revisiting the Case for Retrieval-Augmented Generation

After exploring different strategies for customizing a LLM - including prompt engineering, fine-tuning, and RAG - in Section 5.1, RAG initially appeared to

be the most promising approach for this use case. This assumption was largely validated during the expert interview. RAG directly addresses a core limitation of LLMs: their restricted token window, which prevents them from processing large-scale documentation directly. By retrieving relevant content from a vector database before querying the model, RAG allows dynamic integration of external knowledge without retraining the LLM.
However, the interview also emphasized that RAG alone is not enough. Its success depends heavily on well-structured prompt engineering. Preprocessing user queries, such as validating or rephrasing them, was described as essential for retrieving meaningful results. In contrast, fine-tuning was considered less relevant in production contexts, as it typically adjusts tone or style rather than adding factual knowledge. Overall, the interview reinforced that combining RAG with prompt engineering offers a practical and flexible solution for extending LLMs with domain-specific content.

Where to Host? Balancing Practicality, Privacy, and Energy

While hosting a RAG-based solution locally may seem attractive from a privacy perspective, the expert interview highlighted several reasons why this approach is impractical, particularly given the technical capabilities of the intended user group. Setting up a local deployment requires significant effort: configuring and maintaining the LLM, the vector database, and the orchestration between them. For service designers and similar non-technical users, this would introduce a barrier too high to realistically overcome.
Cloud deployment, by contrast, allows developers to set up and maintain a single shared instance, which all users can access. This simplifies onboarding, ensures consistent system behavior, and centralizes control. While cloud hosting comes with trade-offs, such as potential concerns around data privacy and less transparency in energy use, it also offers more scalable infrastructure and better energy optimization at the system level. Local hosting might encourage more mindful usage patterns, but consumer-grade hardware is not optimized for efficient LLM inference.
Given these considerations, cloud hosting is the most viable starting point. It offers the right balance between simplicity, usability, and performance, while still allowing room to explore hybrid or more privacy-preserving setups in the future if needed.

Choosing the Right Model: How Much Power Do You Really Need?

When it comes to selecting a suitable LLM for a RAG-based system, the interview suggested keeping things simple. Most models perform similarly for standard retrieval tasks, meaning there is often no need to use the most powerful or expensive options. For cloud-based deployments, smaller variants like `GPT-4-turbo` were mentioned as cost-effective choices that still offer strong performance.
If self-hosting ever becomes relevant in the future, open-source models from platforms like Hugging Face may provide a viable path. However, model selection

should not be seen as a one-time decision. It is shaped by the hosting setup, cost constraints, and evolving project needs.

How to Test the System: Ensuring Effective Knowledge Retrieval

To evaluate whether a RAG-based system retrieves the right information at the right time, the expert interview emphasized the importance of structured testing. Testing should be based on a predefined set of queries and expected responses derived from the documentation. This allows for more objective and repeatable validation of the system's behavior.
A key part of this process is assessing whether the system retrieves the relevant document chunks needed to construct an accurate response. Nathan also pointed out that different chunking strategies can significantly impact retrieval performance, and should be tested accordingly. In this context, evaluating the quality of the retrieved context, rather than only the final output, is essential to building a trustworthy and effective RAG pipeline.

5.4 Takeaways

The technical excursion, supported by expert insights, led to the following conclusions that will guide the design and implementation of the RAG-based system:

- RAG is the most suitable approach for extending LLMs with external knowledge, offering flexibility without the need for retraining.
- Its effectiveness depends on strong prompt engineering and thoughtful preprocessing of user queries.
- Local hosting, while more privacy-preserving, is technically too complex for the target user group and introduces significant maintenance overhead.
- Cloud hosting enables a centrally managed, shared setup that simplifies onboarding and ensures consistency across users. It is also more energy-efficient at scale.
- Choosing a model should be guided by practicality - smaller, cost-effective models are sufficient for most retrieval tasks.
- Testing should focus on retrieval quality, with attention to how chunking strategies impact the relevance of retrieved content.

6 Develop

With the solution's objectives clearly defined (see Section 3.4), a foundational understanding of LLM customization via RAG established (see Section 5), and insights into the documentation practices and pain points of service designers gathered (see Section 4), the thesis is now well-positioned to enter the development phase on an informed foundation.

This chapter presents the proposed solution, designed in response to the identified needs and grounded in both technical and contextual feasibility. It unfolds in four parts:

First, Section 6.1 lays the groundwork by addressing Objective 1: Enable service designers to document their knowledge in a way that LLMs can effectively process and interpret. This is achieved through the development of a dedicated toolkit.

Next, Section 6.2 addresses Objective 2, demonstrating how an LLM can be applied to the documentation to enable natural language querying via a RAG pipeline.

In Section 6.3, both streams are brought together in a unified framework: Meet the Framework for Living User-centered Information Documentation (FLUID).

Finally, Section 6.4 outlines the testing approach used to evaluate the framework's usability, performance, and potential impact.

6.1 Service Design Digital Documentation Toolkit: How to Document for LLMs

This section introduces the Service Design Digital Documentation Toolkit (S3DK), developed to help service designers systematically capture, organize, and share their knowledge across tools, teams, and formats. While the toolkit supports Objective 1, enabling documentation that can be processed and interpreted by LLMs, its relevance extends beyond LLM integration.

The S3DK offers a structured yet flexible framework for consolidating fragmented documentation practices into a modern, collaborative, and centralized approach. It guides designers in capturing knowledge from various sources, such as workshops, research findings or visual artefacts, in ways that enhance consistency, accessibility, and long-term value.

The following subsections describe the development of the toolkit, detail its core components, and illustrate how it addresses both the practical needs of service designers and the technical requirements of downstream LLM applications.

6.1.1 Method-Tool Matrix

The survey already indicated it (see Section 2.1.3), but the workshop provided confirmation (see Section 4.1): no single tool is sufficient for documenting knowledge. Service designers rely on a variety of tools and methods to elicit, capture, and communicate their knowledge.

To organize this variety, tools and methods were related to one another, resulting in the Method-Tool Matrix. This matrix serves as both the foundation for the further development of the S3DK and a practical look-up table for selecting appropriate tools for specific methods.
The Method-Tool Matrix was developed through the following steps:

1. Compile a list of methods mentioned during the workshop (see Section 4.1)
2. Extract a list of methods presented in *This Is Service Design Doing: Applying Service Design Thinking in the Real World*
3. Merge, cluster, and simplify both lists into a consolidated set of methods
4. Abstract the tools mentioned in the workshop, cluster them according to functionality, and simplify
5. Combine the method and tool lists into a matrix, evaluating their relationships based on fit: 0 = no fit, 0.5 = partial fit with adaptation required, 1 = strong fit

Based on the evaluation of how well each tool supports different methods, the following ranking can be derived. The tools are ordered from specialist to generalist, meaning those that are suitable for only a few methods appear at the top, while those with broader applicability across many methods appear further down the list.
The ranking was determined by summing the evaluation scores across all methods for each tool, and then ordering them from lowest to highest total score.

– Survey & Feedback (Typeform)
– Desk Research (Chrome)
– Video Editing (Final Cut Pro)
– Citation Management (Zotero)
– Research Analysis (Condens)
– Communication & Meeting Tools (MS Teams)
– Data Analysis & Tabular Tools (Excel)
– Presentation & Communication (Keynote)
– Generative Tooling (ChatGPT)
– Visual Design & Prototyping (Figma)
– Documentation & Writing (Word)
– Analog Capture (Pen & Paper)
– Whiteboarding & Collaborative Ideation (FigJam)

The evaluation of how well each tool supports a given method was, where applicable, informed by insights from the workshop with service designers, and extended through a heuristic assessment based on my own practical experience. While this process draws on elements of self-reflection, it does not aim to be exhaustive or universally valid. Rather, the results should be understood as indicative possibilities rather than comprehensive or definitive mappings.
The resulting Excel file is attached in the *digital annex* as method-tool-matrix and a simplified version can be seen in Figure 34

simplified method-tool matrix

Method	Visual Design & Prototyping (Figma)	Whiteboarding & Collaborative Ideation (FigJam)	Presentation & Communication (Keynote)	Documentation & Writing (Word)	Communication & Meeting Tools (MS Teams)	Research Analysis (Condens)	Survey & Feedback (Typeform)	Generative Tooling (ChatGPT)	Desk Research (Chrome)	Citation Management (Zotero)	Data Analysis & Tabular Tools (Excel)	Video Editing (Final Cut Pro)	Analog Capture (Pen & Paper)
Desk/Secondary Research	❌	❌	❌	⚠️	❌	❌	❌	⚠️	✅	✅	✅	❌	❌
Interviews	❌	⚠️	⚠️	✅	✅	⚠️	❌	⚠️	❌	❌	❌	❌	⚠️
Observations	❌	❌	❌	⚠️	❌	❌	❌	❌	❌	❌	❌	❌	✅
Mobile Ethnography	❌	❌	❌	⚠️	⚠️	❌	❌	❌	❌	❌	⚠️	❌	⚠️
Surveys	❌	❌	❌	❌	❌	❌	✅	⚠️	❌	❌	✅	❌	❌
Affinity Mapping	❌	✅	❌	❌	❌	⚠️	❌	⚠️	❌	❌	❌	❌	⚠️
Personas	✅	✅	⚠️	⚠️	❌	❌	❌	⚠️	❌	❌	❌	❌	⚠️
Journey Maps	✅	✅	⚠️	⚠️	❌	❌	❌	⚠️	❌	❌	❌	❌	⚠️
System Maps	✅	✅	⚠️	⚠️	❌	❌	❌	❌	❌	❌	❌	❌	⚠️
Mind Maps	❌	✅	⚠️	⚠️	❌	❌	❌	❌	❌	❌	❌	❌	⚠️
Value Maps	❌	✅	⚠️	⚠️	❌	❌	❌	⚠️	❌	❌	❌	❌	⚠️
Insight Development	❌	⚠️	❌	⚠️	❌	✅	❌	⚠️	❌	❌	⚠️	❌	❌
Brainstorming	❌	✅	❌	❌	❌	❌	❌	⚠️	❌	❌	❌	❌	⚠️
Co-creative Workshops	❌	✅	❌	❌	✅	❌	❌	❌	❌	❌	❌	❌	⚠️
Low-fidelity Prototyping	⚠️	✅	⚠️	❌	❌	❌	❌	⚠️	❌	❌	❌	❌	✅
Digital Prototyping	✅	❌	❌	❌	❌	❌	❌	❌	❌	❌	❌	❌	❌
Prototyping Experiences	✅	✅	❌	❌	✅	❌	❌	❌	❌	❌	❌	❌	✅
Business Modeling	❌	❌	✅	✅	❌	❌	❌	⚠️	❌	❌	✅	❌	❌
Presentations	✅	❌	✅	❌	❌	❌	❌	⚠️	❌	❌	❌	❌	❌
Visuals	✅	❌	⚠️	❌	❌	❌	❌	⚠️	❌	❌	❌	❌	⚠️
Video Content	❌	❌	⚠️	❌	❌	❌	❌	❌	❌	❌	❌	✅	❌
Written Reports	❌	❌	❌	✅	❌	❌	❌	⚠️	❌	⚠️	❌	❌	❌

✅ strong fit
⚠️ partial fit with adaptation required
❌ no fit

Figure 34: Simplified Method-Tool Matrix

6.1.2 System Overview

Building on the Method-Tool-Matrix introduced in Section 6.1.1, the taxonomy presented in Section 2.3, and anticipating the integration of intelligence in the following section, this part introduces the structure of the S3DK system and explains its different layers.
As illustrated in Figure 35, S3DK is composed of three conceptual layers, named as follows:

1. the Orbit,
2. the Mass of Meaning,
3. the Data Shuttle.

These layer names draw on space-related metaphors to help users intuitively grasp the role of each component within the system.

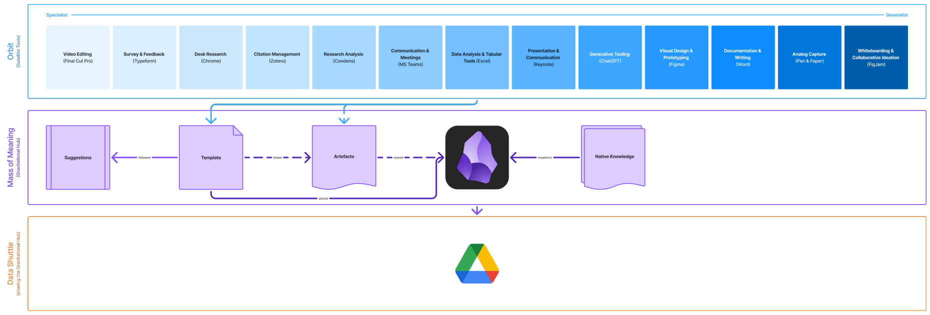


Figure 35: System Overview of S3DK

The Orbit

The Orbit represents the first layer of the S3DK. As suggested by its name, the Orbit contains the satellites. Just like real-world satellites, each one is designed to perform a specific function.
In the context of the S3DK, there are thirteen distinct satellites, each representing a function paired with one representative of a corresponding tool as introduced in Section 6.1.1. These tools are abstracted as functions, reflecting the idea that while tools may evolve or be replaced over time, the underlying functions tend to remain stable and relevant. The emphasis, therefore, lies on the function, while the tools are included to provide concrete examples and reduce abstraction.
Each satellite is tailored to a particular purpose. Some are highly specialized, supporting narrow use cases, while others are more general in nature and applicable to a wider range of activities.
In the context of service design documentation, this could look as follows:
Lisa is starting a new project and chooses to follow the S3DK to document knowledge throughout. She begins the project with a survey. Consulting the Method-Tool Matrix, she finds three tools associated with the survey method:

- Survey & Feedback (Typeform)
- Generative Tooling (ChatGPT)
- Data Analysis & Tabular Tools (Excel)

Each of these is represented by a satellite in the Orbit. First, Lisa drafts her questions and uses ChatGPT, a more general-purpose satellite, also applicable to other methods, as a sparring partner for refining phrasing. She then sets up the actual survey in Typeform, a satellite specialized in conducting surveys. Once responses are collected, she uses the Data Analysis satellite, represented by Excel, to analyze the tabular survey results.
As a result, Lisa creates three artefacts:

- the survey (a Typeform link or template),
- the survey results (a CSV file),

– the analysis results (a CSV file).

How these artefacts are documented within the S3DK is explained in the next paragraph.

The Mass of Meaning

What do the satellites orbit around? The Mass of Meaning. The Mass of Meaning serves as the gravitational hub of the documentation system, drawing in and consolidating all relevant knowledge.
This knowledge is managed using the tool identified as the most suitable for documentation purposes based on the taxonomy introduced in Section 2.3: Obsidian[14].
Obsidian operates as a file-based documentation tool using Markdown to structure and style content. While Markdown introduces a minor learning curve due to its syntax, this challenge is easily mitigated through the use of predefined templates. Templates not only help users unfamiliar with the syntax by providing a familiar structure, they also reduce extraneous cognitive load by offering clear guidance on how to organize information, allowing users to focus on the content rather than the format (see Section 2.1.1). In parallel, templates function as externalized schemas that support the categorization and integration of new knowledge into existing mental models (see Section 2.1.1). Suggested templates and how to use them are detailed in Section 6.1.4.
When information is generated or captured using one or more satellite tools, the resulting artefacts and insights are pulled into the Mass of Meaning by its gravitational force. Depending on the size and nature of these artefacts, it may be more appropriate to document only the derived insights using a template, while linking to the original artefact for reference. Duplicating content across multiple locations is generally avoided to maintain consistency.
On the other hand, when artefacts are relatively lightweight and can be exported in supported formats, it makes more sense to incorporate them directly into the Mass of Meaning. Much like in space, smaller objects are drawn in by the gravitational pull of a larger mass, while larger ones may only be partially influenced.
Returning to Lisa and her three artefacts: in this case, the artefacts are relatively small and are therefore drawn into the Mass of Meaning. Lisa stores both the exported survey results and the processed data files within Obsidian's file system.

[14] Obsidian is a local-first note-taking application that organizes knowledge through a system of interlinked Markdown files stored directly in the file system. It supports plain text editing with Markdown syntax and offers features such as backlinking, filtering, and full-text search to facilitate efficient navigation and retrieval of information. Obsidian includes a graph view to visualize relationships between notes and a canvas feature for spatially arranging content to support non-linear thinking. The application is highly extensible through a large ecosystem of community-developed plugins and is supported by an active and engaged user community. Find out more on their website.

She creates a template entry for the survey following the suggestions, completing the relevant fields and including an external link to the Typeform survey and internal links to both CSV files. Since the survey interface itself cannot be exported, it remains part of the Orbit.
In contrast, consider a more substantial artefact: a workshop Lisa conducted with the same client some time ago. While certain insights remain relevant, the overall size and scope of the workshop make exporting the entire FigJam file as a PDF impractical. In this case, the gravitational pull of the artefact itself outweighs that of the Mass of Meaning. Instead, Lisa documents the key insights in a template and includes a link to the FigJam file in the Orbit. This approach also avoids complications with file types such as PDFs, which, despite containing text, may lack sufficient context or semantic structure for LLMs to interpret effectively, especially in the case of post-it-heavy workshop exports.
Alternatively, knowledge can be captured directly within Obsidian, without relying on any satellite tools for its generation or elicitation. This approach, referred to as Native Knowledge, involves documenting insights natively. While such Native Knowledge entries may not initially require a template due to their potentially rich level of detail, it can be valuable to later abstract them into a templated format. Doing so allows this knowledge to benefit from the advantages associated with structured documentation.

