

TECHNICAL ANNEX

1. S&T EXCELLENCE

1.1 SOUNDNESS OF THE CHALLENGE

1.1.1 DESCRIPTION OF THE STATE OF THE ART

The Action will develop a research framework that will address the key challenges associated with integrating cutting-edge digital technologies in the finance sector. In achieving this aim, the Action will drive forward the digitalization of finance while ensuring that core policy objectives, such as consumer and investor protection, fair competition and stability continue to be met as the digital transformation of the financial sector continues.

In recent years, we have seen the emergence of new technologies, products and business models at an unprecedented speed, all summarised under the label **Digital Finance**. The digitalisation of the financial industry holds great promise. It offers the opportunity to make quick and cost-effective payments, enable the development of innovative financial products and services and foster wider access to financial services thus incorporating previously “unbanked” areas. Put simply, **digital technologies are expected to fundamentally transform the financial service industry**. Some examples of the practitioners’ perspective in terms of the topic’s relevance come from an extensive analysis done by the World Economic Forum (WEF) (2020), which provides a comprehensive picture of how digital technologies are applied in financial services by both incumbents and Fintechs. The study finds that:

- 77% of practitioners anticipate innovative technologies to possess high or very high overall importance to their businesses in the future
- Approximately 64% of practitioners anticipate employing innovative digital technologies in all of the following categories – generating new revenue potential through new products and processes, process automation, risk management, customer service and client acquisition
- Overwhelmingly, practitioners expect that digital technologies will become a key success factor for specific financial service sectors

Despite promises, the fast adoption of innovative technologies in finance poses challenges and risks, encompassing legal issues like disclosure and oversight, technology-related concerns such as poor data quality, protection and privacy, lack of sufficient explainability, algorithmic bias, and inconsistency in ESG assessment. The European Commission has taken steps in addressing some challenges through GDPR, the AI strategy (European Commission., 2023), and the digital finance package (European Commission., 2020b). These issues align with UN Sustainable Development Goals (Department of Economic and Social Affairs, Sustainable Development, 2023) and are increasingly relevant for financial service companies, as per the 2020 WEF study. To this point, the study done by WEF (2020) finds that:

- 91% of the surveyed practitioners consider data quality issues to be a key hurdle to deploying innovative digital technologies like machine learning in practice
- 64% of practitioners consider deficits in trust and user adoption to be another major hindrance of the adoption of digital technologies in finance
- Complex models are often developed and evaluated within closed environments which do not match the conditions of real-world applications
- Firms are particularly wary of the potential for complex models to entrench biases in decision-making

Having in mind this gap between the theoretical capabilities of technology and its actual implementation in real-world scenarios, the Action will develop a research framework that addresses the key technology-related huddles of implementing state-of-art technologies in finance applications and enable the transition to a digital finance ecosystem that is sustainable, transparent and inclusive. Specifically, the action will: (i) bolster the EU’s digital data market by enhancing data quality, protection and privacy; (ii) establish clear guidelines for integrating generative AI in finance by developing innovative solutions for risk management, market trend prediction, and personalized financial products that take into consideration challenges related to data security, ethical considerations and regulatory compliance; (iii) develop domain-driven XAI solutions for the finance sector by solving some of the key challenges of deploying explainability to machine learning (ML) and deep learning (DL) models applied to financial use cases; and (iv) propose data-driven ESG scoring methods.

As a result, the **Action’s research framework will lead to more, better, and more inclusive financial innovations that accelerate the digital and green transition of Europe, in line with Europe’s key strategic priorities such as the development of key digital, enabling and emerging technologies (DG Research and Innovation, 2021), the European Green Deal, the Digital Finance Package and the European Approach to AI (European Commission 2023).**

We elaborate in more detail on the four key technology-related pillars of the future function of finance, which in turn define the research objectives of the Action:

- **Ensuring data protection, privacy and fairness in financial data (WG1).** The distinctive trait of the emerging new financial ecosystem is the increasing availability of data. Data is in the centre of the digital transformation and more is to come (EC, A European strategy for data, 2020). Both academia and industry are increasingly faced with data characterised with staggeringly high number of dimensions, high variability and high veracity. Utilising such data is accompanied by many challenges among which: How do we ensure that all dimensions (accuracy, consistency, completeness, currency, volatility and timeliness) of data quality are satisfied to a necessary extent? What are the key challenges and opportunities in developing a unified data privacy framework, including clear definitions and methods, for ensuring the security and compliance of financial applications through the integration of differential privacy and federated learning techniques? What are the most effective methods and techniques for assessing and mitigating biases in large financial datasets to achieve data fairness, and how do these methods impact decision-making processes and outcomes in various finance use cases?
- **Develop and deploy end-to-end use cases of generative AI's applications in finance (WG2).** Generative AI holds transformative potential for the finance sector, offering capabilities that span from the simulation of intricate financial scenarios and the creation of novel investment strategies, to the generation of synthetic financial data for enhanced analytics. By leveraging these models, financial institutions can potentially devise innovative solutions that enhance risk management and portfolio optimization processes, predict market trends, and offer personalized financial products tailored to individual consumer preferences. However, the journey to integrate generative AI into finance is riddled with challenges: How can sensitive financial data be processed by generative AI models without risking unintentional disclosures? What are the potential applications and limitations of large language models (LLM) in predicting financial market movements, and how can these models be effectively integrated into existing financial forecasting methodologies? How do we assess the suitability and effectiveness of LLM in the specific applications of portfolio optimization and risk management? How can the potential of generative AI be fully harnessed in the finance sector while ensuring no compromises on security, ethics, or regulatory compliance?
- **Ensure explainability and fairness of AI-based systems in finance (WG3).** In order to address the “black box” challenge of AI solutions, the concept of eXplainable AI (XAI) emerged, introducing a suite of techniques attempting to explain to users how complex models arrived at certain decisions. For the most part, these techniques, introduced primarily through academic efforts, are not tailored to financial use cases and datasets and, as such, their ability to bring forward robust and stable explanations concerning the inner-working of complex models applied in finance, is limited. In this context, pending research questions are: To what extent existing XAI tools address the explainability needs of different stakeholders within the financial value chain? –How can we build XAI methods that are not perturbation-based and thus maintain the natural time ordering and dependence structures of the data? How can we make sure that algorithmic systems do not yield socially-biased outcomes, thereby compounding inequalities? How can we deal with the persisting latency in computing and showing explanations in real time? How can XAI platforms enhance ethics in the use of AI predictive models and ensure compliance with GDPR?
- **Streamlining ESG assessment and reporting (WG4).** Sustainable finance will have a key role to play in the future function of finance as climate change and environmental degradation are becoming an existential threat to Europe and the world (EC, European green deal, 2019). As clearly stated in the European Green Deal strategy, sustainable finance and investment will be key to fostering sustainable global development. Though inevitable, transitioning to a sustainable future with inclusive, green economies and resilient ecosystems is associated with many challenges. With the Action, we will answer the following research questions: What are the key components and methodological considerations in developing a real-time, data-driven ESG (Environmental, Social, and Governance) scoring model that integrates sentiment analysis obtained through the utilisation of LLM? How can the resulting model be effectively disseminated, either as an open-source tool or as a policy recommendation, to enhance sustainability assessments and regulatory oversight in the financial sector? How do different data-driven ESG measurement techniques, incorporating LLM for sentiment analysis and news report analysis, compare in terms of accuracy, reliability, and suitability for assessing the sustainability performance of organizations, and what are the implications for informed decision-making by investors and stakeholders?

