EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY

Brussels, 24 March 2020

COST 033/20

DECISION

Subject: **Memorandum of Understanding for the implementation of the COST Action "Fintech and Artificial Intelligence in Finance - Towards a transparent financial industry" (FinAI) CA19130**

The COST Member Countries and/or the COST Cooperating State will find attached the Memorandum of Understanding for the COST Action Fintech and Artificial Intelligence in Finance - Towards a transparent financial industry approved by the Committee of Senior Officials through written procedure on 24 March 2020.

MEMORANDUM OF UNDERSTANDING

For the implementation of a COST Action designated as

COST Action CA19130
FINTECH AND ARTIFICIAL INTELLIGENCE IN FINANCE - TOWARDS A TRANSPARENT FINANCIAL INDUSTRY (FinAI)

The COST Member Countries and/or the COST Cooperating State, accepting the present Memorandum of Understanding (MoU) wish to undertake joint activities of mutual interest and declare their common intention to participate in the COST Action (the Action), referred to above and described in the Technical Annex of this MoU.

The Action will be carried out in accordance with the set of COST Implementation Rules approved by the Committee of Senior Officials (CSO), or any new document amending or replacing them:

a. "Rules for Participation in and Implementation of COST Activities" (COST 132/14 REV2);
b. "COST Action Proposal Submission, Evaluation, Selection and Approval" (COST 133/14 REV);
c. "COST Action Management, Monitoring and Final Assessment" (COST 134/14 REV2);
d. "COST International Cooperation and Specific Organisations Participation" (COST 135/14 REV).

The main aim and objective of the Action is to establish a large and interconnected community across academia, public institutions and industry focusing on Financial Technology and Artificial Intelligence, improving transparency in financial services, especially in and through FinTech, in financial modelling and investment performance evaluation. This will be achieved through the specific objectives detailed in the Technical Annex.

The economic dimension of the activities carried out under the Action has been estimated, on the basis of information available during the planning of the Action, at EUR 80 million in 2019.

The MoU will enter into force once at least seven (7) COST Member Countries and/or COST Cooperating State have accepted it, and the corresponding Management Committee Members have been appointed, as described in the CSO Decision COST 134/14 REV2.

The COST Action will start from the date of the first Management Committee meeting and shall be implemented for a period of four (4) years, unless an extension is approved by the CSO following the procedure described in the CSO Decision COST 134/14 REV2.

OVERVIEW

Summary
The financial sector is the largest user of digital technologies and a major driver in the digital transformation of the economy. Financial technology (FinTech) aims to both compete with and support the established financial industry in the delivery of financial services. Globally, more than $100 billion of investments have been made into FinTech companies and Artificial Intelligence (AI) since 2010, and continue growing substantially. In early 2018, the European Commission unveiled (a) their action plan for a more competitive and innovative financial market, and (b) an initiative on AI with the aim to harness the opportunities presented by technology-enabled innovations. Europe should become a global hub for FinTech, with the economy being able to benefit from the European Single Market.

The Action will investigate AI and Fintech from three different angles: Transparency in FinTech, Transparent versus Black Box Decision-Support Models in the Financial Industry and Transparency into Investment Product Performance for Clients. The Action will bridge the gap between academia, industry, the public and governmental organisations by working in an interdisciplinary way across Europe and focusing on innovation.

The key objectives are:

- to improve transparency of AI supported processes in the Fintech space
- to address the disparity between the proliferation in AI models within the financial industry for risk assessment and decision-making, and the limited insight the public has in its consequences by developing policy papers and methods to increase transparency
- to develop methods to scrutinize the quality of products, especially rule-based “smart beta” ones, across the asset management, banking and insurance industries.