The Data Shuttle

Up to this point, Lisa has been working independently on the new project. Now that she has completed the exploration of the problem space, she wants to involve a colleague to support the prototyping phase. In order to contribute effectively, the colleague needs access to the knowledge documented during the earlier stages. This is where the third and final layer comes into play: the Data Shuttle.
Just as space shuttles are envisioned to transport astronauts to distant planets, the Data Shuttle serves to bring Lisa's team member into her Mass of Meaning. This layer is essential for making the documented knowledge accessible to others. Moreover, it also functions as the interface for integrating intelligence into the documentation (see Section 6.2 for details).
To share the documentation, Lisa simply grants her colleague access to the shared Google Drive where the file system is hosted. The colleague installs Obsidian and opens the same project *Vault*[15] stored in Google Drive. With this setup in place, they are ready to embark on a journey into the endless vastness of the ~~universe~~ solution space.

6.1.3 Templating

As described previously, the knowledge generated in the Orbit will be transferred into the Mass of Meaning. To standardise this process and reduce cognitive load, a structured approach using a template is proposed.

[15] A term used by Obsidian to organize different knowledge bases.

The following section outlines the elements of the template, drawing on the literature discussed in Section 4.3 and the findings from the interview presented in Section 4.2.

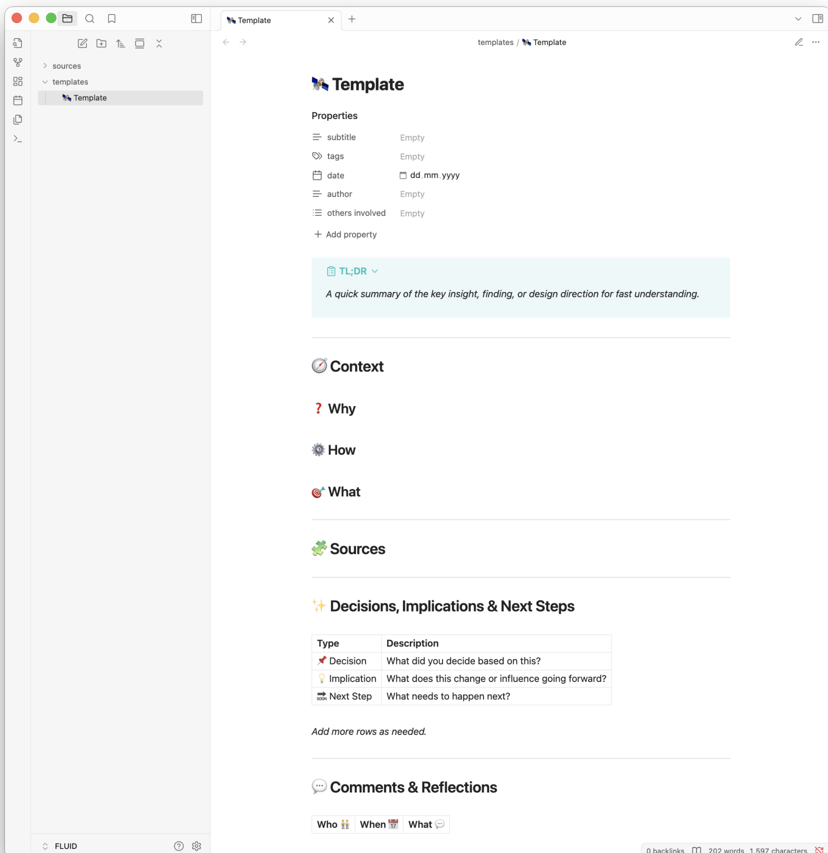


Figure 36: Empty Template to Pull Knowledge from Orbit

As illustrated in Figure 36, the template consists of several fields that are intended to be filled in during documentation.

In the following, each field of the template is described chronologically from top to bottom. The next section will present a completed example, accompanied by suggestions for using the template in practice.

Inspired by the interview findings, the template begins with a *title* and *subtitle*, hinting at the *what*. As Lin (2021) emphasize, it is important to document not only what was designed, but also why, how, and with whom. While the *why* and *how* are addressed in the *Context* section, the *what* is already introduced through the *title* and *subtitle* and expanded upon in the *Properties* section, which also includes the *who* and *with whom*.

The *Properties* section includes additional metadata such as the *author*, *others involved*, *date*, and *tags*. According to Mirafzal et al. (2023), including collaborators is key to enabling peer-to-peer knowledge sharing beyond formal systems. Tags, as Baxter et al. (2009) point out, play a crucial role in filtering and retrieving knowledge.

Following the metadata, a *TL;DR*[16] section provides a concise summary or key takeaway from the entry. This serves to offer readers a quick overview without requiring them to read the entire note.

The next section is *Context*. Capturing context is essential for understanding rationals at a later point in time. Baxter et al. (2009) stress the importance of documenting contextual relevance, while Sangiorgi (2009) highlights the value of recording not only outcomes, but also rationale, reflection, and evolving insight. Lin (2021) even argue that detailed and well-contextualized reports are more likely to be reused than summaries or overly templated formats. They caution that without sufficient contextual depth, structured rationale often fails to transfer effectively across projects due to interpretation barriers and lack of granularity.

Therefore, the *Context* section should capture the *why*, documenting the rationale; the *how*, detailing the method and approach used; and the *what*, elaborating on the key insights behind the title and subtitle.

In line with the need for flexibility, Mirafzal et al. (2023) advise against one-size-fits-all solutions. The S3DK framework supports the use of satellite tools to enable diverse documentation formats. Artifacts created with such tools should be referenced in the template, either via internal Obsidian links (if imported) or external links (if they remain in the Orbit). These references are included in the *Sources* section, supporting the idea of interlinked knowledge units, as also emphasized by Baxter et al. (2009).

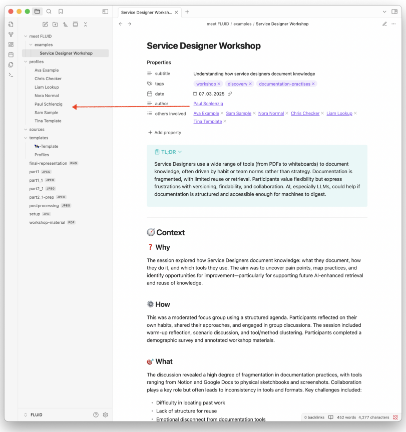
Additionally, the template includes a section titled *Decisions, Implications & Next Steps*, which encourages the author to reflect on forward-looking aspects and identify unresolved issues or required actions.

Finally, the *Comments & Reflections* section is intended to facilitate collaborative feedback and self-reflection (Baxter et al., 2009). Although Obsidian lacks native support for logged commenting, a tabular workaround is used to structure input from multiple contributors.

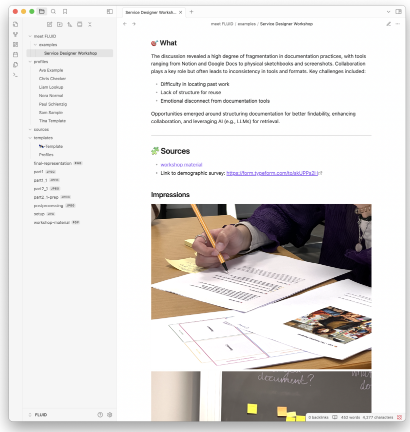
6.1.4 Suggestions

To illustrate the application of the template, it has been completed with example content based on the workshop described in Section 4.1. Screenshots of the filled template are shown in Figure 37. The full file is included as part of the dummy

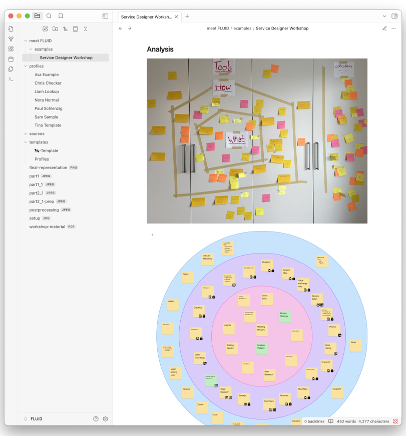
[16] Too Long; Didn't Read



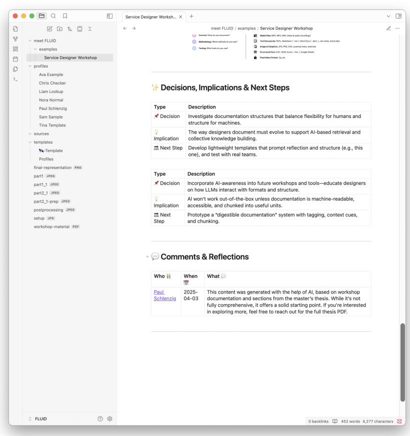
Part 1 of 4



Part 2 of 4



Part 3 of 4



Part 4 of 4

Figure 37: Screenshots of Filled Template - Parts 1 to 4

vault in the *digital annex*, referenced in FLUID-dummy-vault. The following section outlines a set of practical suggestions and best practices:

Use the Template

- Start with the provided template - it guides your thinking and ensures consistency.
- Don't feel locked in - the template is meant to guide, not constrain your thinking.
- An example Obsidian vault is included in the *digital annex*. Use it to explore structure, syntax, and layout examples.
- Screenshots are available in this section for visual reference.
- Helpful Obsidian resources can be found here.

Focus on the Mass of Meaning

- Always work toward the gravitational hub, not away from it.
- Remember: the Orbit is not your documentation. Satellites serve as discovery tools, not data centers.

Exporting Artifacts for AI Use

- If you export data from the satellites, e.g., workshop results or other documents, make sure to use supported formats:
  - Plain text (.txt) - Basic notes or raw text
  - PDF (.pdf) - Make sure the text is selectable (not scanned images!)
  - Word Documents (.doc, .docx) - Files from Microsoft Word or similar apps
  - Markdown (.md) - Common format used in tools like Obsidian
  - LaTeX source files (.tex) - Used for academic or structured writing
  - HTML (.html) - Webpage content or exports from web-based tools
  - CSV and Excel (.csv, .xls, .xlsx) - Structured data from spreadsheets (e.g., research results, workshop outputs)
- When exporting PDFs, ensure it contains text information.
- Reason: LLMs perform best on rich textual content. Supplement visuals like FigJam exports or post-it walls with filled-in templates to provide context.

Organize & Link Artifacts

- Store exported artifacts in a dedicated source folder.
- Reference these and other external artifacts directly in your template using internal or external links.
- Use the *Profiles* template to store contact details or relevant person-based knowledge. You can link them inside other templates for reuse, e.g., when filling out *others involved*.
- Profiles help reduce repetition and create consistency when working across multiple notes or collaborators.

Use & Reuse Tags

- Tags are essential for finding relevant content - reuse them consistently across notes.
- Tags can be used in both the *properties* and in the body text.

Build Your Knowledge Graph

- Make generous use of links - both internal (between notes) and external (using URLs).
- Links form the backbone of your personal knowledge graph, enabling easier exploration and holistic understanding.
- Learn more about Obsidian's graph features here.

Be Generous with Context

- Use the TL;DR section for quick insight, but don't shy away from detail in the context section.
- More context = better retrieval and understanding - both for humans and LLMs.
- Try to structure your writing clearly with headings and sections - this helps both people and AI systems understand it better.

Mark Client Decisions Clearly

- Highlight client decisions using clear conventions like:
- Tags (e.g., #clientDecision)
- Callouts or color-coded blocks

Mix Up Your Tools

- Tools evolve, but methods endure.
- Try different satellite tools to improve workflows and remain agile in your practice.

Adapt the System: Make It Your Own

- These suggestions are a starting point - feel free to adapt the system to better suit your way of working.
- Remember: Links are powerful - use them liberally to connect related content.

6.1.5 Disclaimer

S3DK provides a starting point for organizing service design documentation in a way that enables processing by LLMs, while enhancing structure and long-term usability for human teams. Although digital tools have been used in design practice for years, their potential for meaningful documentation and knowledge reuse has often been underexploited. S3DK introduces a more deliberate approach to digitisation, shifting from scattered artifacts to structured, retrievable knowledge, without compromising the human-centric values of reflection, transparency, reasoning, and collaboration.

That said, this toolkit is not a fixed standard, nor does it claim to be exhaustive. Tools, methods, and workflows evolve, and so should your documentation practice. The templates, file formats, and suggestions offered here are meant as practical recommendations, not rigid rules.

If aspects of the toolkit do not align with your way of working, feel free to adapt or extend them. S3DK is meant to serve as a foundation - not a constraint.

Use it as it fits you. Shape it as you grow.

6.2 Adding Intelligence: Applying RAG

To reach Objective 2 and enable service designers to retrieve knowledge from their documentation using natural language queries, the documentation must be made intelligent. This requires customizing a LLM using the knowledge stored through the S3DK introduced in Section 6.1.
The technical setup required for this customization is addressed in Section 5. To enable retrieval, a RAG system is implemented. For the purpose of rapid prototyping and to reduce complexity, the system is hosted online.
Knowing that the RAG system would be hosted in the cloud, research was conducted on suitable frameworks and cloud providers for implementation. Multiple approaches were explored to assess their suitability in terms of ease of setup, file synchronization, cost, and customisability. The goal was to identify a solution that would not only function well technically but also be approachable for less technical users such as service designers.
Google Cloud's Vertex AI[17] was initially selected due to its promise of effective search capabilities integrated directly into the platform, removing the need to handle vectorization manually. However, in practice, the setup proved complex. Syncing files from Google Drive to Google Cloud required an additional Extract, Transform, Load (ETL) step, and the available tutorials were outdated due to product renaming. While the system was eventually made to work, it became clear that the setup process was too technical for a broader audience. Furthermore, the solution was not easily customisable, as it defaulted to using Gemini as a LLM, introducing a level of vendor lock-in.
Alternatives such as VEXT[18] and Langflow[19] were also identified as potentially viable options, particularly due to their visual interfaces and modular designs. However, they were not tested in depth, as early exploration with n8n already demonstrated promising results.
n8n[20] was ultimately chosen for the prototype due to several advantages:

- it is a no-code platform, making it easier to understand and configure;
- it offers both cloud and self-hosted deployment options;
- it has well-structured documentation;
- the setup was successfully implemented following an existing tutorial (Cole Medin, 2025);
- it allows for flexible customization, such as switching between LLM providers and adapting workflows.

On the whole, n8n offered the best balance between functionality, usability, and prototyping speed in the given context. The following sections introduce and evaluate Prototype 0, after which Prototype 1 is documented as an improved iteration.

[17] https://www.google.com/
[18] https://vextapp.com/flow
[19] https://www.langflow.org
[20] https://n8n.io

6.2.1 Prototype 0

The initial prototype was built using n8n. The workflow presented in a YouTube tutorial by Cole Medin served as the starting point, but it was customized to decouple the logic, enhance modularity, and integrate Slack as a User Interface (UI).

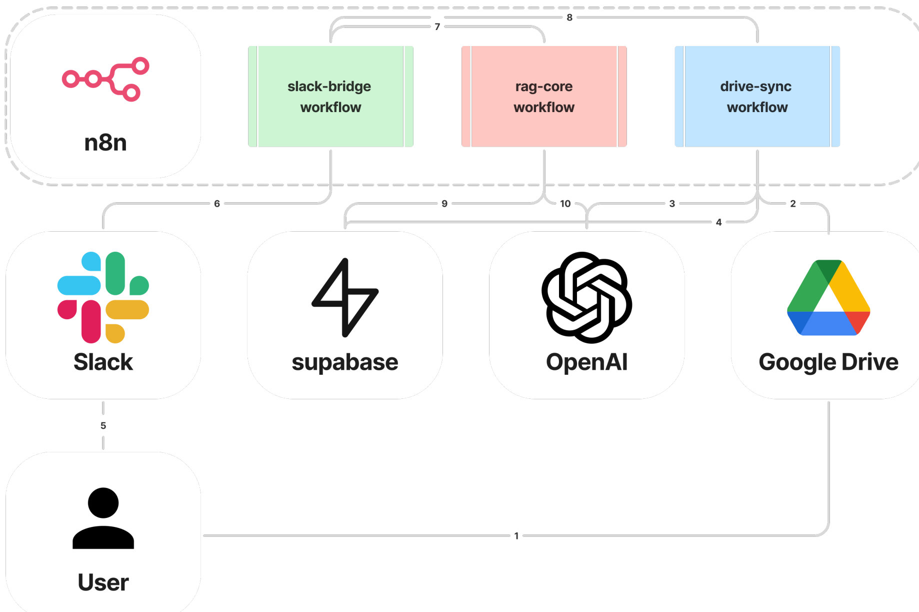


Figure 38: Component Overview of RAG System Prototype 0

Figure 38 presents a simplified overview of the system components and the data flow between them. At the core of the setup are three distinct workflows:

1. Drive-sync Workflow:
   responsible for ingesting files from Google Drive and uploading them to the vector database.
2. Slack-bridge Workflow:
   handles incoming queries and outgoing responses via Slack.
3. RAG-core Workflow:
   processes queries by retrieving relevant context from the vector database and generating answers using a LLM.