In this context, the Action will ensure that the European finance industry will stay globally competitive, give European consumers access to innovative financial products, while ensuring consumer protection, financial stability and contribute to ESG and European Green Deal goals.

A research initiative aimed at overcoming the obstacles associated with AI deployment in finance demands a **transdisciplinary, gender-balanced, international research network with a strong focus on young researchers and innovators for several compelling reasons**. First, financial systems are by design intricately interconnected and globally interdependent, influenced by an array of factors that transcend national boundaries. Researchers from different regions bring valuable perspectives to the table, shedding light on regional nuances and providing a comprehensive understanding of the global financial landscape. Second, addressing these challenges goes beyond the confines of single disciplines. It involves a blend of expertise from computer science, economics, law, ethics, regulation, and cybersecurity. A transdisciplinary approach ensures that all aspects of the problem are thoroughly explored and integrated into potential solutions. Thirdly, financial data is diverse and subject to regional regulations. Collaboration on an international scale facilitates the aggregation of heterogeneous datasets, addresses data privacy concerns, and establishes common data standards crucial for the development and training of AI models. Fourth, financial regulations vary across countries, and ethical considerations are essential. An international research network can facilitate the exchange of regulatory insights and ethical best practices, ensuring that AI systems are compliant with international standards. Lastly, collaboration on an international scale accelerates the development of AI solutions for finance. By pooling resources, knowledge, and expertise from researchers and institutions across Europe, collaborative efforts can drive innovation, leading to more effective and globally applicable solutions.

1.1.2. DESCRIPTION OF THE CHALLENGE (MAIN AIM)

The Action will establish a cross-border network of professionals across finance, mathematics, statistics, computer sciences, law and ethics, focusing on solving the main hurdles of integrating AI systems into the different functions of finance. The main goal is to develop a collaborative platform that derives AI-driven, robust, explainable and sustainable systems that will support the digital transformation of finance. Currently, **there exists a significant gap between the theoretical possibilities of AI-based systems and the actual feasibility of implementing these capabilities in real-world scenarios in finance**. While numerous researchers have established the effectiveness of AI-based systems across diverse predictive tasks (Dingli and Fournier, 2017, Di Persio and Honchar, 2017, Sen and Mehtab, 2021, Cao, 2022), there remains a critical need for research focused on identifying (and addressing) the key barriers hindering their widespread adoption in real-world financial use cases, thus leading to sustained and expansive impacts in Finance, ensuring a green and digital transition. Specifically, through joint international efforts and interdisciplinary expertise, the Action will address hurdles related with the different stages of building and deploying AI-based systems. In order to ensure that all dimensions of data quality are satisfied, the COST action will: develop a comprehensive data quality assessment framework, establish a unified data privacy framework for financial applications, and identify effective methods for assessing and mitigating biases in large financial datasets. Looking at the model deployment hurdles that industry is faced with, the Action will: prototype and deploy end-to-end generative AI use cases in finance, propose guidelines for sensitive financial data processing by AI models, introduce novel metrics for evaluating the utility of LLM for financial market prediction, and run an assessment of their suitability for portfolio optimization and risk management. For the purpose of bringing suitable level of explainability and trust into deployed AI systems in finance, the Action will: evaluate existing XAI tools, propose novel finance-specific XAI methods, train and test strategies for preventing socially-biased outcomes in AI-based risk management systems, and research into real-time solutions for reducing latency in AI explanations. Finally, in order to ensure a data-driven assessment of sustainability, the Action will: create a real-time, data-driven ESG scoring model integrating sentiment analysis, document methods for effective dissemination (either as an open-source tool or policy recommendations), and conduct a comparative analysis of data-driven ESG measurement techniques, including the utilization of LLM for enhanced sustainability assessments and regulatory oversight in finance.

The ultimate goal of the Action is to blend diverse expertise that allows us to optimally use high-dimensional data and state-of-art AI systems to push forward the digitalization of the functions of finance. Emerging AI technologies, distinct from conventional methods, present clear benefits for the financial sector. The effectiveness of these methods will be measured and contextualised in terms of their practicality and challenges of real-world implementation. While the focus is on financial applications, the outcomes will be applicable to wider fields, and efforts will be made to share insights across different industry domains.

1.2 PROGRESS BEYOND THE STATE OF THE ART

1.2.1 APPROACH TO THE CHALLENGE AND PROGRESS BEYOND THE STATE OF THE ART

From a methodological perspective, the Action will focus on bringing forward several contributions to the literature. In the context of ensuring data quality, privacy and protection, the Action will test different state-of-art techniques proposed in the literature for tackling privacy issues in deep and federated learning (FL). Particularly, we will focus on differential privacy (DP). The primary aim of differential privacy (DP) is to enable the examination of dataset characteristics related to a population as a whole, all while safeguarding individual privacy (Dwork, 2006, Dwork 2008, Ouadrhiri et al., 2022). In simpler terms, DP involves introducing perturbations, either in statistical inquiries or the original dataset, to prevent an adversary from determining whether a specific individual is part of the dataset or not. This approach is considered a de facto standard for protecting users' privacy in statistical computations. The Action will run and compare several applications of DP for financial data sets and time series. Moreover, the network will also tackle the challenges evolving in algorithmic bias. Many financial services, such as mortgage or loan approvals, are algorithmically aided decisions. Such techniques, including supervised and unsupervised learning methods, are not inherently biased but often oblivious to sensitive parameters. This can be a result of bias introduced at any step in the life cycle (Davidson et al., 2023) including, e.g., socio-historical bias in the data generation process, Simpson's Paradox as an example of aggregation bias (Prost et al., 2023) or the choice of optimization functions, regularizations that can contribute to biased algorithmic decisions. Within the COST Action, researchers will explore a wide variety of methods to debias algorithmic solutions for financial applications. Since many fair learning algorithms have already been implemented (like IBM (2023) AI Fairness 360 toolkit), the researchers within COST will analyze the possibility of adjusting and extending those methods for problems arising in the financial sector. Moreover, much of the attention will be focused on developing new approaches to fight against bias both on the data and methods side. On the algorithmic side, the researchers will investigate the approach based on disparate learning processes (DLPs) that allows the sensitive attributes during the learning phase but not during the prediction time (Lipton et al., 2018) or Variational Fair Autoencoder, which treats protected attributes as the nuisance variables (Louizos, 2015). On the data debiasing side, a very interesting approach is Fair Adversarial Networks (FairGAN), whose goal is to create synthetic data of similar quality as real data, not discriminatory toward certain demographic groups (Wu, 2022).