Areas of Expertise Relevant for the Action	Keywords
● Economics and business: Finance ● Computer and Information Sciences: Machine learning algorithms ● Economics and business: Econometrics, statistical methods applied to economics ● Computer and Information Sciences: Artificial intelligence, intelligent systems, multi agent systems ● Mathematics: Statistics	● Artificial Intelligence ● Fintech ● Finance ● Transparency ● Financial Markets

Specific Objectives
To achieve the main objective described in this MoU, the following specific objectives shall be accomplished:

Research Coordination
● To develop blended approaches to evaluate innovative financial services and their providers, especially in the FinTech domain, building on Machine Learning methods, focussing on prediction (early warning) of operational fragility, fraudulent and illegal behaviour ranging from appropriation of loaned funds to money-laundering activities.
● The development of conceptual and methodological tools for establishing when black-box models are admissible and, to the extent possible, making them more transparent and/or replacing them with interpretable and explainable models.
● To receive input from regulators and practitioners' communities and to validate results with regard to increasing transparency of artificial intelligence applications.
● Pruning and improvement of the vast array of performance attribution models by contributing to the development of methodologies for reducing the false discovery rate in financial research and applied financial investment management.
● Disseminate to the public and share with regulators the results on investment product performance

evaluation.
● Creation of the first European platform comparing the out-of-sample performance of banks' investment products, insurance-linked investment products and asset management products available to the general public.

Capacity Building
● Create an excellent network of researchers in Europe with lasting collaboration beyond the lifetime of the Action.
● Bringing technological, quantitative and economic researchers together, to tackle future research that can only be done in an interdisciplinary setting, and getting actively involved in the blockchain and FinTech communities across Europe, to constantly monitor developments, get input and disseminate results.
● Bridging the gap between practitioners from the finance industry, academics and regulators by setting up a common knowledge exchange platform.
● Transfer knowledge in terms of expertise, scientific tools and human resources across the different disciplines and between academia and industry.
● Establish an inclusive community of researchers on methodological and technological themes in Machine Learning and Artificial Intelligence, to promote Early Career Investigators and increase their visibility.
● Overcome the siloing of research topics by country and achieve geographical and demographical diversity, with special attention to COST Inclusiveness Target countries.
● Prepare competitive European researchers for a fruitful career in an international environment through intensive use of Short Term Scientific Missions (STSM) and joint educational programs with industrial partners.
● Maximize the job opportunities for PhD students and Early Career Investigators.
● Disseminate the results of the Action's activities to the scientific community, European institutions and to the general public.
● Significantly improve the gender equality in the fields of the Action.

TECHNICAL ANNEX

1 S&T EXCELLENCE

1.1 SOUNDNESS OF THE CHALLENGE

1.1.1 DESCRIPTION OF THE STATE-OF-THE-ART

There will be three related themes in FinAI, each of which will be tackled by a working group (WG). The state of the art with respect to each of the three themes is described here below.

WG1 –Transparency in FinTech

Several emerging technologies have significant potential to change the financial system and industry. Examples of such technologies are those based on the blockchain, which essentially allows for secure decentralized book-keeping. A blockchain is a distributed database of hash coded records of all transactions or digital events that have occurred, shared among participating parties (De Filippi and Hassan, 2016). Each record in this database is verified by the participants through a majority consensus and, once confirmed, the transaction cannot be altered or deleted (see for e.g. Tasca and Hayes, 2016). Crypto currencies are one of the first applications. In the last decade, operating independently of central banks, they have massively grown in popularity and price, but the latter has also been very volatile. The financial industry is especially interested in asset tokenization to create liquidity and additional distribution channels for previously illiquid assets. In some European countries, large established companies offer custody and related services for tokenized assets, enabling access for institutional investors. Technological innovation, in parallel to a steep increase in the regulatory oversight of banks, has also promoted forms of disintermediation (diminished role of traditional financial intermediaries) and the rise of alternative financial intermediaries, such as crowdfunding and “peer-to-peer” (P2P) lending platforms. While these forms of FinTech credit still represent a small fraction of overall credit, they are growing very rapidly and account for a large share of activity in specific credit market segments.