In the following, each of the n8n workflows is described at a high level, with references to the numbered interfaces between components shown in Figure 38.

Drive-sync Workflow

The Drive-sync Workflow ensures that the vector database remains aligned with the latest version of the documentation. The process follows these steps:

[1] Users upload their files to a designated Google Drive folder, following the guidelines outlined in Section 6.1.

[2] Every hour, the workflow checks for changes in the folder and identifies newly added, updated, or deleted files. Updated files are first deleted from the vector database and then reprocessed as new files to ensure consistency.

[3] New files are transformed into semantic vector representations using OpenAI embeddings, as described in Section 5.2.

[4] These embeddings are uploaded to supabase, while vectors corresponding to deleted files are removed to prevent outdated or incorrect information from being retrieved during question answering.

Slack-bridge Workflow

The Slack-bridge Workflow connects the system with Slack to serve as its user interface, enabling interaction for non-technical users. The workflow operates as follows:

[5] Users interact with the system via Slack, where they can submit questions and receive answers directly within the messaging platform.

[6] This interaction is handled by the Slack-bridge Workflow, which captures the user's input, forwards it to the system, and returns the corresponding output as a response in Slack.

[7] When a user submits a question in Slack, the Slack-bridge Workflow retrieves the query and passes it to the RAG-core Workflow. After processing, the RAG-core Workflow returns an answer, which is then delivered back to the user via the Slack-bridge Workflow.

[8] Additionally, when the Drive-sync Workflow completes a synchronization cycle, a summary message is posted to Slack. This message informs the user about how many documents were created, updated, or deleted - enhancing transparency and user awareness.

RAG-core Workflow

The RAG-core Workflow is responsible for processing user queries by retrieving relevant context and generating a response using a LLM. Its logic consists of the following steps:

[9] When the RAG-core Workflow receives an input query, it uses the query to search for relevant information in the supabase vector database.

[10] The user query, system prompt, and retrieved context from the vector store are bundled into a request and sent to OpenAI for processing. The generated answer is then returned to the user via the Slack-bridge Workflow.

6.2.2 Testing Prototype 0

Once Prototype 0 was assembled, its functionality was assessed through a manual system test designed to uncover bugs, errors, and unintended behavior. Additionally, the test served to evaluate how effectively the system could retrieve information from its knowledge base.

To challenge the Drive-sync Workflow, a variety of files, differing in type, size, and folder structure, were uploaded to Google Drive. Files were also deleted and re-uploaded to provoke potential duplications and observe the system's handling of such scenarios. Once the knowledge base was populated, Slack was used to interact with the chatbot interface to test information retrieval in a natural conversational setting.

The following summarizes the key issues identified during testing, along with their corresponding solutions.

Drive-sync Workflow

During testing, it became evident that the Google Drive node also retrieved files that had been deleted but remained in the trash bin. This behavior led to confusion, as previously deleted files were still being processed. To resolve this, the workflow was updated to include a filter that checks the *trashed* flag provided by the Google Drive API, ensuring only active, non-deleted files are considered.

Another issue emerged from a subtle filtering error that prevented files from being properly deleted from the vector database. Files that no longer existed in Google Drive were being overlooked because they lacked MIME type metadata and were thus filtered out before reaching the deletion logic. By moving the MIME type filter earlier in the workflow, all files, regardless of their presence in Drive, could be evaluated for deletion, restoring consistency in the knowledge base.

It was also found that Slack notifications reporting the number of updated or deleted files were being sent before the upload process had actually completed. This created a misleading sense of system stability. To address this, an additional update message was triggered only after the upload had been successfully finalized. In addition, error messages are now forwarded to Slack if any part of the process fails, ensuring transparent feedback for the user.

Edge cases involving empty files led to unexpected workflow failures. Some test files contained no content but were still processed. To mitigate this, the system now treats empty files explicitly by inserting the placeholder string *"empty document"* as content. This prevents upload errors while preserving the user's ability to query for such files.

Finally, through the course of testing, it became apparent that the Drive-Sync Workflow was performing two distinct tasks: detecting changes in Google Drive and uploading content to the vector database. To simplify maintenance and improve modularity, these responsibilities were separated into two dedicated workflows. One now handles file change detection, while the other focuses on the upload process and file-type specific handling. The improved structure of these workflows is documented in Section 6.2.3.

Slack-bridge Workflow

One of the first cosmetic issues observed during testing was that every message sent from the system to Slack included an autogenerated footer stating *Automated with this n8n workflow*. While this message is part of the default configuration of the Slack node in n8n, it added no meaningful value and unnecessarily took up space in the chat interface. The fix was straightforward: the footer could be disabled by unchecking an option in the Slack node configuration, resulting in a cleaner and more professional appearance of the response.

A less visually obvious issue, but one with greater impact on user experience, involved the lack of feedback during query processing. After a user submitted a question to the chatbot via Slack, the system began working on the response. However, there was no indication in the chat that any processing was underway. This made the interaction feel unresponsive, especially in cases where the response generation took longer than expected.

An initial idea to improve this was to show a typing indicator from the bot while it was processing the input. Unfortunately, Slack's API does not currently support this feature for bot accounts (Dennis Mathew Philip, n.d.). As the issue was considered cosmetic and did not affect core functionality, implementing a workaround was deemed unnecessary for this prototype stage.

RAG-core Workflow

One issue that affects both the Slack-bridge Workflow and the RAG-core Workflow is related to formatting. The RAG-core Workflow outputs responses styled using Markdown, while Slack only supports a simplified version of it (Slack, n.d.). I experimented with adding instructions to the system prompt to guide formatting, but the results were inconsistent. Since this is mainly a cosmetic issue, I decided not to spend too much time on it after only minor improvements.

A more substantial issue became visible during usage. While the system is generally good at identifying the right documents and understands the documentation content reasonably well, it sometimes provides incomplete answers. This is due to the way RAG works: the content is split into chunks, and the retrieved chunk may not contain all the information necessary to fully answer a question. This is a known limitation of RAG and one reason it is considered a transitional technology, until LLMs are capable of handling significantly larger token windows (see Section 5.3).

There are ways to work around this, like multi-agent setups or feedback loops that build more context, but I intentionally kept the system simple to ensure accessibility for service designers. Instead, I found a lighter workaround: asking the chatbot to rethink its answer and focus only on the document it pulled the information from often helped improve the completeness of responses.

6.2.3 Prototype 1

Prototype 1 represents the first iteration that addresses several issues identified during the testing of Prototype 0. Key improvements include a more robust ETL pipeline for synchronizing Google Drive with the system's knowledge base, enhanced user transparency through clearer system notifications, and increased modularity by splitting the original Drive-sync Workflow into two dedicated workflows, Drive-sync Workflow Delta for detecting the delta between the knowledge base and Google Drive, and Drive-sync Workflow Upload for uploading new documents to the knowledge base.
Overall, Prototype 1 resolves many of the problems found in the previous version. However, some limitations remain. These include the absence of a typing indicator in Slack, the inability to apply consistent formatting using Markdown, and the occasional issue of incomplete answers due to limitations in the retrieval process. As such, Prototype 1 continues to serve as a prototype and PoC, rather than a production-ready solution. Despite these constraints, the system is fully functional and can reliably support basic use cases. Prototype 1 serves as the current solution to Objective 2 and forms the basis for the upcoming testing phase, which will be detailed in Section 6.4.

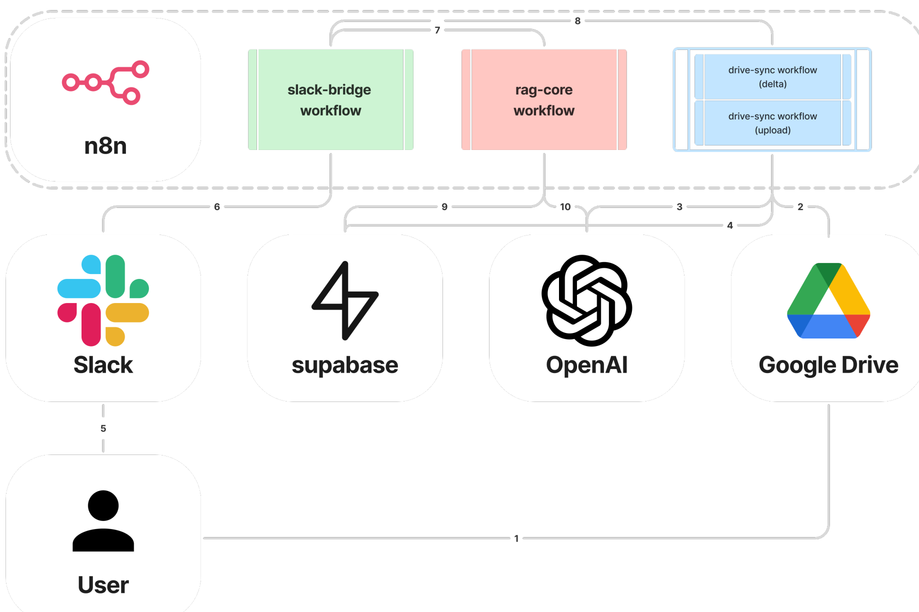


Figure 39: Component Overview of RAG System Prototype 1

In the following, the workflows of Prototype 1 will be documented.
The prototype is hosted and implemented using the no-code platform n8n. The rationale for selecting this platform is outlined at the beginning of Section 6.2.

An additional advantage of n8n is its support for exporting workflows as JSON files, making them easy to share and reuse. This capability is essential for the intended solution, which aims to enable service designers to use LLMs for retrieving knowledge from documentation.
By making the RAGs system open source (see Section 2.2.4), others can adopt and implement similar solutions without building them from scratch. To use the provided workflows, users simply need to import them into their own n8n instance, set up accounts for the necessary third-party services (Slack, Google Drive, OpenAI, and Supabase), and store the corresponding credentials. Whether service designers are actually able to set up the system independently by importing the workflows, configuring third-party services, and storing credentials will be evaluated during the upcoming testing session (see Section 6.4).
To support future users, the workflows have been annotated with brief explanations, and nodes have been grouped by functionality and named descriptively. These details are illustrated in Figures 40, 41, 42, 43, and 44. Additionally, a one-time setup workflow has been created to initialize the necessary databases (see Figure 44). This simplifies the setup process, although the same configuration could also be done manually if preferred. The code required to import the workflows into n8n is included in the *digital annex* under n8n-workflows.

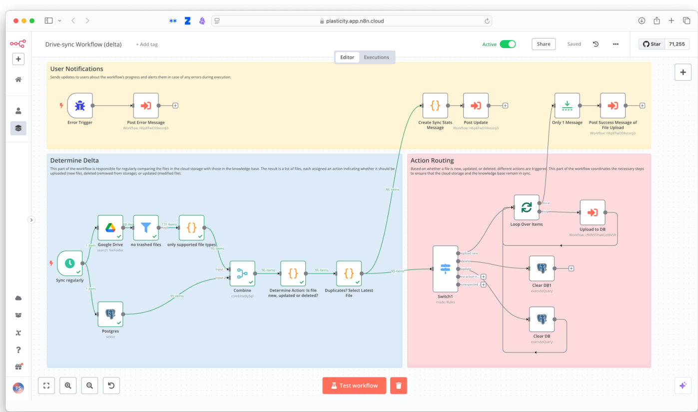


Figure 40: Screenshot of the Annotated Drive-sync Workflow Delta in n8n

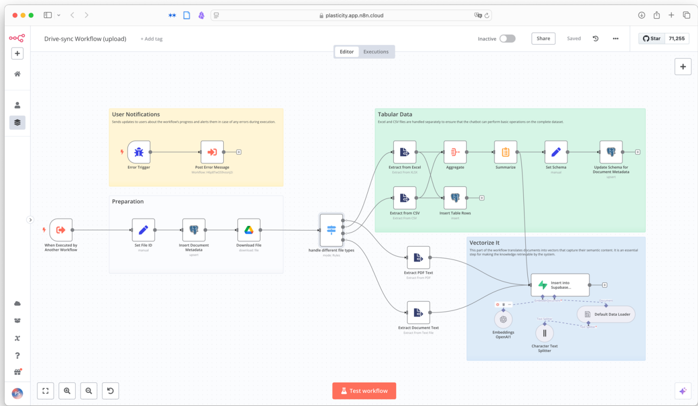


Figure 41: Screenshot of the Annotated Drive-sync Workflow Upload in n8n

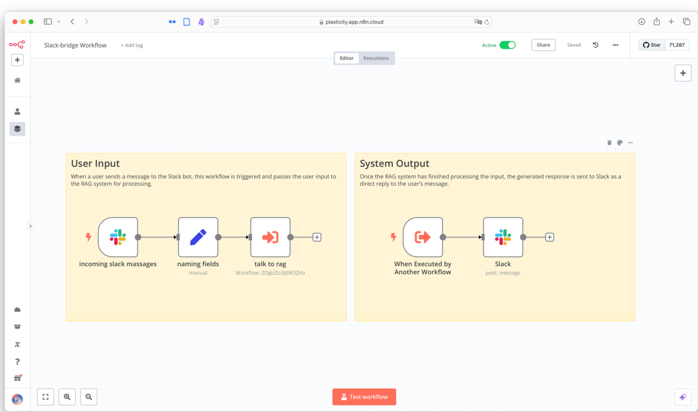


Figure 42: Screenshot of the Annotated Slack-bridge Workflow in n8n

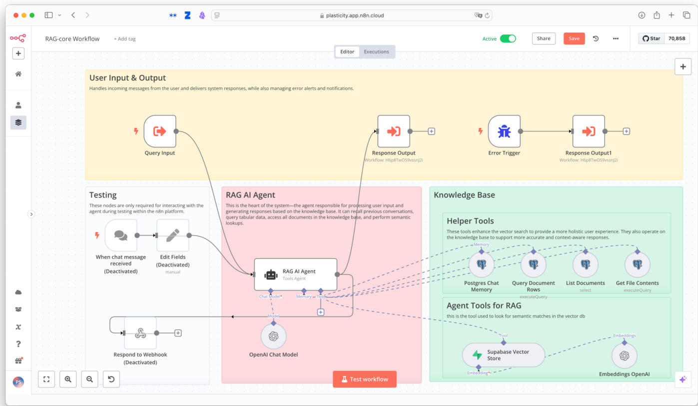


Figure 43: Screenshot of the Annotated RAG-core Workflow in n8n

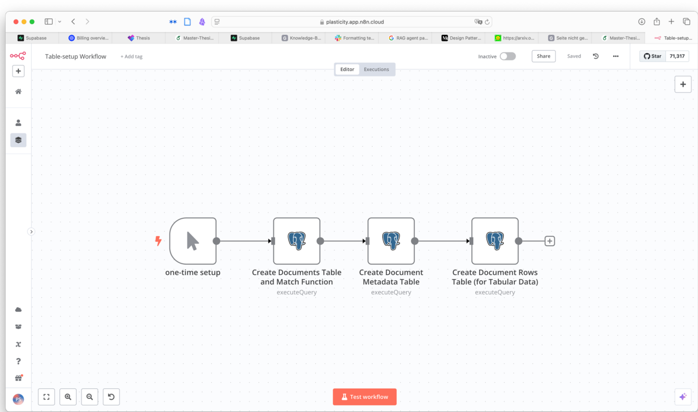


Figure 44: Screenshot of the Annotated Table-setup Workflow in n8n

6.3 Bringing it together: Meet FLUID

In Section 3.4, the two interdependent objectives for the solution proposed in this paper were defined. Objective 1, enabling service designers to document their knowledge in a way that LLMs can effectively process and interpret, has been addressed in Section 6.1.
The resulting solution, referred to as the S3DK, is a practical toolkit that supports the documentation workflows of service designers. It takes into account the diverse tools and methods commonly used in practice and offers a set of suggestions for managing the resulting knowledge in a centralised, LLM-ready format. Drawing on computer science principles[21] the S3DK promotes structured yet adaptable documentation habits. Rather than enforcing a rigid structure, the S3DK provides a flexible approach that supports knowledge integration from specialized tools into a centralized documentation environment. Its goal is to foster more systematic, interoperable, and future-proof documentation practices within the context of service design.
The solution proposed for achieving Objective 2 applies a LLM to the structured documentation created using the S3DK, enabling service designers to retrieve knowledge through natural language queries.
This is made possible through a cloud-hosted, open-source, no-code implementation of RAG, allowing users to interact with their knowledge base via a Slack bot interface called Plasticity. The use of RAG ensures that responses are grounded in the user's own documentation.
Although technically non-trivial, the chosen setup prioritizes ease of use and accessibility. By relying on a no-code configuration, and being both cloud-hosted and open source, the solution can, at least in theory[22], be implemented and maintained by non-technical users, such as service designers.
This approach contributes to the democratization of AI within the service design domain. In the case of successful adoption, it has the potential to support scaling out by making intelligent retrieval broadly accessible, and potentially scaling deep by raising awareness and understanding of AI's technical capabilities and limitations among practitioners, thus fostering a more informed, reflective use of GenAI in design practice.
As mentioned, reaching Objective 2 relies on the effective application of the S3DK. Without LLM-ready documentation, making the documentation intelligent would not be possible. Due to their tight coupling, the two solutions developed for Objective 1 and Objective 2 are combined into a single framework: Meet FLUID.