Considering the application of generative AI in finance, the Action will develop end-to-end use cases which will detail the entire pipeline of building AI-systems incorporating LLMs for financial applications. LLM have been shown to be very effective on a variety of language tasks (information and knowledge queries, analysing text data, generating briefs and reports) (Wu et al., 2023, Xie et al., 2023, Zhao et al., 2023, Hadi et al., 2023). However, most of the implementations available in the literature do not take into consideration the practical constraints (like regulatory compliance, scalability, privacy concerns, etc.) in which the financial sector operates. To this end, the Action will assess the potential and limitations of LLM for various financial applications (i.e. predicting financial markets, enhancing risk management and portfolio optimization processes) and propose guidelines for effectively integrating their outputs into classic methodologies for classification and prediction.

Furthermore, the Action will also aim at proposing solutions for the growing "trust" issues with complex models. The introduction of complex ML and DL methods for financial use cases (i.e. time series forecasting or credit scoring), potentially enables higher predictive accuracy but this comes at the cost of higher complexity and thus lower interpretability (Hulsen, 2023). ML models are referred to as "black boxes" because it is often difficult to understand how variables are jointly related to arrive at a certain output (Arrieta et al., 2019). This reduced ability to understand the inner workings and mechanisms of complex models unavoidably affects their trustworthiness and the willingness among practitioners to deploy such methods in sensitive domains such as finance. As a result, the scientific interest in the field of eXplainable artificial intelligence (XAI) has grown tremendously within the last few years (Gunning et al., 2019, Linardatos et al., 2021, Dazeley et al., 2021 and Saeed and Omlin, 2023). XAI aims at introducing a suite of techniques attempting to communicate understandable information about how an already developed model produces its predictions for any given input (Arrieta et al., 2019). The growing popularity of the topic notwithstanding, research on XAI in finance remains limited and most of the existing explainability techniques are not suited for financial data which are characterised with dependence of features and non-stationarity. Many state-of-the-art XAI methods are originally tailored for certain input types such as images (ex. Saliency Maps) or text (ex. LRP) and have later been adjusted to suit tabular data as well. However, temporal dimensions and features' dependence are often omitted, and the literature currently offers only a limited consideration of the topic. Notable examples are interpretable decision trees for time series classification (Hidasi and Gáspár-Papanek, 2011) and using attention mechanisms (Hsu et al., 2019, Schockaert, 2020) with none of the applications looking specifically at explainability for financial data. To address this gap in

the literature as well as in the considered application field, the Action will focus on investigating the utility of existing state-of-art XAI methods and proposing novel methods for financial applications. Finally, the Action will also focus on tackling several methodological challenges related to the sustainable finance domain. Numerous organisations are assessing businesses' non-financial endeavours by employing environmental, social, and governance (ESG) metrics as assessment criteria (Almeyda and Darmansya, 2019 and Bassen and Kovacs, 2020). Nevertheless, the reliability of existing ESG ratings is constrained by variations in criteria among assessment bodies, resulting in significant discrepancies in a company's ESG rating when assessed by different organisations (Lee and Kim, 2023). Thus, a data-driven approach to ESG estimation is needed, and the studies that focus on the need for automatic and direct extraction and classification of ESG information are limited. The Action will investigate the utility of LLM in effectively analyzing and extracting insights from vast amounts of sustainability-related textual data, such as news articles, to gain deeper insights into companies' ESG performance and their societal impact.

1.2.2 OBJECTIVES

1.2.2.1 Research Coordination Objectives

The scientific progress will be pursued by capitalising on the COST research coordination tools. The specific objectives in this respect are shown below.

RC1. Unified Data Protection Framework (WG1): Develop a common framework and definitions for data privacy methods, specifically focused on differential privacy and federated learning techniques.

RC2. Data Sourcing Standardization for LLM (WG2): Coordinate the collection and curation of financial datasets, and establish a standard set of performance metrics specifically for Transformer Neural Networks used in portfolio optimization and risk management.

RC3. Harmonized Protocols for XAI (WG3): Develop standardized protocols for experimentation and data collection XAI, focused on non-perturbative XAI methods applicable to financial time-series data.

RC4. Comparative Assessment of ESG Measurement (WG4): Conduct a comparative analysis of data-driven ESG techniques, including the use of LLMs for sentiment and news analysis.

RC5. Shared Resource Portal (All WGs): Establish a centralized digital portal where resources like datasets, software tools, and methodological guidelines can be shared across all WGs to accelerate research in data-driven processes, generative AI, XAI, and sustainable digital finance.

RC6. International Coordination for Fairness Models (WG1): Coordinate with international bodies and standardization agencies to establish guidelines that ensure fairness and data protection in financial algorithms, leveraging differential privacy and federated learning methodologies.

RC7. Stakeholder Input for Algorithmic Bias Mitigation (WG3): Engage with policymakers and regulatory bodies to translate the WG's findings on algorithmic bias mitigation into actionable policies.

RC8. Tangible Output for Real-Time ESG Scoring (WG4): Develop a real-time, data-driven ESG scoring model that leverages sentiment analysis and other language model-based techniques, to be shared as an open-source tool or as a policy recommendation for financial regulatory bodies.

1.2.2.2 Capacity-building Objectives

The focus of capacity-building goals, achieved through the facilitation of knowledge exchange and collaborative research agenda development, will be centred around the following subject areas:

CB1. Joint Research Agenda on Data Protection (D1): Foster knowledge exchange between legal experts, data scientists, and policymakers to develop a joint research agenda focused on creating comprehensive data privacy guidelines for financial applications.

CB2. Interdisciplinary Collaboration for Fairness in Financial Algorithms (D2, D9): Bridge the gap between ethics, data science, and finance to facilitate interdisciplinary research aimed at fairness models and algorithmic bias mitigation in financial algorithms.

CB3. Young Researchers in Federated Learning (D3): Engage young researchers and innovators to contribute to the report on federated learning techniques and protocols, thereby building their capacity.

CB4. Stakeholder Platform for Generative AI in Finance (D4, D5, D6): Act as a trans-national practice community involving financial institutions, AI researchers, and regulators to foster the adoption of Generative AI models for portfolio optimization, risk, and personalized financial advice.

CB5. Inclusive XAI Methods (D7, D8): Involve under-represented genders and teams from countries/regions with less capacity in the field to contribute to the development of scalable XAI methods and transparent Transformer Neural Networks.

CB6. Sustainability Focus in Digital Finance (D10, D11, D12): Develop a joint research agenda that includes environmental scientists, financial analysts, and data scientists to advance sustainable digital finance, particularly in ESG sentiment analysis and real-time scoring models.

CB7. Comprehensive Capacity-building Through Overall Action Deliverables (D13-D19): Utilize the online presence, data collection, publication plan, training materials, and gender balance reports as tools for ongoing capacity-building across all research groups and stakeholder communities.

2. NETWORKING EXCELLENCE

2.1 ADDED VALUE OF NETWORKING IN S&T EXCELLENCE

2.1.1 ADDED VALUE IN RELATION TO EXISTING EFFORTS AT EUROPEAN AND/OR INTERNATIONAL LEVEL

The proposed Action distinctively positions itself within a number of prior and ongoing European and international projects and initiatives. To highlight its added value, we systematically contrast it with previous efforts across multiple platforms:

Marie Skłodowska-Curie Actions (MSCA):

TraDE-OPT, REBOOT.AI, BigDataFinance, DEDS, BehindAI, and AIFocus have made valuable contributions in specialized areas such as big data analytics, regulatory sandboxes for AI, and the impact of AI on firm strategy. However, these actions focus on segmented expertise, lacking a holistic framework that combines these elements. Our Action integrates these specialized insights into a multidisciplinary dialogue.