These developments can lead to cheaper access to financial resources and investment opportunities but also less transparency in the financial system. While many acknowledge the potential benefits in terms of improving market efficiency (completing markets), regulators remain cautious. For example, a recent report by the Hong Kong Securities and Futures Commission warns that “as these arrangements and the parties involved operate online and may not be regulated, investors may be exposed to heightened risks of fraud”. The regulatory approach, however, varies greatly, including across Europe. For example, some regulators treat initial coin offerings (ICOs) as regulated securities, which improves their quality and reduces the risk of frauds, others simply warn investors of their risks.

WG2 – Transparent versus Black Box Decision-Support Models in the Financial Industry

Regulators do not accept non-transparent “black box” models developed for any aspect of risk exposure. For example, some AI approaches – typically based on machine learning techniques – have not yet received full acceptance by regulators even though they are successfully applied internally by banks. The resulting incentive towards model simplicity bears however some risks: 1) overly simplified models might not apply to the evaluation of some of the more complex modern financial products, creating an indirect and perhaps unintended barrier to financial innovation; 2) regulators and the public using overly simplified models might be left with inferior information about true risk exposures, including systemic risks. Additionally, while AI and machine learning tools hold the potential to improve risk management, they remain untested at addressing risk under shifting financial conditions because they have been only recently deployed.

A serious investment into transparent, interpretable and explainable AI in Finance is therefore urgently needed. Such research would encourage regulators to consider and apply more advanced AI-based models. Consequently, explainable artificial intelligence (XAI) is an emergent and very important research area. It not only aims at providing a rationale for model selection but also creates stability in model formulation, an important requirement for trust in models (Došilović et al. 2018, Biran et al. 2018).

WG3 – Transparency into Investment Product Performance for Clients

Active investment products collectively are often unable to offer outperformance relative to passive products like ETFs (Exchange Traded Funds), that are cheaper in terms of fees because they simply replicate broad market indices. Especially so-called "smart beta" strategies offered by banks have systematically underperformed. An empirical analysis of Suhonen et al. (2016) demonstrated an endemic “overfitting” of banks' investment strategies in their development phase and their significant underperformance after they go live. Lopez de Prado and Lewis (2018) attribute this effect to a "proliferation of false discoveries" about sources of investment performance and calls it "the greatest threat faced by finance as an industry and an academic discipline". Institutional investors use the experience and expertise of specialized investment consultant companies like Mercer, Willis Towers Watson and Siglo to assess potential investments, but private clients and smaller investors do not have access to this. Academic statistical publications offer methods to quantify the overfitting problem, but these methods require data about "failed trials" only available to the product vendors.

As a consequence of the ex-ante difficulty for investors to screen active investment managers and the ex-post underperformance of actively managed investment funds relative to passive investment strategies, the former have experienced a substantial outflow of assets under management in favour of the latter. This has led to a substantial reduction in expensive independent research activities, which only active funds can afford. Active managers publicly warn that this can result in a decrease in market efficiency.

1.1.2 DESCRIPTION OF THE CHALLENGE (MAIN AIM)

WG1 –Transparency in FinTech

A first point of concern with respect to blockchain applications in finance is that of fraudulent Initial Coin Offerings. International regulatory authorities have raised many concerns, particularly in the context of investor protection, suggesting that, in most cases, investors do not adequately understand the risk involved with ICOs. Although many legitimate start-ups use ICOs for the purpose of raising money, the market has seen many cases of fraudulent ICOs which in turn raises many concerns for investor protection and overall financial stability. If ICOs qualify as financial instruments, there are several existing European pieces of legislations which FinTechs need to comply with, including the Prospectus Directive, the Markets in Financial Instruments Directive (MiFID), the Alternative Investment Fund Managers Directive (AIFMD) and the Fourth Anti-Money Laundering Directive (European Securities and Markets Authority, 2017). Nevertheless, there are many contexts in which ICOs fall outside the scope of laws and regulations. The European Securities and Markets Authority has argued that the hype concerning ICOs, virtual currencies and blockchain technology can lead to speculative behaviour in which only very limited attention is paid to the underlying project and the risks associated with it.