6.3.1 Overview

In short, FLUID is a framework that enables users to interact with their knowledge base through a conversational chatbot interface. It is built on the S3DK, a

[21] such as modularity, reusability, extensibility, graph theory, and labeling
[22] this assumption is evaluated during testing in Section 6.4.

toolkit that supports collaborative, digital, and text-based documentation practices, and powers the operation of Plasticity, a cloud-hosted, no-code, open-source RAG system.
Plasticity is aware of the user's knowledge base and helps surface relevant documentation through simple, natural language queries. Because interaction happens through everyday language, the documentation becomes more user-centered, lowering the barrier to access and making knowledge retrieval feel intuitive. Thanks to its cloud-based nature, Plasticity continuously learns from newly added files and forgets removed ones, ensuring that its responses remain timely and relevant.
Figure 45 offers a systemic overview of FLUID, illustrating its two subsystems - S3DK and Plasticity - as well as the user interaction points across system components, along with the flow of data and knowledge.

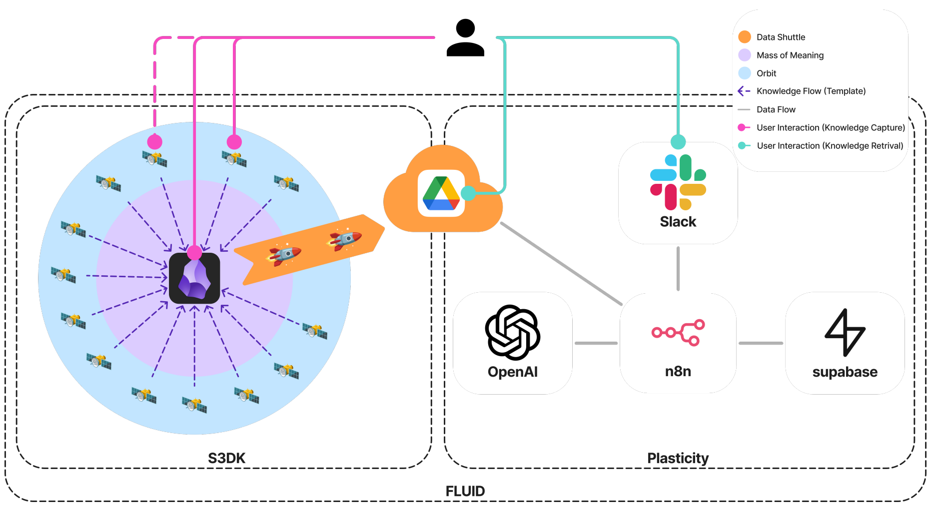


Figure 45: System overview of FLUID

A typical use of FLUID begins with the user engaging in knowledge-generating activities through one or more satellite tools from the Orbit; for instance, running a remote workshop via *MS* Teams and capturing insights in a *FigJam* board, as part of the S3DK subsystem.
Once the session concludes, the generated knowledge is synthesized into the Mass of Meaning using a documentation template that links relevant artefacts such as a PDF export of the board or a video recording of the meeting. These files are then shared with collaborators through the Data Shuttle, that uploads them to *Google Drive*.
At this stage, the documentation has been stored in an LLM-ready format, completing the process proposed by S3DK. The Plasticity subsystem now takes over by synchronizing the contents of *Google Drive* and extracting semantic inform-

ation to populate the knowledge base of the RAG system, hosted in *supabase*. This is accomplished using *n8n* workflows in combination with services provided by *OpenAI*.
Once synchronization is complete, Plasticity becomes aware of the newly documented workshop content. The user can then interact with the system via *Slack*, asking questions in natural language. Plasticity responds by querying its knowledge base, generating an answer using *OpenAI*'s LLM, which is returned directly within Slack, often accompanied by direct links to the relevant files stored in *Google Drive*.
In this way, users can effortlessly retrieve the information they are looking for, with responses grounded in the documentation they and their team have created, making Plasticity's answers transparent and actionable.

6.3.2 Value Proposition

The following Value Proposition Canvas illustrates why FLUID is a suitable approach to design documentation and how it creates value for service designers in their daily workflows.
The canvas, shown in Figure 46, synthesizes the key challenges, needs, and goals of service designers with the core capabilities of FLUID. It is grounded in empirical insights from the survey and workshop (see Section 2.1.3, Section 3.2, and Section 4), as well as the technical and conceptual development of FLUID itself (see Section 6).
Specifically, the pains were derived from user-reported frustrations and tool limitations uncovered through the survey analysis and scenario mapping. The gains and pain relievers reflect the design goals and system capabilities of FLUID, developed in direct response to those challenges. The customer jobs reflect recurring tasks and expectations articulated by service designers when working with documentation, captured through the workshop and interview activities, as well as from the broader expectations identified in the survey analysis.
The resulting overview not only clarifies FLUID's core offering, but also provides a coherent foundation for communicating its benefits to prospective users and stakeholders. It serves as a bridge between the documented user needs and the system design that addresses them.

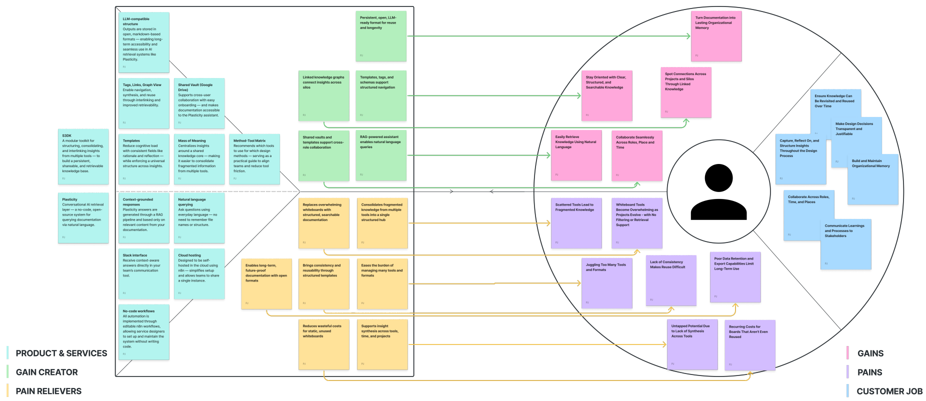


Figure 46: Value Proposition Canvas of FLUID

6.3.3 Planned Deliverables

To support the implementation of FLUID and meet the objectives outlined in this thesis, the final delivery will consist of two core components:

– a dummy Vault,
– a Pitch, available both as a PDF and a Website.

The dummy Vault offers a practical, hands-on environment built in Obsidian. It includes the complete template for capturing knowledge within the Mass of Meaning and represents the most direct, ready-to-use format of S3DK. As such, it is particularly suited for users who want to explore and adopt the framework in depth.
In contrast, the Pitch serves as a condensed and communicative version of the system's core ideas. Designed to introduce FLUID to a broader audience, it emphasizes clarity, simplicity, and visual storytelling. Its purpose is to spark interest, convey the value of the system, and communicate its overall logic - without going deep into technical or implementation details. It will be delivered in two formats: a visually engaging PDF and a website to support sharing and outreach.
While both the Vault and the Pitch are grounded in the same conceptual foundation, they differ in emphasis and depth. The Vault addresses all three dimensions - **What**, **Why**, and **How** - with comprehensive guidance and implementation tools. The Pitch, on the other hand, focuses primarily on the **What** and **Why**, offering only a brief glimpse into the **How** to support initial orientation and curiosity.
The full set of deliverables will be finalized and described in Section 7. The dummy Vault and the PDF Pitch will be included in the *digital annex*, while the website will be accessible via the a link[23] once published.

[23] https://aboutpjs.github.io/FLUID/

6.4 Testing

Now that FLUID has been introduced in the previous section as a solution addressing the objectives of this paper, it is necessary to test the framework to determine the extent to which these objectives are achieved.
As outlined in Section 6.3, FLUID consists of two interconnected subsystems. While these components can be tested independently, they are designed to function in tandem. In particular, the effectiveness of Plasticity depends on the presence of a well-structured and complete knowledge base. Therefore, the test setup must reflect the integrated nature of the system.
Ultimately, the testing aims to evaluate the fulfillment of Objective 1 and Objective 2. To address Objective 1, enabling service designers to document their knowledge in a way that LLMs can process and interpret, the S3DK was developed. In turn, Objective 2, retrieving knowledge from documentation using natural language queries, is addressed through the implementation of Plasticity.
During the development of Plasticity (see Section 6.2), the decision was made to implement the system using n8n. This choice was driven by the aspiration to make the solution accessible to service designers, allowing them to potentially set up the system themselves. Although this was not a primary objective at the outset, it became increasingly important as it became clear that the outcome would be a framework rather than a digital service. Empowering service designers to engage more deeply with LLM-based systems thus became an integral part of the vision. Consequently, the testing must also examine whether the technical setup is realistically achievable by service designers.
In summary, the testing seeks to answer the following questions:

- Test Question 1: Is the S3DK a practical and worthwhile approach for service designers to document their knowledge with the purpose of making it more easily retrievable?
- Test Question 2: Can knowledge documented using the S3DK be effectively retrieved through natural language queries using Plasticity?
- Test Question 3: Is the setup process of the Plasticity system realistic for service designers to carry out independently or with minimal technical support?

6.4.1 General Framing

The testing will be conducted with service designers as participants. To respect their time and engagement while gathering meaningful insights, a mixed-method exploratory evaluation has been chosen. This approach combines qualitative self-reporting with asynchronous, interaction-based observation to capture both reflective and real-time user experiences.
Concretely, participants will receive access to the system and be given one week to explore it. During this period, they are encouraged to document their experiences through diary studies, reflecting on usability, perceived value, and any challenges encountered. In parallel, their interactions with Plasticity, conducted asynchronously via a dedicated Slack channel, will be observed. This enables a

form of digital shadowing, allowing the researcher to analyze natural language queries and the system's responses in their original context.
Insights gathered from both methods will be synthesized to evaluate the solution's effectiveness and usability, and will directly inform the conclusions drawn from the testing.
Normally, since FLUID is conceived as an empowering framework rather than a ready-made digital service, the Plasticity component would need to be set up by the user before it could be fully used.
However, for the sake of testing, and to make the most of participants' time while ensuring all test questions can be addressed, the order of operations has been adjusted. Instead of asking participants to begin with the technical setup, Plasticity will be pre-configured. This decision is intended to avoid the risk of discouraging participants due to the initial complexity of the setup, and instead aims to motivate them by allowing them to experience the full solution before reflecting on whether the system is realistic for them to set up independently.
The testing will be conducted using a dummy Obsidian Vault, representative of the Mass of Meaning, which forms part of the final delivery and is detailed in Section 7.2. The vault content used for testing is functionally final, providing a realistic and representative basis for evaluating the system. However, there may still be minor changes - in the visual design of included graphics - between the version used during testing and the final delivery.
Insights gathered through this testing will serve as the foundation for the discussion presented in Section 8, the documentation and materials can be found in the *digital-annex*, under FLUID-testing

6.4.2 Milestone 1: Getting Access to an Already Existing System

The first step of the testing involves granting participants access to a pre-configured instance of the FLUID framework. Participants will be added to a dedicated Slack workspace, where Plasticity is already set up, and given access to a shared Google Drive folder containing the dummy vault.
To interact with the system as intended, participants need to install Obsidian and ensure that the Google Drive folder is synced to their local file system. This enables direct access to the vault's contents. Additionally, it is recommended to use the Slack desktop app rather than the browser version for a smoother experience.
Although the vault is described in detail in Section 7.2, a brief overview of its purpose is provided below:

- **Guiding:** The vault includes all relevant guides and explanations about FLUID, with dedicated files explaining the what, why, and how of the system, along with useful resources for orientation.
- **Templating:** The vault also serves as a template for the S3DK. By exploring the files, participants can understand how documentation can be structured, making the features of Obsidian more tangible. It includes the core template for capturing knowledge, as outlined in Section 6.1.3.

- **Easing Onboarding:** As Obsidian relies on markdown, the syntax may appear overwhelming to non-technical users. The dummy vault provides multiple example files showcasing different styles and functions, demonstrating markdown's capabilities. This allows participants to copy and paste content rather than having to learn the syntax from scratch.

Moreover, in this testing context, the dummy vault also enables a knowledgeable Plasticity chatbot. Without pre-existing content, the chatbot would have no material to retrieve, rendering interactions meaningless. Including a populated vault ensures that meaningful conversations can take place and that the retrieval capabilities of Plasticity can be evaluated even before capturing own content.

6.4.3 Milestone 2: Making It Your Own

Building on the initial milestone, where participants were introduced to the system and its components, this second milestone focuses on active engagement and personalization. It marks the core phase of the testing and is designed to generate insights relevant to two of the three test questions introduced earlier: Test Question 1 and Test Question 2.

Participants are now expected to begin using the system as if it were their own. This includes applying the S3DK to capture knowledge and using Plasticity to retrieve it through natural language queries. This phase is intended to assess whether the system is both practical to use and functionally effective. It also helps evaluate whether the system feels motivating and valuable enough for service designers to consider setting it up themselves in the future; serving as an early motivational indicator that may support, but not resolve, the feasibility question posed in Test Question 3.

The milestone spans one week and involves asynchronous use of the system, during which participants will document their experiences through diary entries. In parallel, their interactions with Plasticity in the Slack workspace will continue to be observed via digital shadowing. Together, these methods will provide insight into the system's usability, retrieval performance, and real-world applicability.

To support participants in capturing not only general impressions but also specific interactions and outcomes, a simple structure is suggested for the diary entries. Inspired by the Given-When-Then format from software testing, this approach helps frame observations in a way that is both practical and easy to follow. For example:

Given: I captured knowledge about *[topic]* using the template.
When: I asked Plasticity, "*[insert query]*"
Then: It responded with *[summary of answer]*. I expected *[expected result]*.

This format allows participants to describe concrete actions and outcomes while making it easier to reflect on where the system performed well - or not. While its use is not mandatory, it offers a helpful scaffold for those unsure how to structure their notes and encourages a more detailed and analyzable form of

self-reporting. Participants are also welcome to expand on each entry with more open reflections, such as how the experience of capturing knowledge felt, whether the process supported their way of thinking, or if any frustrations or unexpected moments arose during interaction.
To ensure sufficient depth and consistency across participants, the following basic tasks should be completed:

1. **Explore and understand FLUID:** Use Plasticity to ask questions about the framework, its subsystems, or specific documentation practices. Study the provided material to deepen your understanding of how the system is intended to function.
2. **Capture your own knowledge:** Using the included template, document a piece of knowledge relevant to your own domain or practice. You may either work within the dummy vault or create a new one - but in both cases, the content must be stored inside the shared Google Drive folder, as Plasticity depends on this location to retrieve content.
3. **Retrieve what you've documented:** Interact with Plasticity by asking questions related to the content you've created. Evaluate whether the responses are accurate, helpful, or limited. This will help identify how effectively the system supports knowledge retrieval (Test Question 2) and highlight any mismatches between user expectations and system behavior.

While participants are free to go beyond these tasks, the aim is not to conduct a stress test but rather to explore the system's possibilities and limitations in a realistic, everyday context. For example, participants may try rephrasing queries, navigating uncertainty, or deliberately asking slightly ambiguous questions to gauge how Plasticity handles them.
This milestone is central to understanding whether the S3DK offers a practical documentation method (Test Question 1), whether Plasticity can successfully retrieve knowledge from that documentation (Test Question 2), and whether the experience is motivating enough for service designers to consider setting the system up themselves, offering early insight into the feasibility explored in Test Question 3.

6.4.4 Milestone 3: Setting Up the System

Following the completion of the one-week engagement in Milestone 2, participants' diary entries will be collected, and a short debrief session will be conducted to reflect on their experience. This session offers an opportunity to clarify any remaining questions, validate interpretations of the diary notes, and assess whether participants found the system valuable and motivating enough to consider adopting it for their own practice.
For those participants who express interest in having their own instance of the system, Milestone 3 introduces the opportunity to attempt setting it up themselves. This stage is designed to directly address Test Question 3, which explores whether the Plasticity system can realistically be set up and maintained by service designers without significant technical expertise.

To support this, a guided *active shadowing* session will be offered. In this setup, participants follow a provided step-by-step tutorial to set up Plasticity using the same tooling stack. While the goal is to allow participants to complete the process independently, technical support will be available if needed to avoid unnecessary frustration or dead ends.

As the feasibility of this milestone depends on the participants' willingness and available time, it remains optional. However, it provides critical empirical grounding for evaluating Test Question 3 beyond hypothetical assumptions, translating motivation observed in Milestone 2 into action, and revealing what barriers or enablers exist when service designers attempt to operationalize the system on their own.

6.4.5 Limitations

While the testing approach was designed to be pragmatic and exploratory, several limitations should be acknowledged when interpreting the results.