COST Actions:

While COST CA19130 Fintech and AI in Finance and COST CA21163 HiTEc Text have initiated discussions on fintech and econometrics, they have not sufficiently explored the intersectionality between technological, regulatory, and ethical dimensions in finance. Our Action fills this gap by synergizing these aspects.

Horizon 2020 and Horizon Europe:

Projects like TANGO, FAME, AI for Alpha, HACID, FINTECH, SINGULARITY, Great.Power.Finance, and FINE offer essential technological advancements and insights. Yet, they often fail to comprehensively address the coordination between technology, ethics, and regulations. Our Action aims to meld these disparate threads into a unified framework.

EU Initiatives and Collaborations:

European Blockchain Partnership (EBP), European Fintech Association, the European Green Deal, the European Digital Finance Package, the European Data Governance Act, AI4EU, and ELISE have made strides in their respective domains. However, these platforms typically focus on specific facets of finance or technology. Our Action expands on this by offering an integrative strategy that aligns with EU priorities, thereby ensuring Europe's competitive position on the global stage.

Key Differentiators and added value

- **Interdisciplinary Convergence in WG1 to WG4:** Across all our work packages, our platform uniquely brings together professionals from computer science, finance, sociology, and regulatory bodies. This integrative approach allows us to tackle issues such as data privacy (WG1), generative AI (WG2), explainable AI and bias (WG3), and sustainability (WG4).
- **Holistic Approach to Regulatory Compliance in WG3 and WG4:** Unlike prior initiatives that either focus on technological feasibility or regulatory challenges, our Action harmonizes these by incorporating ethical and regulatory considerations, particularly in WG3 and WG4.
- **Future-proofing the Financial Sector in WG2:** While previous efforts like AI for Alpha and TANGO have addressed some aspects of market adaptability, our WG2 aims to comprehensively understand how AI models can adapt to evolving market conditions.
- **Operationalizing Ethical Governance in WG3:** We move beyond theoretical discussions of ethical considerations to actualize them, especially in WG3 where we tackle explainable AI and algorithmic bias, ensuring these methods align with societal norms and values.
- **Inclusivity of Stakeholder Perspectives in WG1 and WG4:** WG1 focuses on user trust and experience, and WG4 addresses sustainability across sectors. This ensures a more democratic approach to finance, incorporating a broad range of stakeholder perspectives.
- **Global Competitive Positioning in WG1 to WG4:** In line with EU policy agendas, our Action's objectives strategically align Europe's financial technologies with global competitive requirements. This is particularly emphasized in our cross-WG challenges on interdisciplinary approaches, fostering collaboration, and navigating regulatory landscapes.

It becomes evident that our Action provides a comprehensive, multidisciplinary, and future-oriented roadmap for advancements in the field of finance and technology. It not only builds upon but significantly extends the existing body of work, targeting a balanced, actionable, and forward-looking approach to complex challenges in the financial sector.

2.2 ADDED VALUE OF NETWORKING IN IMPACT

2.2.1 SECURING THE CRITICAL MASS, EXPERTISE AND GEOGRAPHICAL BALANCE WITHIN THE COST MEMBERS AND BEYOND

Our team brings together a wide array of scientific disciplines including computer science, finance, cybersecurity, data privacy, artificial intelligence, regulatory compliance, sustainability studies, ethics, user experience design, algorithmic development, socio-economic studies, legal studies, and cross-cultural communication, ensuring a rich, comprehensive approach to tackling the complexities and challenges in advancing financial technologies through data-driven processes and sustainable, ethical AI implementation across diverse European financial ecosystems.

That is needed in view of our objectives and challenges:

Interdisciplinary Synergy: Our interdisciplinary approach ensures that every aspect, from data-driven processes and AI model development to ethical and sustainable technology deployment, is underpinned by authoritative knowledge and innovative thinking.

Practical and Theoretical Knowledge: The combination of both academic researchers and industry professionals ensures a balanced blend of theoretical insight and practical know-how. Our academic experts bring forth the latest research and theoretical frameworks, while our industry professionals provide real-world application insights, thereby ensuring solutions are both innovative and applicable.

Regulatory insights: With specialists experienced in the financial regulatory landscapes across Europe, our network is acutely aware of the varied and often complex regulatory environments in different countries. This expertise is crucial to develop and implement financial technologies that are not only innovative but also compliant with regional and international standards.

Technological Proficiency: Inclusion of experts in AI and FinTech provides a solid foundation to explore, develop, and validate cutting-edge technologies that align with the evolving needs of the financial industry, ensuring that our solutions are not just current but also future-ready.

Sustainability Insight: Engaging with specialists in sustainability, especially within the financial sector, ensures that our network can innovatively combine financial technologies with sustainability goals, creating solutions that are both economically and environmentally viable.

Data Privacy Expertise: With authorities in data privacy and protection, our network will create solutions that are not only efficient and innovative but also stringently adhere to data protection laws, safeguarding user information and building user trust.

Geographical and Cultural Awareness: Having experts from different geographical and cultural backgrounds ensures a wide perspective, enabling the development of solutions that are mindful of cultural, social, and regional nuances, thereby ensuring wider applicability and acceptability of the devised technologies and strategies.

Economic and Financial Insight: Experts in economics and finance within our network ensure a thorough understanding of market dynamics, providing crucial insights into creating technologies and strategies that are not only innovative but also economically viable and market-ready.

Furthermore, we have variation across socio-economic factors:

- **Regulatory Divergence:** Our experts are from countries that have different financial rules, helping us build technologies that work across various legal frameworks, especially considering the different ways countries implement rules like the GDPR, AI regulations and Fintech sandboxes.
- **Economic Variation:** Our network has participants from all sorts of economies, from big financial hubs like Frankfurt and London to growing markets in Eastern Europe, ensuring our solutions work everywhere and can scale according to different economic contexts.
- **Technology Adoption:** Our network includes countries at different stages of adopting FinTech, like tech-forward Sweden and others that are just starting their digital finance journey, helping us understand and plan for varied tech landscapes.
- **Cultural and Social Differences:** We have professionals and academics from areas with diverse attitudes toward finance and data privacy, ensuring our solutions are sensitive to different cultural norms and can be adopted widely.
- **Environmental Priorities:** Our countries have different approaches and progress levels toward sustainability in finance, ensuring our solutions are comprehensive and mindful of varied green finance initiatives and policies.

With our COST members, our network strategically encompasses seasoned fintech innovators from nations with rigorous data protection regulations, data scientists experienced in dealing with multiple economic climates, and AI specialists who've formulated models adaptable to multiple financial scenarios; synergistically, collaborations with NNC provide insights from emerging markets, while our affiliations with IPC ensure that the developed technologies are globally relevant and adaptable, and engagement with Specific Organisations like international fintech forums and regulatory bodies strengthen our initiative with a global, industry-relevant, and regulatory-compliant perspective, thereby increasing our capacity to enhance financial technologies

2.2.2 INVOLVEMENT OF STAKEHOLDERS

In the Action, relevant stakeholders have been identified as:

- **Financial Institutions:** This encompasses a wide range of entities such as banks, insurance companies, credit unions, microfinance institutions, fintech startups, and investment firms, all integral to the evolving financial technologies landscape.
- **Regulatory and Compliance Entities:** Bodies ensuring that financial technologies adhere to legal and ethical guidelines.
- **Technology Providers and Developers:** Entities that create and innovate data-driven solutions and AI technologies.
- **Academic Researchers:** Institutions and academics focusing on finance, sustainability, and technology research.
- **Sustainability Organizations:** Advocates for environmentally responsible practices in financial technologies.
- **Consumer Advocacy Groups:** Organizations protecting and promoting consumer interests.
- **Global Partners:** This includes entities from Non-COST countries and Third States (IPC), particularly focusing on key players from countries like the USA, Singapore, Hong Kong, Japan and the UAE, enriching our understanding and ensuring a global perspective.

It's noteworthy that we have successfully onboarded representatives from each of these stakeholder categories, ensuring that a wide spectrum of expertise and perspectives is embedded from the outset.

Stakeholder Involvement Plan:

- **Inclusive Initiating Workshop:** Establish a foundational understanding, initial stakeholder input, and network cohesiveness by convening a workshop with virtual and in-person participation options to initiate collaborative action. The outcome will be a consolidated document capturing an initial roadmap, main challenges identified, and strategies to address them
- **Continuous Collaboration and Communication:** Ensure a sustained dialogue and cooperation by implementing a digital platform for continual discussion, knowledge sharing, and collaboration among stakeholders.
- **Regular Stakeholder Check-Ins:** Ensure consistent feedback and iterative development by implementing bi-annual meetings for updates, inputs, and collaborative efforts.
- **Thematic Working Groups:** Achieve in-depth progress in specialized areas by focussing on various aspects like technological development and sustainability, inviting stakeholder participation through open calls.
- **Capacity Building and Dissemination:** Enhance stakeholder capacity and disseminate insights by conducting workshops and webinars to share findings and build capacity.
- **Continuous Feedback and Improvement:** Ensure that the Action is consistently refined based on stakeholder feedback by implementing bi-annual surveys and feedback tools, integrating insights into ongoing Action adaptations.
- **Policy Dialogue and Aligning Outputs:** Ensure findings and outputs align with and influence policy by organizing annual forums with policy-makers, e.g. in Brussels, to ensure findings are policy-relevant and contribute to policy evolution.
- **Final Evaluation and Future Planning Workshop:** Assess impact and a plan for future sustainability by hosting a concluding workshop to evaluate impacts, understand shortfalls, and plan future trajectories.

Through this approach, we cement a bi-directional, ongoing dialogue between the Action and its stakeholders, ensuring our research is not only grounded in scientific and technological excellence but also remains tightly connected with real-world applications, challenges, and policy landscapes. Our cross-sectoral and interdisciplinary stakeholder base fortifies the Action's potential to realize meaningful, practical, and transformative impacts across the financial technology landscape.

3. IMPACT

3.1 IMPACT TO SCIENCE, SOCIETY AND COMPETITIVENESS, AND POTENTIAL FOR INNOVATION/BREAKTHROUGHS

3.1.1 SCIENTIFIC, TECHNOLOGICAL, AND/OR SOCIOECONOMIC IMPACTS (INCLUDING POTENTIAL INNOVATIONS AND/OR BREAKTHROUGHS)

The Action will have a major impact in all of the nine primary scientific, economic/technological and societal Key-Impact Pathways of Europe.

A. Scientific Impact

Short-Term Perspective: Immediate Research Outcomes

The proposal's immediate scientific impact is based on the advancement of financial technologies through data-driven methodologies and AI. In the short term:

- **Enhanced Data Privacy and Protection:** The emphasis on differential privacy methods and federated learning will lead to immediate improvements in data protection. It will set a benchmark for how financial data should be handled in the digital age.
- **AI-driven Financial Models:** With the deployment of Transformer Neural Networks in portfolio management and risk assessment, financial entities can expect models that are more accurate, leading to safer financial decisions and strategies.
- **Introduction of Explainable AI:** In a field where AI decisions can have significant monetary implications, introducing XAI ensures that stakeholders can understand and trust AI outputs. This transparency is crucial for regulatory compliance and building user trust.

Long-Term Perspective: Sustained and Expansive Impacts in Finance

- **Setting New Industry Standards:** The guidelines and models developed for data privacy, fairness, and explainability will likely become industry standards. Financial technology firms will adhere to these models, ensuring a consistent level of data protection and AI transparency across the sector.
- **Algorithmic Bias Mitigation:** The focus on identifying and mitigating algorithmic bias will have a long-standing impact on ensuring fairness in AI-driven financial decisions. This will lead to more equitable financial systems, minimizing the risk of systematic biases in lending, insuring, and other financial services.
- **Sustainable Financial Decisions:** The emphasis on data-driven ESG scoring models is a step towards sustainable financial decisions. In the future, these dynamic scoring models will shape the investment strategies of big financial players, driving capital towards more sustainable businesses.

A.1 Creating high-quality new knowledge

We will publish 20 peer-reviewed articles in recognized journals (e.g. Journal of Finance, Journal of Financial Innovation) within the first two years and will monitor the field-weighted Citation Index of peer-reviewed publications in the medium term ultimately reaching a significant number and share of peer-reviewed publications that are core contributions within Sustainable Digital Finance.

A.2 Strengthening human capital in research and innovation

Our Action will strengthen human capital in research and innovation. Consequently, 100 researchers will benefit from extensive upskilling activities, including training, mobility, and access to vital infrastructures. Additionally, we will work towards ensuring that 50 of these researchers gain substantially more influence in the Sustainable Digital Finance field, resulting in improved working conditions for them, both in academia and industry. Simultaneously, our goal is to elevate Europe's standing on the global stage by increasing its share of top-tier Digital Finance researchers.

A.3 Fostering diffusion of knowledge and Open source

100% of our research output, including open data, publications, and software, will be disseminated through open knowledge infrastructures and frequently cited. Platforms such as Arxiv.org, osf.io, github.com/, <https://protocolexchange.researchsquare.com/>, zenodo.org, <https://eosc-portal.eu>, <https://opensource.org/licenses>, and <https://open-research-europe.ec.europa.eu> will be used in our distribution efforts. Moreover, a significant 30% of COST members, through the benefits of the network, will forge new transdisciplinary and trans-sectoral collaborations, partnering with users to maximize the potential of their open R&I outputs. Overall, we will ensure that scientific results are made openly accessible to bolster Europe's standing in scientific competitiveness.

B. Societal Impact

B.1 Addressing EU Policy Priorities and Global Challenges through Research and Innovation

Digital Transformation aligned with EU Strategy: By emphasizing sustainable digital transformation, our Action directly aligns with Europe's strategic priorities to establish itself as a frontrunner in digital innovation while addressing environmental and ethical considerations (EU Digital Finance Package, EU Green Deal, European Approach to Artificial Intelligence).

Data Privacy and Fairness as global challenges: By setting data privacy and fairness at the core of our actions (WP1), we are tackling worldwide concerns about data misuse and inequity. Additionally, our focus on sustainable digital finance (WP4) resonates with global sustainability goals, aiming to make the financial sector more responsive and responsible in the face of environmental, social, and governance challenges.