First, the typical setup sequence of the FLUID framework was modified for testing purposes. As described in Milestone 1, participants were introduced to a fully pre-configured system to enable immediate interaction with Plasticity and the S3DK. While this helped conserve participant time and allowed all test questions to be addressed, it diverges from the real-world flow in which users would first need to install and configure the system themselves. This means that the initial setup "pain", which could deter adoption, was bypassed during the primary testing phase, and only addressed later as an optional step in Milestone 3. As such, the overall experience observed may differ from how users would approach the system if setup was required upfront.

Second, the participant sample was small and relatively homogeneous. Testing was conducted with two female service designers, both enrolled in the same Master's program as the author, and aged between 26 and 28. While their background made them highly relevant to the intended target group, this narrow sample limits the generalizability of the findings across different types of service designers, professional contexts, age groups, or levels of technical experience. Furthermore, neither participant possessed advanced technical expertise, although both regularly use common digital consumer tools in their personal, educational, and professional lives. This makes them representative of digitally literate but non-technical users, a key audience for whom the system is ultimately intended.

In addition, all participants completed the testing on macOS, which reflects the author's own development and testing environment. While Obsidian and the broader system are cross-platform, it remains untested whether the same workflows would be as seamless on other operating systems such as Windows or Linux.

Finally, although participants were given a degree of freedom in their use of the system, as encouraged in Milestone 2, this also introduces variability in how thoroughly each component was explored. Even with guiding tasks and suggested diary formats, the asynchronous nature of the testing means that levels of

engagement, interpretation of instructions, and willingness to experiment likely varied between participants.
Despite these limitations, the testing process offered valuable qualitative insights into how the FLUID framework might be received and used by its intended audience. These constraints will be considered when discussing the results in Section 8.

7 Deliver

The conclusion of the Develop phase marks a key milestone in this thesis: the core solution has been created. With this foundation in place, the final stage of the Double Diamond, the Delivery, can begin. In this phase, the focus shifts from iteration to implementation, with an emphasis on clearly communicating the value of the developed solution and ensuring it can be effectively adopted and understood by its intended users.

This section showcases the final outcomes of the thesis. Section 7.1 introduces the visual identity that will support the communication of FLUID. Section 7.2 presents the first deliverable: the Dummy Vault. More than a conceptual prototype, it acts as an interactive learning tool that introduces what FLUID is, how it works, why it is valuable, and how to use the accompanying S3DK. Finally, Section 7.3 details the second deliverable: the Pitch. It conveys the overall value proposition of FLUID, aiming to generate interest, build understanding, and invite users to explore its potential.

Together, these deliverables encapsulate the essence of the thesis. They not only communicate the outcomes but also act as practical resources for engaging with and applying FLUID in real-world contexts.

7.1 Visual Communication: Finding an Identity

Until now, the topic of visual communication has received little attention in this thesis, despite its crucial role in shaping how users first encounter and understand the system. As the first impression often sets the tone for trust and engagement, the visual language used, particularly in key touchpoints like the pitch (see Section 7.3), should reflect a coherent identity and professional quality.

Yet visual communication extends beyond branding or aesthetics. It serves as a powerful medium for simplifying and expressing the complex flows, couplings, and modular components of the system in an intuitive and accessible manner. According to Friendly and Wainer (2020), (data) visualization holds unique cognitive and emotional advantages, making it a fundamental layer of communication in any technically complex system.

First, well-designed visuals are instrumental in communicating across audiences. They help bridge the gap between technical experts and non-technical stakeholders, such as service designers. Through approachable metaphors and clear annotations, visualizations offer entry points into complex systems, enabling users to orient themselves, understand functionality, and consider how they might participate or contribute.

Second, visual communication enables visual thinking, a form of reasoning where insights emerge through patterns that become apparent when seen rather than read. This aligns with the principles of dual coding theory (see Section 2.1.1), which suggests that learning is enhanced when verbal and visual information are presented together. By translating abstract interactions into spatial and symbolic representations, users can more easily make sense of structural relationships.

Third, visuals can leave a lasting emotional impression. Certain design choices, such as using metaphors like *space* to frame unfamiliar territories (see FLUID-pitch), can invite curiosity and openness. The sense of entering an unexplored visual landscape can shift the user's mindset from cautious observation to active exploration.

Visual storytelling has also played an influential role in how new ideas have been introduced and shared over time. Rather than merely reflecting data, visualizations have often opened up new perspectives, revealing connections and surfacing insights that were previously overlooked. In the case of AI-ready documentation, a thoughtful visual language can serve a similar purpose, not just making systems legible to broader audiences, but inspiring engagement and deeper involvement in shaping AI-enabled services.

Furthermore, well thought out visual communication can aid cognitive processing by helping users integrate new information into existing mental models, as described in Schema Theory (see Section 2.1.1). By organizing content visually, it also reduces extraneous cognitive load, making it easier for users to focus on the core functions and relationships within the system, as emphasized by Cognitive Load Theory (see Section 2.1.1). In essence, visual communication in this context is not decorative, it is strategic: It supports onboarding, insight, collaboration, and innovation, while also aiding cognitive processing and retention, all in alignment with the overarching identity and goals of the system.

To lay the foundation for a coherent visual language, the first step was to explore and define a suitable aesthetic direction. For this purpose, Pinterest[24] served as a source of inspiration, where a curated collection of compelling visualizations and graphic styles was assembled into a dedicated board[25]. Selected highlights from this board were then composed into the moodboard shown in Figure 47, which served as a creative anchor for the visual development that followed.

In the final step, the initial visuals were restyled and simplified to enhance clarity and consistency. The following pages present a side-by-side comparison of the original and refined diagrams. Additionally, a logo was developed (see Figure 52), along with the *S3DK Satellite Radar* (Figure 53), which was informed by the Method Tool Matrix introduced in Section 6.1.1. The corresponding Figma design files, showcasing visual iterations and providing insight into key design decisions, are included in the *digital annex* under FLUID-Figma-file.

[24] https://pinterest.com
[25] https://pin.it/4F1FC5KrG

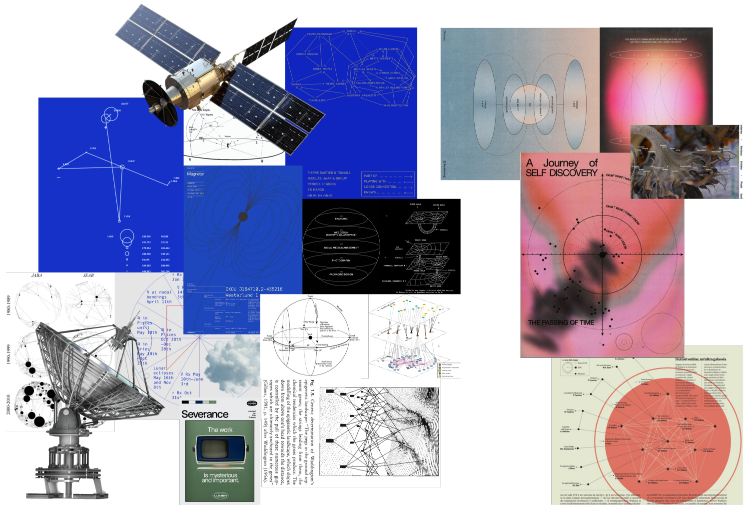


Figure 47: Moodboard for Visual Identity of FLUID Communication

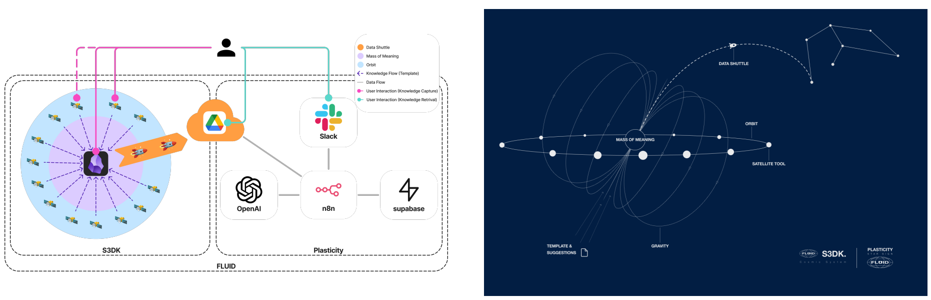


Figure 48: Juxtaposing Old and New System Overview Diagrams

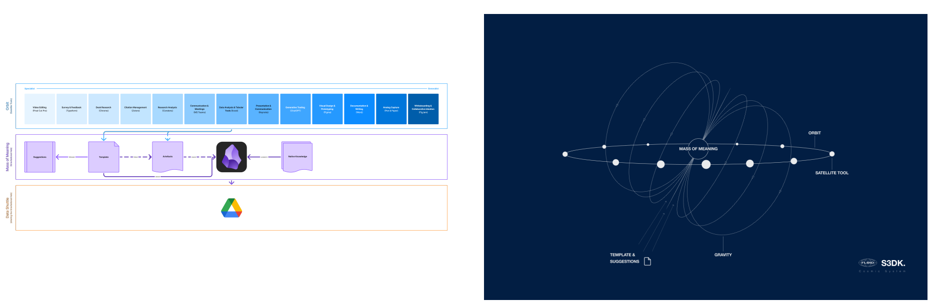


Figure 49: Juxtaposing Old and New S3DK Architectural Diagram

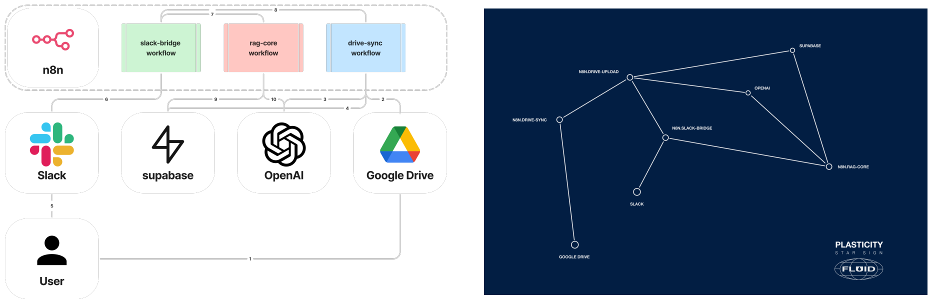


Figure 50: Juxtaposing Old and New Plasticity Flowchart

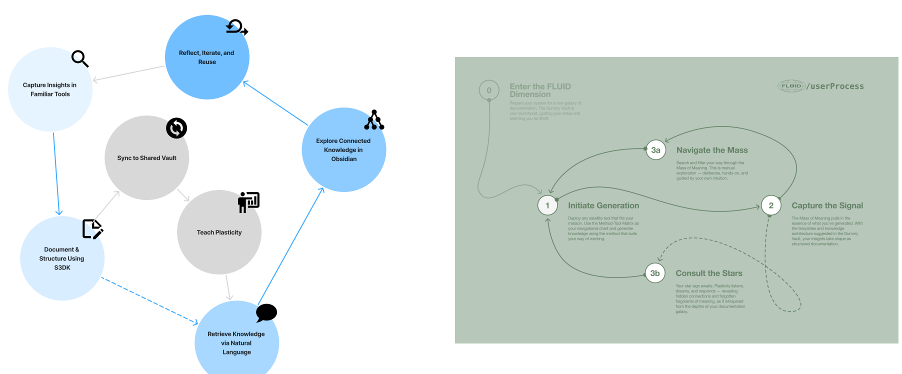


Figure 51: Juxtaposing Old and New User Journey

Figure 52: Logo for FLUID

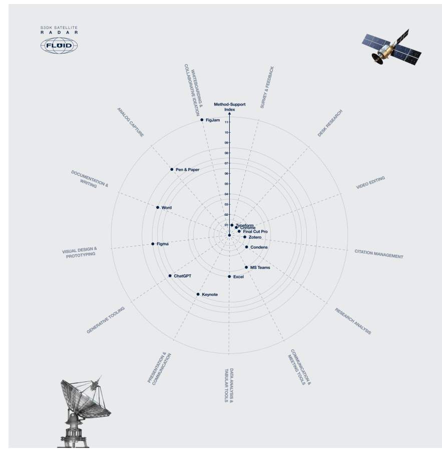


Figure 53: S3DK Satellite Radar Visualisation

7.2 Dummy Vault

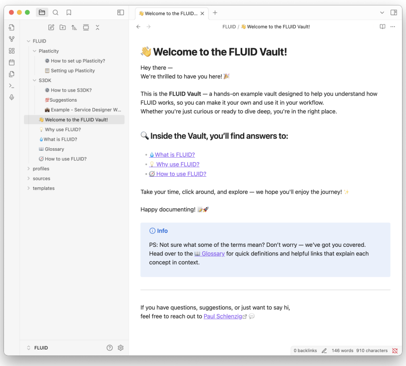


Figure 54: Screenshot of the Vault's Welcome Page

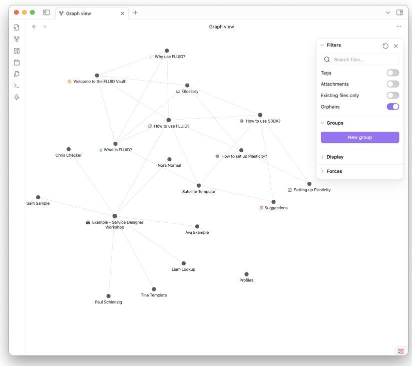


Figure 55: Screenshot of the Vault's Graph View

As introduced in Section 6.3.3, one of the key components of the final delivery of this thesis is the so-called dummy vault. The dummy vault is an Obsidian project designed to support service designers who decided to adopt FLUID by offering a hands-on, structured, and approachable starting point.
Its main purpose is not to spark initial interest, that role is fulfilled by the Pitch (see Section 7.3), but rather to help users who are already convinced take the next step. It provides the practical guidance and structure needed to begin using and setting up the system. In this sense, the dummy vault complements the Pitch by offering a more detailed and less promotional format. While the content is more in-depth, it continues to use visual communication to support understanding. The dummy vault serves several core functions:

- It lowers the entry barrier for users by offering a pre-filled environment to explore.
- It demonstrates how a documentation system could be structured, including where to store notes, how to link files (e.g. PDFs), how to organize with tags, and how to use Obsidian's graph view.
- It showcases how key Obsidian features can be used effectively in the context of FLUID, enabling users to gain confidence in navigating and modifying the system.
- It also provides a gentle introduction to Markdown syntax. Since users can see the rendered results of well-formatted notes, they can copy and paste elements such as styles or layouts, helping them gradually become familiar with writing in Markdown themselves.
- Throughout the vault, users are guided through the *What*, *Why*, and *How* of FLUID. The *What* introduces the overall concept and structure of the

framework, helping users understand its key components and how they relate. The *Why* communicates the underlying rationale for adopting FLUID, highlighting the value it can bring to different design contexts. The *How* offers practical guidance on setting up and using the system, showing how the different parts work together in practice without requiring deep technical knowledge.

Importantly, this educational content is delivered without being overly technical. The vault is written with its target group in mind, using accessible language and visuals to explain concepts that are functionally complex but conceptually graspable.
The dummy vault documents the core of FLUID in a way that invites service designers to follow along and adopt the system for their own use. If the Pitch sparks their interest, the dummy vault is what enables them to act on it.
At the time of writing, the vault is actively being used as part of the testing process (see Section 6.4). It serves as the main environment through which participants engage with FLUID, offering a realistic basis for evaluating its usability and applicability. The outcomes of this testing will be discussed in Section 8.
The vault will be made publicly available via the following GitHub repository[26] and will also be included in the *digital annex* as FLUID-dummy-vault. To access the vault, users simply need to download the repository and open the folder in Obsidian using the “Open folder as vault” option.

7.3 Pitch

The Pitch serves as the first touchpoint a potential user will have with the FLUID framework. Its main purpose is to communicate what FLUID is and why it matters, highlighting the value of documenting knowledge in the proposed way, and how this can benefit the user’s daily work. In contrast to the dummy vault, the Pitch does not focus on implementation details but instead aims to create initial interest and understanding.
Considering the target audience, the Pitch is designed to be visually engaging and accessible, avoiding overly technical language. To support understanding of the system’s structure and workflows, the S3DK already leverages space-related metaphors that make abstract concepts easier to grasp and communicate.
Although the Pitch is not an advertisement in the commercial sense, it is still intended to persuade. It will contain concise explanatory text to introduce key concepts of the framework, striking a balance between clarity and brevity to avoid overwhelming or boring the reader. To maintain this focus, the Pitch will be limited to five content pages plus a cover.
To convey the *Why* of FLUID in a relatable way, the Pitch will be structured around a user scenario. This will illustrate the challenges service designers face when documenting their work and how FLUID can help overcome these through clear pain relievers and gain creators.

[26] https://github.com/aboutPJS/FLUID-dummy-vault

Multiple supporting graphics will be used to enhance visual communication and reinforce the key messages presented in the text. The visual design will follow the identity principles established in Section 7.1 to ensure consistency and recognizability.

While the content remains the same, the Pitch will be delivered in two formats: a PDF document and a website. The PDF offers a traditional, easily shareable format, well-suited for email distribution and offline viewing. The website, on the other hand, ensures easier access, supports discoverability, and allows for the inclusion of links to related resources and potential future extensions. The website can be accessed here[27], the PDF under FLUID-pitch as part of the *digital annex*.