B.2 Delivering Benefits and Impact through Research and Innovation Missions:

Generative AI will revolutionize the financial sector: The Action's emphasis on Generative AI in finance (WP2) promises to redefine areas like portfolio optimization, risk management, and fraud detection, leading to more efficient and secure financial systems.

Promotion of Ethical AI: Our dedicated effort on explainable AI and algorithmic bias mitigation (WP3) not only drives technological advancements but also ensures the ethical deployment of AI in finance. This paves the way for more transparent, accountable, and unbiased financial decision-making.

B.3 Strengthening the Uptake of Research and Innovation in Society:

Explainable AI will promote transparent technologies: Through the Action's work on explainable AI (WP3), we are enabling society to understand and trust AI-driven financial solutions better. This transparency is pivotal in fostering public trust and encouraging the broader adoption of AI technologies.

The Action will have substantial educational outreach: By producing easy-to-implement models and guidelines, the COST Action serves as a resource for educational institutions, facilitating the integration of cutting-edge AI and financial tech knowledge into curricula. This ensures the next generation of financial professionals is equipped with both the skills and ethical considerations vital for the industry's future.

All WPs prioritise an enhanced stakeholder engagement: The actionable outcomes from our research missions, such as the data-driven ESG scoring models (WP4), provide tangible tools for stakeholders ranging from policymakers to financial institutions. This strengthens the bond between research, innovation, and its real-world applications, driving societal progress and European competitiveness.

C. Socioeconomic Impact

C.1 Generating Innovation-based Growth:

Innovative Financial Tools: We anticipate 15 new AI-driven financial tools and 10 sustainable digital finance tools by the end of the Action as well as five potential IPR applications for unique methodologies in AI and sustainable finance.

Generative AI Innovations: Forecasting the emergence of 12 standout innovations from the Action. Four of these will stem directly from awarded IPRs, particularly in the area of generative AI.

Economic Growth and Startups: Expectation of a 10% growth in market share for companies integrating our AI and sustainable digital finance tools. Three new startups could emerge, focusing exclusively on WP3 and WP4 innovations.

C.2 Creating More and Better Jobs:

Supported Employment: The Action will directly lead to the creation of 320 FTE jobs by the end of the Action, predominantly in AI, data management, and sustainable finance roles.

Sustained Employment: 400+ FTE roles are anticipated post-project, focusing on the maintenance, scalability, and continuous improvement of the developed tools and methodologies. This figure also includes positions in academic research and high-profile R&D positions in collaborating industries.

Total Employment: The diffusion of the Action's outcomes will indirectly generate or sustain an additional 600 jobs across sectors that will leverage these innovations.

C.3 Leveraging Investment in Research and Innovation:

Investment Mobilization: The work of the Action will draw €3+ million in public and private investments during its life-time. Post-project innovations are expected to attract an additional €7 million for scaling up and widespread application.

EU GDP Target Progress: The Action's initiatives are set to contribute towards the EU's ambitious 3% GDP target, spurred by the adoption and diffusion of the generated technologies.

D. The Action's key indicators

80% of the output will be aimed at directly addressing EU policy priorities, with a prominent focus on SDGs 9 (Industry, Innovation, and Infrastructure) and SDG 13 (Climate Action). In the medium to

long-term, 10 innovations and scientific results will address EU policy priorities, in particular the EU Digital Finance Package, EU Artificial Intelligence programme and the Green Deal, leading to a substantial advancement of EU policies on Digital Finance and the European single digital market.

40 outputs (research articles, white papers and prototypes) will span sustainable energy, climate action, and reducing inequalities, i.e. EU missions.

In terms of Engagement and Societal Uptake, 20% of our projects will actively involve EU citizens in co-creation, which will lead to substantial societal uptake in the long-run, impacting over 100,000 European citizens directly, via industry-academia generated products and regulations.

E. Potential Innovations and Breakthroughs

E.1 Scientific Breakthroughs:

- **Dynamic Data Privacy Protocols:** Harnessing differential privacy methods combined with federated learning will establish new benchmarks in data science, particularly in financial data protection. This will drive a paradigm shift in how financial data is handled, balancing between utility and privacy.
- **Universal Framework for AI Transparency:** The advancement of non-perturbative XAI methods will result in a universally accepted scientific framework for AI transparency. This will lay the foundation for standardized methodologies and measurements across AI applications in the financial domain.

E.2 Technological Innovations:

- **Generative AI in Financial Systems:** Integration of Transformer Neural Networks into portfolio optimization, risk assessment, and fraud detection will pave the way for more advanced financial technologies. These tools will not only optimize current processes but will also create novel avenues for financial decision-making.
- **Real-time Sustainability Metrics:** Utilizing large language models to drive real-time ESG scoring will set a new technological standard. By providing instantaneous updates, financial entities will enhance their responsiveness to rapidly changing global events and sustainability trends.

E.3 Socioeconomic Breakthroughs:

- **Economic Growth through AI:** The deployment and broader acceptance of AI tools, backed by trust and transparency, will spur economic growth. Enhanced financial decision-making tools can optimize investments, resulting in substantial economic gains.
- **Inclusive Financial Systems:** By addressing and mitigating algorithmic biases, the financial ecosystem will be shaped into a more equitable platform. This paves the way for fairer financial outcomes, ensuring a broader segment of society benefits from financial growth and stability.
- **Sustainable Finance as Norm:** The emphasis on real-time sustainability metrics and their adoption will drive the entire financial sector towards more sustainable operations, aligning financial growth with global sustainability goals.

3.2 MEASURES TO MAXIMISE IMPACT

3.2.1 KNOWLEDGE CREATION, TRANSFER OF KNOWLEDGE AND CAREER DEVELOPMENT

A. Maximizing Impact through Knowledge Creation with COST Tools

The Action will lead to groundbreaking research in European sustainable digital finance, leveraging data-driven processes, artificial intelligence, and sustainability insights. We will use the COST Action's synergies as follows:

Strategic Meetings for Overall Research Direction: Our biannual hybrid MC meetings set the overarching research directions. These directions are then refined and explored in our quarterly working group meetings, ensuring a focused and collaborative approach. The core group oversees these efforts, setting tangible implementation goals to ensure cohesiveness across work packages.

Advanced Research Through Short-Term Scientific Missions: These missions will ensure practical engagement, facilitating knowledge transfer and hands-on training across all work packages.

Empowering the Next Generation: Our commitment to involving young researchers to a large extent is about creating knowledge with fresh perspectives and innovative methodologies

Hands-on Collaborative Research via Virtual Mobility Grants: Our joint hybrid paper-writing workshops are planned as knowledge creation sessions, where the Action creates new knowledge.

B. Maximizing Impact through Transfer of Knowledge

In the framework of the Action, we will implement a systematic approach for knowledge transfer. We facilitate PhD Training Schools, targeting doctoral candidates with intensive research methodologies. Our STSMs enable researchers to collaborate and gain insights into varied practices across different

institutions. To bolster remote collaborations, we utilize Virtual Grants. Structured Mentoring Sessions are in place, with seasoned researchers guiding newcomers. Furthermore, through academic talks and conferences, we not only share our advancements with the academic community but also engage with other key stakeholders in the industry and government organisations.

C. Contribution to Career Development

The Action integrates core domains: data-driven processes, generative AI in finance, explainable AI, and sustainable digital finance. By advancing methodologies like differential privacy, Transformer Neural Networks, and Large Language Models for ESG evaluations, participants equip themselves with skills highly demanded in contemporary financial research and applications.

The vast stakeholder network within our Action provides significant networking opportunities, facilitating transitions into multiple sectors. Participation in decision-making roles during the Action fosters essential management capabilities. Direct contributions to tangible research outcomes further solidify the credentials of researchers, improving their academic and industry prospects.

3.2.2 PLAN FOR DISSEMINATION AND/OR EXPLOITATION AND DIALOGUE WITH THE GENERAL PUBLIC OR POLICY

In our Action's first MC meeting, a comprehensive science communication plan will be laid out.

Science Communication Plan: This plan is grounded on three core principles:

- **Transparency:** Ensuring all communications are clear, open, and understandable.
- **Continuous Outreach:** A pledge to maintain persistent engagement with all stakeholders.
- **Engagement:** Fostering connections across diverse fields, from academia to industry.

Academic Seminars: Every partner institution will host at least one academic seminar annually.

Conference Presence: COST members will participate in high-quality international conferences across Europe, ensuring our research and innovations are showcased on leading platforms.

Publications: Our strategy includes aiming for publications in reputable journals recognized for their robust impact metrics.

Industry Engagements: Seminars designed for industry experts are planned in hybrid formats. The objective: to captivate a minimum of 100 participants and spur subsequent collaborative projects.

Multimedia Outreach: For every Action activity, an informational video will be produced targeting the wider public. Our digital strategy will also encompass the creation of a dedicated website, active social media engagement, and insightful blog posts.

Intellectual Property Management: Our approach here is two-fold:

- Encouraging collaborations and external research initiatives.
- Channeling resources into product evolution and development.

Community Engagement: Twice annually, we will connect with communities, the general public, and end users (Open Lab Days, Open Science Festivals). Our findings and innovations will also be presented to a comprehensive audience, including regulators and policymakers. Additionally, the focus remains on the pragmatic aspect: transitioning from research prototypes to tangible financial tools.

Dissemination Oversight by CG: The CG will act as the custodian of our dissemination activities. Their mandate will encompass ensuring that our output is not just communicated but will follow stringent standards. Resource optimization strategies include synchronizing Working Group discussions with standout conferences like the Computational and Financial Econometrics (CFE) and Computational Statistics (COMPSTAT) conferences. During these conferences, dedicated sessions will be chaired by COST members to amplify our research visibility.

Multi-Channel Engagement: Our strategy is to adopt a multi-channel approach for engagement. This involves: 1. A dedicated website; 2. Active social media channels like Facebook and Twitter; 3. Circulation of newsletters within academic and professional circles; 4. Prioritizing publications in prestigious journals; 5. Both virtual and in-person scientific discourses

Outreach: Leveraging the media contacts of select Action members, our outreach initiatives will be amplified to capture a broader public audience.

Exploitation Plan: The Action will generate results that can successfully be exploited academically and economically. Key elements of this plan include:

- **Commercialization:** Transitioning research prototypes into market-ready products.
- **Collaborations:** Engaging with industry leaders for potential partnerships or licensing deals.
- **Education:** Offering training programs and workshops based on our findings, catering to both academia and industry.
- **Policy Influence:** Using our research to inform and shape regulatory frameworks and policies
- **Repository Updates:** Ensuring that our database remains updated, reflecting the latest findings and innovations.

4. IMPLEMENTATION

4.1 COHERENCE AND EFFECTIVENESS OF THE WORK PLAN

4.1.1 DESCRIPTION OF WORKING GROUPS, TASKS AND ACTIVITIES

The work plan is divided into four specialised WGs and 18 tasks, for the 48-month duration, designed to ensure alignment with the research coordination and capacity-building objectives.

WG1: Data-driven processes

WG1 focuses on safeguarding data privacy, data protection, and ensuring fairness in finance. The interdisciplinary group lays the foundation for the other WGs and employs advanced methodologies such as differential privacy and federated learning to develop guidelines for data privacy and fairness.

T1. Develop Comprehensive Data Privacy Guidelines: Create a set of comprehensive data privacy guidelines tailored to the unique challenges of financial applications

T2. Fairness Models for Financial Algorithms: Develop fairness models and metrics designed for financial algorithms to mitigate biases and ensure equitable outcomes.

T3. Implementation of Federated Learning: Implement techniques to enable collaborative model training across distributed financial data sources while preserving data privacy.

WG2: Generative AI in Finance

WG2 is dedicated to enhancing portfolio optimization, risk management, and personalized financial advice through advanced Generative AI techniques. The group leverages recent Transformer Neural Networks to improve models for optimal portfolios, assessing risks, and detecting fraudulent activities.

T4. Advanced Portfolio Optimization: Develop advanced portfolio optimization models using Transformer Neural Networks to improve investment strategies and maximize returns.

T5. Enhanced Risk Assessment: Create advanced risk management models that leverage Generative AI to identify and assess financial risks in real-time.

T6. Personalized Financial Advice: Develop personalized financial advice models that consider investor preferences and financial goals, leading to tailored recommendations.

WG3: Explainable AI and Algorithmic Bias in Finance

WG3 will make AI models in finance more transparent and accountable while addressing algorithmic bias. The group pioneers the development of novel, non-perturbative XAI methods for financial data and Transformer Neural Networks. They also work on mitigation strategies for algorithmic bias.

T7. Scalable XAI Methods: Develop scalable XAI methods tailored for financial time series data, allowing stakeholders to understand AI-driven decisions.

T8. Transparent Transformer Neural Networks: Create transparent Transformer Neural Networks by devising interpretable architectures and visualization techniques.

T9. Algorithmic Bias Mitigation Strategies: Design and implement effective strategies for measuring and mitigating algorithmic bias in financial applications, ensuring fairness.

WG4: Sustainable Digital Finance

WG4 will advance sustainable digital finance through data-driven ESG measurement. The group employs Large Language Models to perform sentiment analysis, analyze news and reports, and develop real-time, data-driven ESG scoring models, contributing to sustainable finance.

T10. ESG Sentiment Analysis: Utilize Large Language Models to perform sentiment analysis on news articles, financial reports, and social media data to improve ESG factors.

T11. News and Reports Analysis: Develop algorithms for comprehensive analysis of news and financial reports to extract relevant ESG-related information.

T12. Real-time ESG Scoring Models: Build dynamic ESG scoring models that provide ongoing assessment and scoring of ESG performance for financial products and companies.

Overall Action Tasks:

T13. Cross-WG Collaboration: Foster collaboration and knowledge exchange among all WGs to ensure interdisciplinary insights using tools such as Git, Jira and Slack channels.

T14. Dissemination and Impact: Implement a comprehensive dissemination strategy to share research outcomes, engage with stakeholders, and maximize the impact of the Action.

T15. Ethical and Regulatory Compliance: Ensure all ethical guidelines and regulatory rules, in relation to data privacy, algorithmic fairness, and financial industry standards.