Compared to the dummy vault, the Pitch plays a different but complementary role. While the vault is hands-on and designed for actual implementation, the Pitch is meant to create awareness and spark interest. It focuses on communicating the value and purpose of FLUID, while the vault enables users to explore and apply the framework in practice. Together, they form a coherent entry path, moving from first encounter to meaningful adoption.

[27] https://aboutpjs.github.io/FLUID/

8 Discussion

With the Delivery of the solution completed, the design process for the PoC concludes. This chapter now shifts focus from implementation to discussion, considering how the developed solution performs in practice, what limitations emerge, and how the concept of FLUID might evolve beyond its current form.
Section 8.1 evaluates the PoC, informed by the user test described in Section 6.4, and discusses where the solution proves effective and where limitations become apparent.
Building on these insights, Section 8.2 explores how FLUID could evolve into a digital service. This outlook addresses potential shortcomings of the PoC.
Finally, Section 8.3 reflects on the broader vision behind FLUID, considering its potential to strengthen designers' role in shaping future digital service design by fostering greater technical literacy; while arguing that offering it as a service would compromise that ambition.

8.1 Evaluation

In Section 6.4, the testing activities conducted on FLUID were outlined. The test involved two service designers working independently with the dummy vault, attempting to document parts of their own work using the S3DK. A debriefing followed to collect reflections, impressions, and feedback. The test aimed to explore the three questions Test Question 1, Test Question 2, and Test Question 3, with all artefacts documented in the *digital annex* under FLUID-testing.
The participants described themselves as "tech dummies" and faced considerable difficulty engaging with the system. They uploaded PNG exports from Figma despite clear, but perhaps not sufficiently prominent, instructions to use PDFs, which are necessary for the LLM to process text. This led to unprocessable input and hallucinated responses from Plasticity, ultimately blocking progress. As a result, participants disengaged before completing setup, and Test Question 2 and Test Question 3 could not be meaningfully evaluated.
Nonetheless, Test Question 1 - concerning whether the S3DK offers a practical approach to knowledge documentation - remains partially addressable. While the concept was received positively, participants reported feeling overwhelmed by the heavy reliance on text, lack of visual guidance, and the cognitive effort required to navigate the dummy vault. They expressed a desire for a more accessible and visually supported onboarding experience.
The test was conducted asynchronously and relied solely on the dummy vault, which was designed to support setup rather than introduce the concept of FLUID. At the time, the pitch was not available to clearly convey the purpose, value, and expected benefits of the system; likely contributing to initial confusion and lack of orientation. Combined with the small sample size (n=2) and limited prior exposure to the project, the test results have limited generalizability. Future testing should take the form of a facilitated workshop, offering a longer, guided, and interactive format that enables questions, real-time support, and deeper engagement.

While the underlying technical system performs as intended when correctly set up, the evaluation highlights clear limitations in usability and onboarding. It remains unclear whether the outcome would have differed with access to the pitch. Further testing is needed to assess the system's usability under more complete and realistic conditions.
Importantly, the current delivery of FLUID assumes a certain level of interest, patience, and willingness to engage with technical setup; an expectation rooted in its broader ambition to foster technical literacy (as discussed in Section 8.3). If future tests reveal that this entry barrier is too high, the introduction and delivery of the system will need to be reevaluated to better reflect the realities of service design practice and how designers prefer to engage with new tools. An alternative development path addressing this challenge is explored in the following section.
These challenges also invite a degree of self-critique: coming from a technical background, there is a possibility that the onboarding experience was overly ambiguous or that the technical effort required was underestimated. Addressing this will require not only refining usability but also critically reassessing assumptions about what users are realistically prepared - and motivated - to take on.
Furthermore, the long-term value of successfully applying FLUID within a professional service design team remains an open question, calling for continued observation and evaluation in real-world settings.

8.2 Outlook

How could the learning curve be lowered? One potential future direction could be to deliver FLUID as a service. Similar to other Software as a Service (SaaS) applications, FLUID could be hosted online as a service, allowing users to store their documentation and access assistive search functionalities without needing to set up infrastructure themselves. Users would still be responsible for providing their data in an LLM-ready format, but the burden of connecting third-party services, hosting, and maintaining the system would be removed. Instead, users would simply sync or upload their files and interact with their documentation through a ready-to-use chat interface. Following common SaaS models, such a service could be monetized via subscription fees to cover infrastructure, development, and integration costs.
Further development could also explore ways to move toward Scenario 4 (see Section 3.2), where, in addition to retrieval, knowledge would also be captured with AI support. This could also include capturing information from analog sources, such as extracting content from workshops directly, without the need for manual debriefing sessions.
However, delivering FLUID as a service would come with significant trade-offs. Without the need to set up the system manually, the opportunity for users to engage with the underlying mechanisms of LLM-powered retrieval would decrease considerably, reducing the chance to build technical understanding and awareness - which is one of FLUID's aspirations (see Section 8.3).

Another major limitation would concern data sovereignty and customization. Currently, FLUID's modularity allows users to select and control their own storage solutions, LLM models, and interface applications. A hosted service would likely restrict such options, offering less flexibility and user control. While it is technically possible to preserve some autonomy within a service-based model, this would increase development complexity, time-to-market, and operational costs, raising the question of whether such flexibility is actually valued by service designers. It remains to be tested whether this level of control is seen as an advantage or simply as unnecessary overhead in practice.

Beyond these challenges, entering the market with a FLUID service would mean competing directly with major AI players such as Alphabet, OpenAI, Anthropic, and Meta. These organizations have vastly superior resources, enabling them not only to stay state-of-the-art, but to drive innovation itself. Given the rapid pace of AI development, there is a real possibility that the current FLUID setup could become obsolete in the near future, for example if LLMs achieve unlimited token lengths, making RAG approaches redundant (see Section 5.3).

Establishing a sustainable service under these conditions would be a major challenge, particularly when founded in Europe. Although AI and open-sourced LLMs present opportunities for European competition (see Section 2.2.6), the founding environment in the EU remains difficult, with heavier regulation and comparatively limited access to venture capital.

Nonetheless, delivering FLUID as a service remains an option worth further investigation, especially if future research reveals that the current approach is too complex for effective adoption.

8.3 Reflection

Why not design FLUID as a service in the first place? The motivation behind FLUID goes deeper than merely guiding service designers on how to structure data to enable assistive documentation retrieval through natural language. While not explicitly stated as an initial objective, the idea of *enabling* service designers emerged as a central aspiration during the development of FLUID (see Section 6), as the technical architecture took shape and questions of usability, transparency, and system understanding became increasingly relevant.

Since then, FLUID is not just about improving documentation practices; it is about empowering service designers to gain a better understanding of how LLMs function; what they require, how data flows through them, which infrastructures are necessary to operate them effectively, and most importantly, what they can and cannot reliably do. FLUID condenses this knowledge into an applicable, customizable, and open-source framework, intended to reduce technical complexity to a feasible minimum so that non-technical users can engage with it meaningfully.

Unlike a conventional tutorial, FLUID offers a practical entry point: it future-proofs documentation habits, increases team efficiency, and simultaneously fosters technical literacy and awareness about AI systems. It is a step toward bridging the gap between design and technology, supporting service designers in developing capabilities essential for the future of service design.

In this sense, FLUID embodies the idea of *scaling deep*. Rather than merely promoting wider adoption or superficial adaptation, it seeks to foster a cultural change among service designers: developing technical literacy, critical thinking, and a proactive stance toward AI integration. By making the underlying mechanisms of LLMs more accessible, FLUID aims to cultivate a shift in mindset, from limited engagement or passive observation of AI technologies to informed, confident designers capable of critically shaping the design of AI-powered services.

Of course, implementing and using FLUID will not turn service designers into AI engineers. However, the increased technical literacy can be tremendously valuable in professional design processes, especially when the services being designed involve AI components. By fostering fundamental technical understanding and awareness, FLUID can support service designers in beginning to: understand technical limitations, strategically frame service concepts that involve AI, recognize ethical and privacy implications early, and evaluate the feasibility of AI-related ideas during the design process. While FLUID cannot guarantee full proficiency in these areas, it lowers the entry barrier and provides a valuable foundation for building these capabilities over time.

As AI technologies continue to grow in influence, service designers must position themselves at the heart of designing these services. If AI-powered services are to remain user-centered, ethically sound, and inclusive, it is essential that service designers develop the ability to critically assess AI system limitations, biases, and broader societal impacts. Otherwise, there is a real danger that service designers may become marginalized in shaping the services of the future.

9 Conclusion

This thesis investigated how service designers might capture and structure knowledge in ways that support AI-enabled retrieval, addressing key limitations not only of whiteboard-based tools but of documentation tools in general. Through a multiphase design research process, drawing on user insights, trend analysis, technical exploration, and conceptual development, the FLUID framework was developed as a PoC for intelligent documentation, integrating structured input with LLM-driven interaction via natural language. The work concludes with a critical reflection on its feasibility, potential future directions, and its ambition to foster greater technical awareness among service designers working in increasingly AI-mediated contexts.

Several insights emerged from the research that help illuminate the current state and future potential of documentation in service design.

First, the investigation into current practices revealed why whiteboard-based tools remain the default for many service designers: their ease of use, visual flexibility, and collaborative features make them well-suited for creative processes. However, these strengths often come at the expense of long-term consistency, structure, and retrievability.

Second, the widespread use of multiple, loosely connected tools points to a fragmented documentation landscape, where knowledge continuity and retrieval are frequently compromised. This fragmentation, confirmed through survey data, benchmarking and the second part of the workshop, underscores a broader need for more coherent and sustainable documentation practices.

While participants did not explicitly propose structured alternatives, they acknowledged key pain points and expressed interest in more effective ways of working. The scenarios and pain points introduced during the Define phase were recognised as realistic in the workshop, helping to surface the trade-offs between ease of use and consistency that shape current documentation habits.

Finally, the thesis demonstrated that integrating AI into documentation is both feasible and potentially transformative, provided the documentation is structured accordingly. LLMs can enable intuitive, language-based access to design knowledge, but their effectiveness depends on how that knowledge is captured. The S3DK addresses this by making documentation AI-ready, while the FLUID framework as a whole showcases the potential of RAG, enabling more accessible and context-aware knowledge retrieval for designers navigating complex projects.

In this context, the thesis contributes a working PoC that demonstrates how AI can enable intelligent documentation, while offering a service-design-specific approach to capturing knowledge in a future-proof, machine-readable, and shareable format; laying the foundation for further exploration and adaptation of AI-enabled documentation systems.

The testing phase revealed that the current delivery of FLUID assumes a level of interest, patience, and initiative that may not reflect the realities of everyday design practice. Without real-time guidance, participants struggled to engage meaningfully with the system. Due to time constraints and limited resources, no user-informed iteration of FLUID could be developed after the test, meaning the framework remains at the stage of a PoC. To move beyond this, future testing under more realistic, guided conditions is essential. More broadly, the introduction, set up and usage should be re-evaluated to align more closely with the realities of service designers.

Looking ahead, one possible direction is to develop FLUID as a service. This would lower the entry barrier and simplify setup, potentially making it more accessible to a wider range of teams. However, this approach would introduce important trade-offs. While it may improve convenience, it risks reducing users' exposure to the system's inner workings, thereby weakening its capacity to foster technical understanding. Additionally, delivering FLUID as a service raises critical concerns around data sovereignty, flexibility, and long-term maintainability. These tensions would need to be carefully negotiated to preserve the framework's original ambitions.

Ultimately, the core aspiration of FLUID remains: not just to make documentation more intelligent, but to help service designers engage more thoughtfully with emerging technologies. Whether through further refinement of the framework or entirely new directions, future work should continue to support this goal, fostering the basic technical awareness needed to design responsibly and confidently in AI-enabled contexts.

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Appendix

List of Appendices

A Digital Files

This thesis is accompanied by a digital file named *digital-annex.zip*. Once unpacked, the folder contains all digital assets necessary to retrace the discoveries made throughout the research. Table 24 provides an overview of the filenames and their respective directory paths within the folder.

Filename	Filepath
survey-results.xlsx	`./digital-annex/discover/survey/survey-results.xlsx`
sql-inserts	`./digital-annex/discover/survey/sql-inserts/*`
sql-statements	`./digital-annex/discover/survey/sql-statements/*`
interview-clara-bonde	`./digital-annex/define/interview-clara-bonde.m4a`
interview-mary-jackson	`./digital-annex/define/interview-mary-jackson.m4a`
taxonomy	`./digital-annex/discover/taxonomy.numbers`
workshop-material	`./digital-annex/develop/workshop-material.pdf`
workshop-recording.m4a	`./digital-annex/develop/workshop-recording.m4a`
demography-survey-responses.csv	`./digital-annex/develop/demography-survey-responses.csv`
conversation-nathan-ayalon-1.m4a	`./digital-annex/develop/conversation-nathan-ayalon-1.m4a`
conversation-nathan-ayalon-2.m4a	`./digital-annex/develop/conversation-nathan-ayalon-2.m4a`
n8n-workflows	`./digital-annex/develop/n8n-workflows/*`
method-tool-matrix	`./digital-annex/develop/method-tool-matrix.xlsx`
FLUID-testing	`./digital-annex/develop/testing/*`
FLUID-dummy-vault	`./digital-annex/deliver/FLUID/*`
FLUID-pitch	`./digital-annex/deliver/pitch.pdf`
FLUID-Figma-file	`./digital-annex/deliver/FLUID.fig`

Table 24: Contents of *digital-annex.zip*

B Questions of the Survey

In the following sections, all questions along with their response options are listed. The 'Other' option provided participants with the opportunity to personalize their responses. Questions marked with an asterisk (*) were mandatory. Response types included both multi-select and single-select options, differentiated by checkboxes and radio buttons, respectively.

B.1 Survey Section 1

Documentation and Knowledge Management Practices

* Required

Demographic Information

This section collects essential demographic data to better understand the diverse backgrounds of participants in our survey. The information will assist in analyzing how different demographic factors, such as age, education, industry of employment, and geographic location, may influence practices and perceptions regarding documentation and knowledge management in professional settings.

1. What is your age group? *

- ◯ <18
- ◯ 18-24
- ◯ 25-34
- ◯ 35-44
- ◯ 45-54
- ◯ 55-64
- ◯ >64

2. What is the highest level of education you have completed? *

- No High School Diploma
- High School Diploma
- Some College or Associate Degree
- Bachelor's Degree
- Master's Degree
- Doctoral Degree (e.g., PhD, EdD)
- Other

3. What is your current employment status?
*

- Employed full-time
- Employed part-time
- Self-employed
- Unemployed
- Student
- Retired
- Other

4. In which industry do you currently work? (Please select the option that best describes your primary area of employment.)
*

- Information Technology and Communication
- Education, Training, and Research
- Healthcare and Social Assistance
- Financial and Insurance Services
- Arts, Entertainment, and Recreation
- Manufacturing and Engineering
- Retail and Wholesale Trade
- Professional, Scientific, and Technical Services (including design and consulting)
- Public Administration and Defense
- Construction and Real Estate
- Transportation and Logistics

5. What is your role within your organization?
*

- Technical Specialist
- Researcher/Analyst
- Freelancer/Consultant
- Project Manager
- Designer (Graphic, UI/UX, Service, etc.)
- Product Manager
- Operations Staff
- Human Resources Professional
- Sales Professional
- Customer Support
- Other

6. How many years of experience do you have in your current field?
*

- Less than 1 year
- 1-3 years
- 4-7 years
- 8-15 years
- More than 15 years

B.2 Survey Section 2

Documentation and Knowledge Management Practices

* Required

Tool Usage and Attitudes Towards Documentation

This part of the survey focuses on the tools you use for documentation, your satisfaction with these tools, and the importance of various features such as privacy, collaboration, and ease of use. Your responses will help us understand current trends and needs in documentation practices.

7. How frequently do you need to document findings or knowledge as part of your work? *

- ◯ Daily
- ◯ Weekly
- ◯ Monthly
- ◯ Yearly
- ◯ Rarely

8. Which tools are you currently using for documentation?

*

- [ ] FigJam
- [ ] Miro
- [ ] Notion
- [ ] Dovetail
- [ ] Google Drive
- [ ] Airtable
- [ ] Confluence
- [ ] OneNote
- [ ] XMind
- [ ] Obsidian
- [ ] Other

9. What features or capabilities do you feel are missing from your current documentation tools?

Enter your answer

10. How satisfied are you with your current tools in regards to documentation? *

Very satisfied	Somewhat satisfied	Neither satisfied nor dissatisfied	Somewhat dissatisfied	Very dissatisfied
○	○	○	○	○

11. Question *

	Not important	Somewhat important	Neutral	Important	Very important
How important is privacy in your documentation tools?	○	○	○	○	○

How important is collaboration in your documentation tools?	◯	◯	◯	◯	◯
How important is ease of use in your documentation tools?	◯	◯	◯	◯	◯

12. Please rank how often you revisit and navigate through documentation.
*

	Never	Rarely	Occasionally	Often	Always
How often do you revisit documentation?	◯	◯	◯	◯	◯
Do you get lost when revisiting documentation?	◯	◯	◯	◯	◯

B.3 Survey Section 3

Documentation and Knowledge Management Practices

* Required

Evaluating Documentation Usability and Clarity

This section explores how easily and effectively you can access, understand, and use information in professional documentation. Your insights will assist in identifying potential improvements to make documentation more intuitive and user-friendly.

13. Please rate your agreement with the following statements based on your experiences.
*

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
The information in my documentation can only be understood in context.	○	○	○	○	○
I often struggle to find what I am looking for when revisiting documentation.	○	○	○	○	○

I am motivated to consult the documentation when I need to recall details about my projects.

I am motivated to consult the documentation when I need to recall details about my projects.	○	○	○	○	○

B.4 Survey Section 4

Documentation and Knowledge Management Practices

* Required

Information Seeking and Interaction in Documentation Systems

This section examines how often you interact with various types of data and assess the functionality of features within your documentation system. Your insights will contribute to understanding the effectiveness of current documentation practices across different dimensions and tasks.

14. Please rate how often you use documentation featuring the following types of data *

	Never	Rarely	Sometimes	Frequently	Always
How often do you use documentation consisting of 1-dimensional data such as lists, documents, text or code?	○	○	○	○	○

How often do you work with documentation that includes 2-dimensional data, like maps or floor plans?	○	○	○	○	○
How frequently do you use documentation with 3-dimensional representations, such as building models or molecular structures?	○	○	○	○	○
How often do you interact with temporal data in your documentation, such as timelines or event records?	○	○	○	○	○

How often do you work with documentation that requires analyzing data across several variables or dimensions at once, such as in complex spreadsheets, statistical models, or when combining multiple data sources to draw conclusions?	◯	◯	◯	◯	◯
How often do you use documentation with tree-like data structures, where information is organized in a parent-child hierarchy, like organizational charts or file directories?	◯	◯	◯	◯	◯

How often does your documentation involve network data structures with interconnections (e.g. graph, actor networks)?	○	○	○	○	○

15. Please rate how often your documentation features the following functionalities.

*

	Very ineffective	Ineffective	Neutral	Effective	Very effective
How effectively does your documentation system provide an overview of the entire dataset?	○	○	○	○	○

How effective is the zoom functionality in your documentation system for focusing on detailed areas?	○	○	○	○	○
How effective is the filtering feature at removing irrelevant items to focus on what matters?	○	○	○	○	○
How effective is the 'details-on-demand' feature for accessing detailed information about selected items?	○	○	○	○	○
How effectively can you view and understand relationships among items in your documentation?	○	○	○	○	○

How effectively does your documentation system track your history of interactions, allowing you to undo or review changes?	◯	◯	◯	◯	◯
How effective is the extraction feature in your documentation system for external use, like emailing, printing or further analysis?	◯	◯	◯	◯	◯

B.5 Survey Section 5

Documentation and Knowledge Management Practices

* Required

Understanding the Use and Effectiveness of Organizational Schemas in Documentation

This section aims to explore your familiarity with, usage of, and perspectives on different organizational schemas used in documentation. Your responses will help us understand how these structures impact the clarity and usability of information, as well as identify any common challenges encountered.

16. For each of the following organizational structures, indicate how often you use them in your documentation, if at all. If you are familiar with any but do not use them, please select 'Familiar but not used.
 *

	Not familiar	Familiar but not used	Rarely use	Occasionally use	Frequently use
Hierarchical structures (e.g., folders, tables of contents)	○	○	○	○	○

Step-by-step workflows (e.g., guides, instructions)	○	○	○	○	○
Visual representations (e.g., flowcharts, diagrams)	○	○	○	○	○
Timeline or chronological formats	○	○	○	○	○
Problem-solution structures (e.g., FAQs, troubleshooting guides)	○	○	○	○	○
Relational models (e.g., network diagrams)	○	○	○	○	○

17. Rank the following organizational structures by their effectiveness in making documentation clear and easy to understand. *

Hierarchical structures

Step-by-step workflows

Visual representations

Timeline or chronological formats

Problem-solution structures

Relational models

18. Which structures do you rely on most? Please provide examples.

Enter your answer

19. What challenges do you face when using organizational structures in documentation?
*

- [ ] Lack of familiarity with appropriate schemas
- [ ] Difficulty integrating all information into one schema
- [ ] Discrepancies in schema use among collaborators
- [ ] Complexity of schemas for end-users
- [ ] Other

20. Do you find documentation easier to understand when it follows a clear and familiar structure?
*

Strongly agree	Agree	Neutral	Disagree	Strongly disagree
○	○	○	○	○

21. What schemas make documentation most understandable for you? Please provide examples or insights.

Enter your answer

Never give out your password. Report abuse

B.6 Survey Section 6

Documentation and Knowledge Management Practices

* Required

Effectiveness of Text and Visual Integration in Documentation

This section assesses how effectively text and visuals are integrated in your documentation to enhance understanding and recall. Please indicate your level of agreement with the following statements based on your experience.

22. Please indicate your level of agreement with each of the following statements regarding the integration of text and visuals in your documentation.
 *

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Text and visuals are combined effectively to explain concepts in the documentation I use.	◯	◯	◯	◯	◯

The documentation facilitates easy transitioning between text and visuals for a comprehensive understanding.	○	○	○	○	○
I find it easier to recall information from documentation that uses both text and visuals compared to text-only documentation.	○	○	○	○	○

B.7 Survey Section 7

Documentation and Knowledge Management Practices

Thanks!!

Thank you for participating, contact me if you have any questions: pschle23@student.aau.dk

23. Do you have anything to add?

Enter your answer

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Never give out your password. Report abuse

Microsoft 365

C Results of the Survey

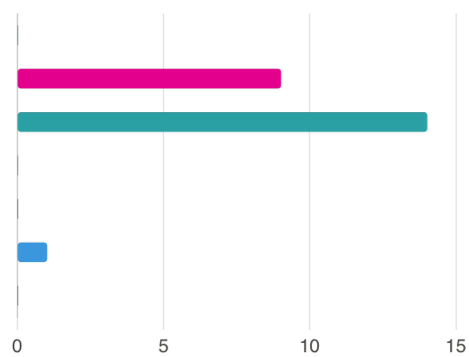
Responses Overview

Closed

Responses	Average Time	Duration
24	13:20	41 Days

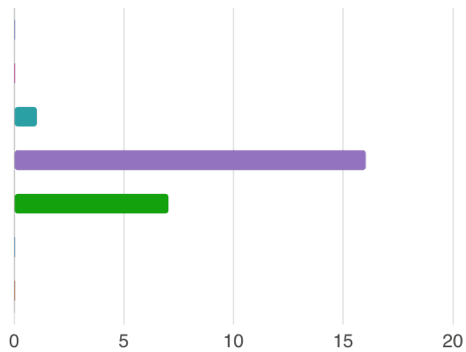
1. What is your age group?

<18	0
18-24	9
25-34	14
35-44	0
45-54	0
55-64	1
>64	0



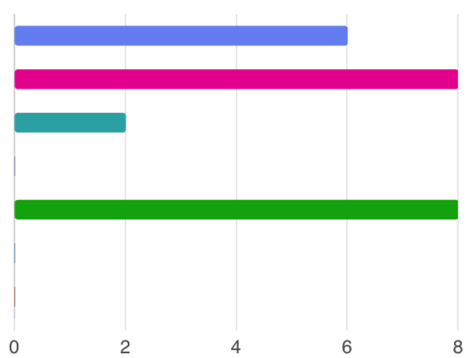
2. What is the highest level of education you have completed?

No High School Diploma	0
High School Diploma	0
Some College or Associate Degree	1
Bachelor's Degree	16
Master's Degree	7
Doctoral Degree (e.g., PhD, EdD)	0
Other	0



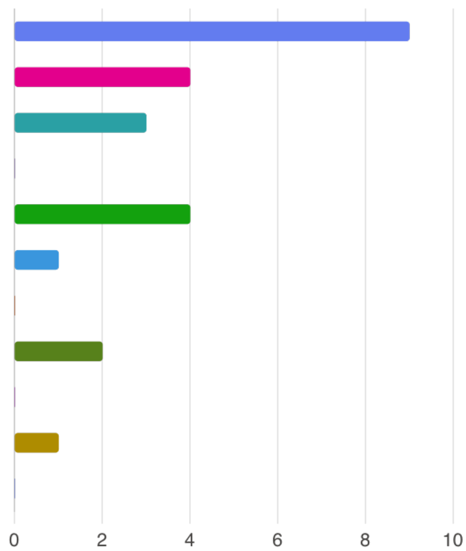
3. What is your current employment status?

Employed full-time	6
Employed part-time	8
Self-employed	2
Unemployed	0
Student	8
Retired	0
Other	0



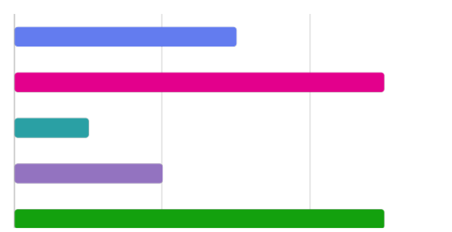
4. In which industry do you currently work? (Please select the option that best describes your primary area of employment.)

Information Technology and Communication	9
Education, Training, and Research	4
Healthcare and Social Assistance	3
Financial and Insurance Services	0
Arts, Entertainment, and Recreation	4
Manufacturing and Engineering	1
Retail and Wholesale Trade	0
Professional, Scientific, and Technical Services (including design and consulting)	2
Public Administration and Defense	0
Construction and Real Estate	1
Transportation and Logistics	0

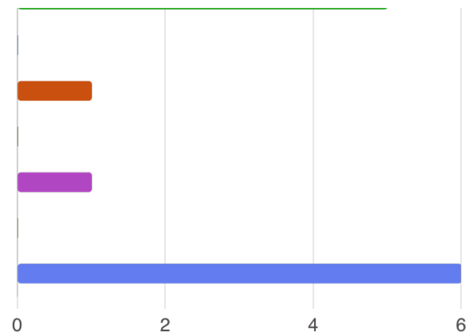


5. What is your role within your organization?

Technical Specialist	3
Researcher/Analyst	5
Freelancer/Consultant	1
Project Manager	2
Designer (Graphic, UI/UX, Service, etc.)	5

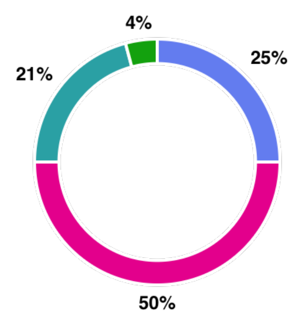


Product Manager	0
Operations Staff	1
Human Resources Professional	0
Sales Professional	1
Customer Support	0
Other	6



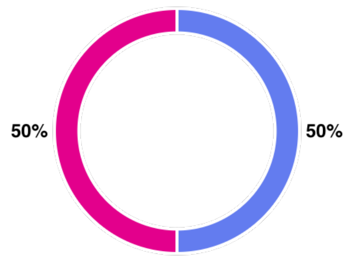
6. How many years of experience do you have in your current field?

Less than 1 year	6
1-3 years	12
4-7 years	5
8-15 years	0
More than 15 years	1



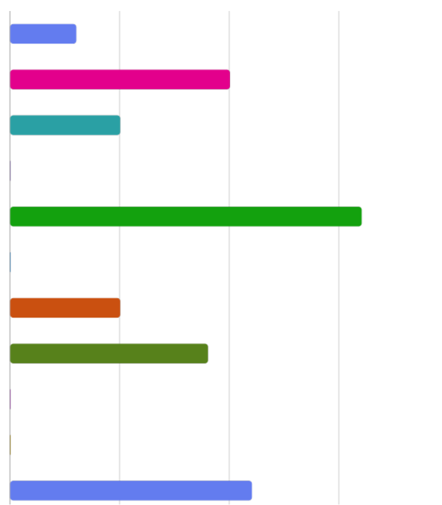
7. How frequently do you need to document findings or knowledge as part of your work?

Daily	12
Weekly	12
Monthly	0
Yearly	0
Rarely	0



8. Which tools are you currently using for documentation?

FigJam	3
Miro	10
Notion	5
Dovetail	0
Google Drive	16
Airtable	0
Confluence	5
OneNote	9
XMind	0
Obsidian	0
Other	11



9. What features or capabilities do you feel are missing from your current documentation tools?

14

Responses

Latest Responses

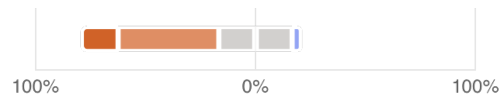
"Well working AI integration"

...

2 respondents (14%) answered calendar for this question.

10. How satisfied are you with your current tools in regards to documentation?

● Very satisfied ● Somewhat satisfied ● Neither satisfied nor dissatisfied ● Somewhat dissatisfied ● Very dissatisfied



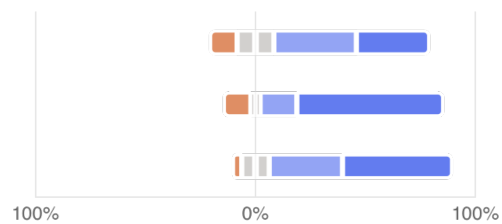
11. Question

● Not important ● Somewhat important ● Neutral ● Important ● Very important

How important is privacy in your documentation tools?

How important is collaboration in your documentation tools?

How important is ease of use in your documentation tools?

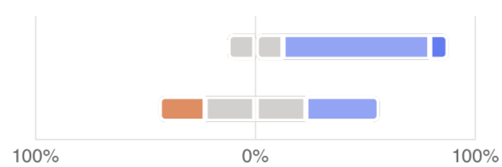


12. Please rank how often you revisit and navigate through documentation.

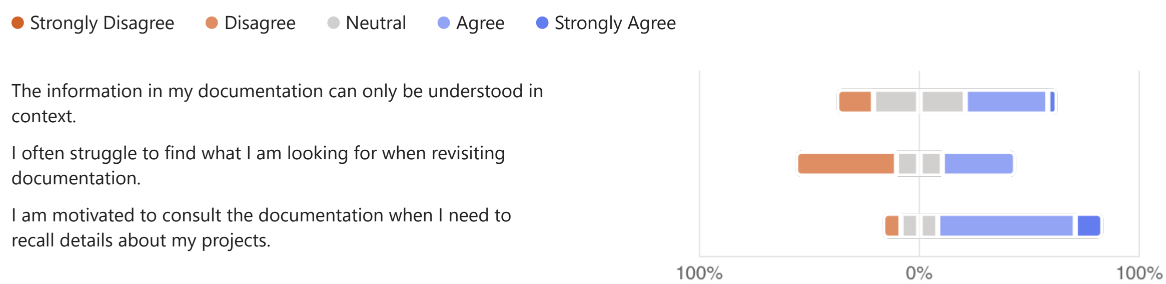
● Never ● Rarely ● Occasionally ● Often ● Always

How often do you revisit documentation?

Do you get lost when revisiting documentation?



13. Please rate your agreement with the following statements based on your experiences.



14. Please rate how often you use documentation featuring the following types of data

- Never
- Rarely
- Sometimes
- Frequently
- Always

How often do you use documentation consisting of 1-dimensional data such as lists, documents, text or code?

How often do you work with documentation that includes 2-dimensional data, like maps or floor plans?

How frequently do you use documentation with 3-dimensional representations, such as building models or molecular structures?

15. Please rate how often your documentation features the following functionalities.

How often do you interact with temporal data in your documentation, such as timelines or event records?

● Very ineffective ● Ineffective ● Neutral ● Effective ● Very effective

How often do you work with documentation that requires analyzing data across several variables or dimensions at once,...

How often do you use documentation with tree-like data structures, where information is organized in a parent-child...

How effectively does your documentation system provide an overview of the entire dataset?

How often does your documentation involve network data structures with interconnections (e.g., graph, actor networks)?

How effective is the zoom functionality in your documentation system for focusing on detailed areas?

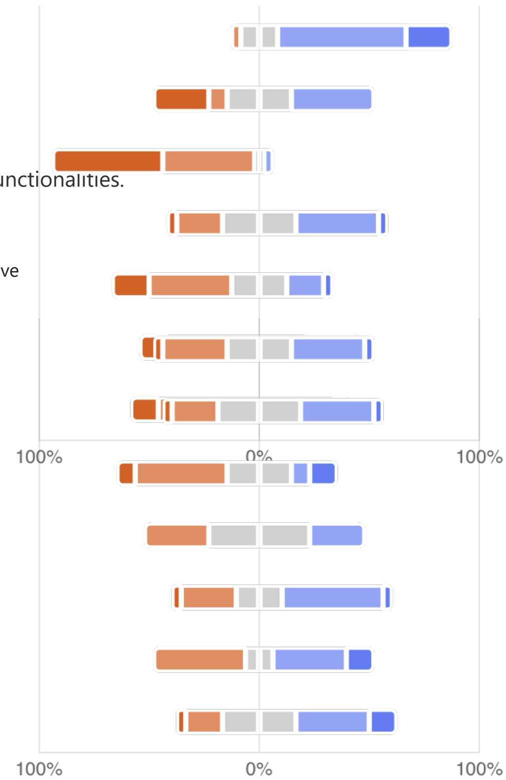
How effective is the filtering feature at removing irrelevant items to focus on what matters?