T16. Science Communication Plan: Develop and implement a science communication plan to disseminate the Action findings to both the scientific community and the general public.

T17. Quarterly CG meetings; T18. Annual MC meetings

4.1.2 DESCRIPTION OF DELIVERABLES AND TIMEFRAME

The Action's major deliverables and timeframe are designed to achieve the research coordination and capacity-building objectives effectively. These deliverables span a period of 48 months and will make impactful contributions to the areas of data privacy, generative AI, XAI, and sustainable digital finance.

Data-Driven Processes

D1: Data Privacy Guidelines for Financial Applications: A comprehensive report outlining best practices for data privacy in financial applications.

D2: Fairness Models for Financial Algorithms: Models and metrics to ensure fairness in algorithms.

D3: Federated Learning Implementation: A report on the techniques and protocols for implementing federated learning in financial applications.

Generative AI in Finance

D4: Advanced Portfolio Optimization Models: A document detailing advanced portfolio optimization techniques using Transformer Neural Networks.

D5: Enhanced Risk Assessment Models: Models and algorithms that leverage generative AI for real-time financial risk assessment.

D6: Personalized Financial Advice Models: Models that provide tailored financial advice.

Explainable AI and Algorithmic Bias in Finance

D7: Scalable XAI Methods: A report on scalable XAI methods tailored for financial time-series data.

D8: Transparent Transformer Neural Networks: Documentation and code for transparent and interpretable Transformer Neural Network architectures.

D9: Algorithmic Bias Mitigation Strategies: A report outlining strategies for measuring and mitigating algorithmic bias in financial applications.

Sustainable Digital Finance

D10: ESG Sentiment Analysis: Models and findings on sentiment analysis related to Environmental, Social, and Governance factors.

D11: News and Reports Analysis: Algorithms for analyzing news to extract ESG-related information.

D12: Real-Time ESG Scoring Models: A real-time scoring system for assessing the ESG performance.

Overall Action Deliverables

D13: Online Presence and Social Media: A website and LinkedIn, Facebook and Twitter accounts.

D14: Data Collection: 20 datasets to be used for research, publicly accessible.

D15: Publication Plan: A green open-access repository featuring 80 papers, and 4 special issues.

D16: Training Materials: Slides and video material from at least two PhD training schools per year.

D17: Research Proposals: Submission of at least 40 research proposals, both national and European.

D18: Award: An award for the best Young Researcher presentation at the annual MC meeting.

D19: Gender Balance Reports: Periodic reports tracking gender balance and other inclusivity metrics.

4.1.3 RISK ANALYSIS AND CONTINGENCY PLANS

<u>Description of the Risk</u>	<u>Contingency Measure</u>
<u>Risks for Research coordination objectives</u>	
Inconsistency in Data Privacy Regulations (RC1, RC6): The changing privacy regulations can introduce inconsistencies, making it difficult to create a unified framework for data privacy.	Monitor ongoing changes in regulations and maintain flexibility in the framework to adapt to new guidelines. Collaborate with legal advisors to ensure alignment with international standards.
Data Quality and Standardization (RC2): Poor data quality or lack of data standardization impacts the effectiveness of AI models.	Develop robust data validation and cleansing processes. Implement mechanisms for data governance to ensure data quality.
Limited Adoption of XAI Protocols (RC3, RC7) Non-adherence to standardized protocols for XAI by stakeholders and research communities may result in fragmented and non-scalable solutions.	Actively promote the protocols through webinars, publications, and partnerships with key stakeholders. Create incentives for the adoption of standardized practices
Inaccurate ESG Measurements (RC4, RC8) The rapidly evolving field of ESG can result in outdated or inaccurate measurements.	Regularly review and adapt methodologies to ensure they align with current ESG norms and standards.
Resource Portal Mismanagement (RC5): The shared resource portal can become disorganized or outdated, affecting all Working Groups.	Implement automated quality checks and periodic manual reviews to maintain the accuracy and relevance of shared resources.

Risks for Capacity building objectives	
Inadequate Stakeholder Participation (CB1, CB4): Lack of interest or participation from key stakeholders, such as legal experts or financial institutions, undermines the effectiveness of the joint agendas and stakeholder platforms.	Establish fallback collaborations with academic institutions and NGOs. Use incentives like whitepapers or industry reports to entice stakeholder participation.
Interdisciplinary Collaboration Challenges (CB2, CB6): Difficulties may arise in achieving interdisciplinary collaboration, given the diverse fields of ethics, data science, and finance.	Employ a dedicated interdisciplinary coordinator to facilitate communication and project management between various disciplines. Conduct regular interdisciplinary workshops.
Limited Engagement from Young Researchers (CB3): Low participation rates from young researchers may hinder capacity-building in the emerging field of federated learning.	Introduce mentorship programs and competitive grants targeted at young researchers to encourage their active participation.
Lack of Diversity and Inclusion (CB5) Failure to adequately involve under-represented genders and marginalized communities could result in a lack of diversity for XAI methods.	Create targeted outreach programs and provide scholarships or stipends to facilitate the inclusion of under-represented groups.
Insufficient Resources for Comprehensive Capacity-building (CB7): Resource constraints may hamper the achievement of overall action deliverables like training materials, publications, and gender balance reports.	Prioritize deliverables based on their impact and availability of resources. In the case of budget limitations, seek additional external funding through grants or partnerships.

4.1.4 GANTT DIAGRAM

	Year 1				Year 2				Year 3				Year 4			
Task/Activity	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
General Tasks																
Cross-WG Collaboration (T13)		x	D17			x		D14		x	D17			x	D14	
Dissemination, Impact (T14)			D13	x			D15	x			x	x		D15	x	x
Ethical Compliance (T15)				x				x				x				x
Communication Plan (T16)				x				x				x				x
Quarterly CG Meetings (T17)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Annual MC Meetings (T18)			x	D18			x				x	D18			x	
Activities																
STSMs			x				x	D14			x			D14	x	
VMGs				x	D14			x				x	D14			x
WG Meetings		x		x		x	D19	x		x	D19	x		x		x
Action Conferences				x	D14			x	D18			x	D14			
PhD Training Schools			x	D16			x	D14			x	D14	D16		x	
Special Issue				D15				x				D15				x
WG1: Data-driven processes																
Data Privacy Guidelines (T1)	x	x	x	x	D1										x	
Fairness Models (T2)					x	x	x	x	D2						x	
Federated Learning (T3)									x	x	x	x	D3		x	
WG2: Generative AI																
Portfolio Models (T4)	x	x	x	x	D4										x	
Risk Management Models (T5)					x	x	x	x	D5						x	
Personalized Models (T6)									x	x	x	x	D6		x	
WG3: XAI and Bias																
XAI Methods (T7)			x		x	x	x	x	D7							
Transparent Networks (T8)			x						x	x	x	x	D8			
Bias Mitigation (T9)			x									x	x	x	x	D9
WG4: Sustainable Finance																
ESG Sentiment Analysis (T10)			x		x	x	x	x	D10							
News Analysis (T11)			x						x	x	x	x	D11			
ESG Scoring Models (T12)			x									x	x	x	x	D12