How effective is the 'details-on-demand' feature for accessing detailed information about selected items?

How effectively can you view and understand relationships among items in your documentation?

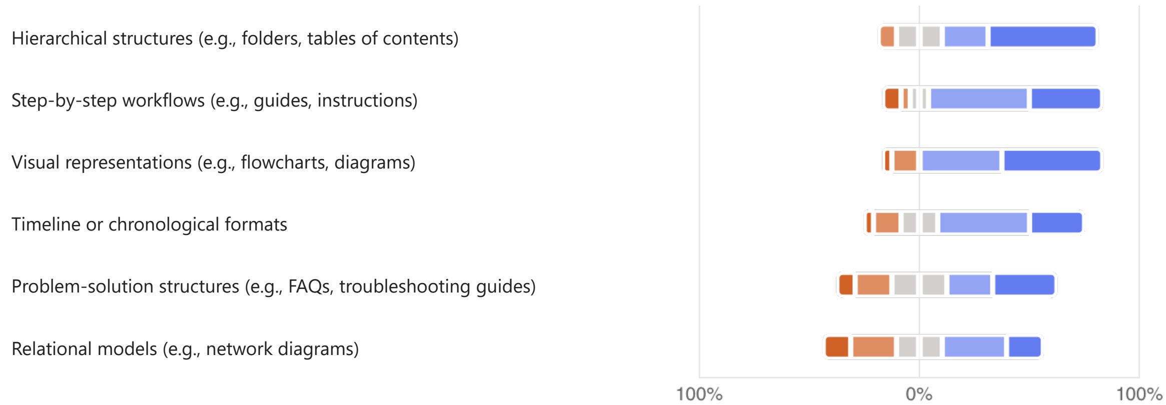
How effectively does your documentation system track your history of interactions, allowing you to undo or review changes?

How effective is the extraction feature in your documentation system for external use, like emailing, printing or further analysis?



16. For each of the following organizational structures, indicate how often you use them in your documentation, if at all. If you are f amiliar with any but do not use them, please select 'Familiar but not used.

● Not familiar ● Familiar but not used ● Rarely use ● Occasionally use ● Frequently use



17. Rank the following organizational structures by their effectiveness in making documentation clear and easy to understand.

18. Which structures do you rely on most? Please provide examples

18. Which structures do you rely on most? Please provide examples.

12

Responses

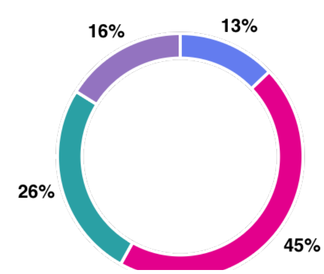
Latest Responses

...

3 respondents (25%) answered Step by step for this question.

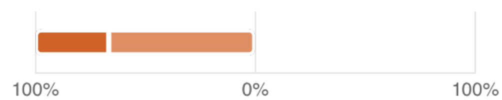
19. What challenges do you face when using organizational structures in documentation?

Lack of familiarity with appropriate schemas	4
Difficulty integrating all information into one schema	14
Discrepancies in schema use among collaborators	8
Complexity of schemas for end-users	5
Other	0



20. Do you find documentation easier to understand when it follows a clear and familiar structure?

● Strongly agree ● Agree ● Neutral ● Disagree ● Strongly disagree



21. What schemas make documentation most understandable for you? Please provide examples or insights.

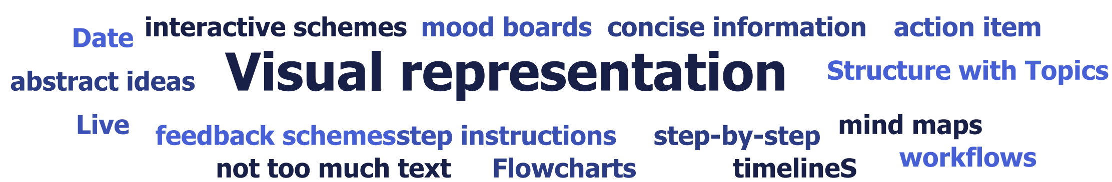
7

Responses

Latest Responses

...

2 respondents (29%) answered Visual representation for this question.



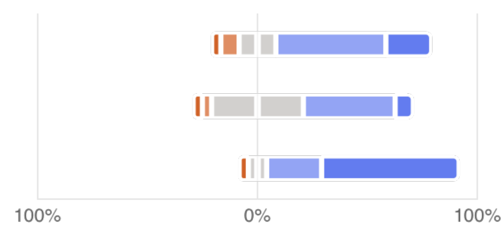
22. Please indicate your level of agreement with each of the following statements regarding the integration of text and visuals in yo ur documentation.

Strongly disagree · Disagree · Neutral · Agree · Strongly agree

Text and visuals are combined effectively to explain concepts in the documentation I use.

The documentation facilitates easy transitioning between text and visuals for a comprehensive understanding.

I find it easier to recall information from documentation that uses both text and visuals compared to text-only documentation.



23. Do you have anything to add?

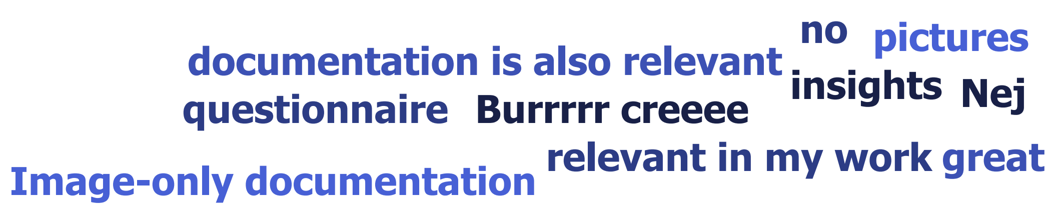
5

Responses

Latest Responses

...

1 respondents (20%) answered Burrrrr creeee for this question.



D Taxonomy

D.1 Developing the Taxonomy

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The taxonomy developed for assessing different tools consists of six criteria, each contributing up to 10 points based on specific yes/no questions. These questions are deliberately designed to be straightforward, allowing for objective answers and reducing ambiguity in the evaluation process. The sum of all criteria points provides a composite score, with a maximum of 60 points achievable across all categories. This structured approach ensures a standardized evaluation of tools, highlighting their strengths and weaknesses in distinct functional areas. The following paragraphs detail the individual categories and the corresponding yes/no questions used to evaluate each tool.

Collaboration

This category evaluates the tool's ability to facilitate effective teamwork. Points are awarded based on the level of collaborative functionality available, choose one:

- T.1.2: Does the tool support live collaboration?
  - Explanation: Assessing if multiple users can work on the same content simultaneously with real-time updates.
  - Score: 10 points if *Yes*.
- T.1.2: Does the tool use a shared database?
  - Explanation: Checks if there is a central data repository that users can access and contribute to synchronously.
  - Score: 7 points if *Yes*, only if live collaboration is *No*.
- T.1.3: Is content sharable within the tool?
  - Explanation: Determines if users can share content like files or documents asynchronously.
  - Score: 4 points if *Yes*, only if the two higher options are *No*.
- T.1.4: Is the tool designed for individual use without sharing features?
  - Explanation: Identifies tools intended for personal use with no built-in collaboration features.
  - Score: 0 points if all other questions are *No*.

Control over Data

This category assesses how well users can manage and control their data within the tool:

- T.2.1: Can you decide where the data is stored?
  - Explanation: Evaluates whether users have the authority to choose the physical or digital location of their data storage.
  - Score: 4 points if *Yes*.
- T.2.2: Can you manage who has access to the data?

  - Explanation: Checks if users can set and modify access permissions for different stakeholders.
  - Score: 3 points if *Yes*.
- T.2.3: Are you informed about where the data is stored?
  - Explanation: Assesses if the tool provides transparency about the data storage location.
  - Score: 2 points if *Yes*.
- T.2.4: Can you download the data?
  - Explanation: Determines if users have the capability to export or download their data from the tool.
  - Score: 2 points if *Yes*.

Ease of Use

This category evaluates the usability of the tool, focusing on user-friendliness and accessibility:

- T.3.1: Are no additional skills or languages required to use the tool effectively?
  - Explanation: Checks if the tool can be used without requiring users to learn new skills or programming languages.
  - Score: 2 points if *Yes*.
- T.3.2: Does the tool provide integrated learning aids, tutorials, documentation, forums, or community support?
  - Explanation: Assesses the availability of support materials and community engagement to aid users in maximizing tool usage.
  - Score: 2 points if *Yes*.
- T.3.3: Is it easy to set up and start using the tool for specific tasks, including project setup and configuration adjustments?
  - Explanation: Evaluates how straightforward it is for a new user to begin using the tool, particularly for setting up projects and adjusting settings.
  - Score: 2 points if *Yes*.
- T.3.4: Is the tool responsive and performs well across different devices and platforms?
  - Explanation: Determines whether the tool operates effectively across various hardware and software environments.
  - Score: 2 points if *Yes*.
- T.3.5: Can the tool be used effectively offline?
  - Explanation: Checks if the tool has offline capabilities, allowing users to work without an internet connection.
  - Score: 2 points if *Yes*.

Support of Data Types

This category measures the tool's ability to handle various types of data:

- T.4.1: Can you upload pictures?
  - Explanation: Assesses the tool's capability to manage image files.
  - Score: 2 points if *Yes*.
- T.4.2: Can you upload text files?
  - Explanation: Checks if the tool supports text files, crucial for managing documents and written content.
  - Score: 2 points if *Yes*.
- T.4.3: Can you upload videos or audio files?
  - Explanation: Evaluates the tool's ability to handle multimedia content.
  - Score: 2 points if *Yes*.
- T.4.4: Can you upload files of any type?
  - Explanation: Determines if the tool is versatile enough to manage various file formats, enhancing its utility for diverse data storage needs.
  - Score: 4 points if *Yes*.

Tasks

Reflecting the ISM (see Section 2.1.1), this category evaluates the tool's support for essential data handling tasks. The total score from these tasks, based on a maximum of 7 points, is then multiplied by 1.43 to normalize it to a 10-point scale. Each task is assessed individually to determine if it is supported:

- T.5.1: Overview: Does the tool provide a way to view the entire collection or dataset at once?
  - Explanation: Enables users to obtain a comprehensive view of all available data, facilitating better understanding and management.
  - Score: 1 point if *Yes*.
- T.5.2: Zoom: Can users focus on an item of interest without losing sight of the broader context?
  - Explanation: Allows detailed examination of specific data elements while maintaining awareness of their relation to the whole.
  - Score: 1 point if *Yes*.
- T.5.3: Filter: Does the tool allow users to filter out uninteresting or irrelevant items?
  - Explanation: Facilitates the focusing of user attention on relevant data by removing non-essential information.
  - Score: 1 point if *Yes*.
- T.5.4: Details-on-demand: Can users access more detailed information about an item when they need it?
  - Explanation: Provides additional data details upon request, enhancing user interaction and understanding of the data.
  - Score: 1 point if *Yes*.
- T.5.5: Relate: Does the tool show relationships among items or datasets?

  - Explanation: Helps users see connections and dependencies between different data items, crucial for analysis and decision-making.
  - Score: 1 point if *Yes*.
- T.5.6: History: Can the tool track and display the history of user actions or choices?
  - Explanation: Tracks user interactions within the tool, offering insights into past activities and the evolution of the data.
  - Score: 1 point if *Yes*.
- T.5.7: Extract: Does the tool enable users to extract subsets of data or create reports from their analyses?
  - Explanation: Allows for the compilation and exportation of data insights, essential for reporting and further analysis.
  - Score: 1 point if *Yes*.

Cost and Scalability

This category evaluates the economic aspects and scalability potential of the tool:

- T.6.1: Is there a free version or free tier available?
  - Explanation: Identifies if there is an option to use the tool at no initial cost, beneficial for budget-conscious users and small teams.
  - Score: 2 points if *Yes*.
- T.6.2: Is the pricing model independent of user count?
  - Explanation: Assesses whether cost implications are not tied to the number of users, favoring scalability.
  - Score: 2 points if *Yes*.
- T.6.3: Are all essential features included in the base price?
  - Explanation: Checks if critical functionalities are accessible without additional fees, ensuring full utility without extra investment.
  - Score: 2 points if *Yes*.
- T.6.4: Is the pricing structure transparent and easy to understand?
  - Explanation: Determines the clarity and straightforwardness of the pricing details, essential for proper financial planning.
  - Score: 2 points if *Yes*.
- T.6.5: Does the tool offer the freedom to reduce cost burdens by outsourcing parts of its functionality or by managing aspects of it yourself?
  - Explanation: Evaluates the flexibility of the tool to adapt to user-controlled cost management strategies, potentially reducing long-term expenses.
  - Score: 2 points if *Yes*.

D.2 Equal Weight Taxonomy

D.3 Personalised Taxonomy

Question	Google Drive	Miro	OneNote	Notion	Confluence	Obsidian
			Collaboration			
T.1.2	10	10	-	10	10	-
T.1.2	-	-	7	-	-	7
T.1.3	-	-	-	-	-	-
T.1.4	-	-	-	-	-	-
SUM	10	10	7	10	10	7
			Control over Data			
T.2.1	0	0	4	0	0	4
T.2.2	2	2	2	2	2	2
T.2.3	2	0	0	0	2	2
T.2.4	2	2	2	2	2	2
SUM	6	4	8	4	6	10
T.3.1	2	2	2	0	2	0
T.3.2	2	2	2	2	2	2
T.3.3	2	2	2	0	0	0
T.3.4	2	0	2	2	2	2
T.3.5	0	0	2	0	0	2
SUM	8	6	10	4	6	6
			Support of Datatypes			
T.4.1	2	2	2	2	2	2
T.4.2	2	2	2	2	2	2
T.4.3	2	0	0	2	2	2
T.4.4	4	0	0	4	4	4
SUM	10	4	4	10	10	10
			Tasks			
T.5.1	1	0	1	1	1	1
T.5.2	1	1	1	1	1	1
T.5.3	1	0	0	1	1	1
T.5.4	1	1	1	1	1	1
T.5.5	0	1	0	0	0	1
T.5.6	1	1	1	1	1	1
T.5.7	1	0	0	1	0	1
SUM	6	4	4	6	5	7
Normalized	9	6	6	9	7	10
			Cost and Scalability			
T.6.1	2	2	2	2	2	2
T.6.2	0	0	0	0	0	2
T.6.3	2	2	2	0	2	2
T.6.4	2	2	2	2	2	2
T.6.5	0	0	0	0	0	2
SUM	6	6	6	4	6	10
			Result			
SUM	49	36	41	41	45	53

Table 25: Detailed Evaluation of Tools using Questions of Taxonomy

Category	**Points**	**Google Drive**	**Miro**	**OneNote**	**Notion**	**Confluence**	**Obsidian**
Ease of Use	2	16	12	20	8	12	12
Collaboration	3	30	30	21	30	30	21
Tasks	0.5	4.5	3	3	4.5	3.5	5
Control over Data	0	0	0	0	0	0	0
Support of Data Types	0.5	5	2	2	5	5	5
Cost and Scalability	0	0	0	0	0	0	0
Total Score	6	55.5	47	46	47.5	50.5	43

Table 26: Weighted Evaluation Scores of Documentation Tools Based on Lisa's Preferences

E Visual Identity

In Section 7.1, Figure 47 presented a moodboard showcasing graphic inspiration for the visual communication of FLUID. The following images were used in the creation of the moodboard:

- https://i.pinimg.com/736x/bf/31/e6/bf31e6e9ff434ee41cb762e04048c29c.jpg
- https://i.pinimg.com/736x/bf/31/e6/bf31e6e9ff434ee41cb762e04048c29c.jpg
- https://ro.pinterest.com/pin/774124930157685/
- https://ro.pinterest.com/pin/33354853484573912/
- https://i.pinimg.com/736x/59/3f/02/593f02c4bc211772cce520ebafd6879a.jpg
- https://i.pinimg.com/736x/72/48/73/724873314ac1e0639aaf066c2667c582.jpg
- https://i1.sndcdn.com/artworks-edIDjLf7ZqLB-0-t500x500.png
- https://i.pinimg.com/736x/8e/d5/6e/8ed56e266aca8d36656c5354f1608105.jpg
- https://i.pinimg.com/736x/21/1f/4c/211f4c1c6b232d1456091234f72c2159.jpg
- https://i.pinimg.com/736x/2e/64/02/2e6402d77214358c4e85088f2314582b.jpg
- https://www.freepik.com/premium-psd/space-satellite-isolated-transparent-background_136179961.htm
- https://i.pinimg.com/736x/7c/9e/a6/7c9ea6930d9d9ab5fd5a4e4770062cdc.jpg
- https://i.pinimg.com/736x/33/1f/52/331f5280ab08591c620dddda5c2b57c9.jpg
- https://i.pinimg.com/736x/f7/84/d8/f784d819c1996ddab51c14f904eba3c3.jpg
- https://ro.pinterest.com/pin/33354853484822237/
- https://pngimg.com/d/satellite_dish_PNG6.png
- https://i.pinimg.com/736x/b8/d3/2e/b8d32ef68d500dcc4678c20fb44cb04e.jpg