Another cause of concern is that crypto assets allow for a multi-billion dollars global market of anonymous transactions, which is not subjected to supervision. Hence, its growth can create considerable challenges for market integrity, particularly coming from money laundering activities. Money laundering embraces all those operations to disguise the illicit origin of capital, to give it a semblance of legitimacy, and facilitate the subsequent reinvestment in the lawful economy.

In P2P lending, fraudulent behaviour by P2P platforms was recently shown to be a large-scale problem in China following a tightening of regulatory oversight, and might become (or might even be already) a problem elsewhere, including in Europe.

More generally, in many of the emerging market segments and activities commonly referred to as FinTech (seen as a sector of the financial industry), there is great need for transparency about fund flows, activities, intermediaries and risks. Lacking this transparency, the emerging sectors will not develop in full and there will be system-wide risks to financial stability and integrity.

WG2 – Transparent versus Black Box Models in the Financial Industry

Regulators need to ensure the transparency of rules and criteria used to judge the admissibility of decision algorithms employed by financial institutions, to avoid possible negative impact on the industry such as discrimination among market players.Thus, it is important that regulators and policy-makers have conceptual tools and research at their disposals to make quick and motivated decisions on how to regulate the use of data science techniques.

Additionally, while AI and ML tools hold potential to improve risk management, their recent deployment means that they remain untested at addressing risk under shifting financial conditions. Moreover, for more novel asset classes such as those comprising exposure to crypto-assets, the lack of long time series compounds the difficulty of understanding how a given model performs. Thus, it is important to develop methodologies to make inferences on model performance in unstable environments and in the absence of long time series (e.g., along the lines of Athey and Kuang (2018)).

Another point of concern is that black-box models can (inadvertently or otherwise) introduce biases in decision making within the financial industry that can have important discriminatory effects, as stressed by Kusner, M.; Loftus, C.; Russell, C. and Silva, R. (2017). For example, credit scoring models might discriminate based on race and socio-cultural characteristics that might be correlated but not have any direct causal link to individuals' creditworthiness.

WG3 – Transparency into Investment Product Performance for Clients

The investment challenge for clients is the decision between passively and actively managed products of both asset managers and banks. This decision however requires data and methods for evaluating investment performance, which give rise to an analytic and a data challenge, respectively.

Starting from the data challenge, this arises because judging the risk-adjusted performance of the products requires estimating their risk as well as their (expected) return. This requires long time series of returns on the products, otherwise valid statistical inferences on risk -adjusted performance would be impossible. This however poses a data availability problem because, while investment fund time series are widely available as their net asset values (NAVs) must be published with regular frequency, other financial products usually have a fixed expiry date and are invisible after their expiry. To circumvent this problem, the calculation of indices that replicate the payoffs of the products over time is required. This, in turn, requires long time series of data on prices of underlying assets and market conditions (risk factors), which must be collected and stored for each product. Some of the required information, such as execution costs for the implementation of the strategies underlying the products, is also not readily observable and must be modelled or otherwise inferred.

In terms of methodology, one key challenge is that the "failed trials" produced during the development process are not known to any other party who was not involved in this development process. In these situations, the analytical tools reviewed by Bailey and Lopez de Prado (2014), Bailey et al. (2015) and Lopez de Prado and Lewis (2018), among others, are not applicable. In contrast to the product development process in the pharmaceutical industry, there is also no regulation on how to set up a backtest, which also requires the choice of an appropriate benchmark, what data needs to be stored to ensure replicability, how to test parameter sensitivity and how to deal with failed trials. Hence, the analytic challenge is to provide industry and regulators with guidance on how to deal with these methodological issues and how formulate the necessary regulation, respectively.

Overall, the scientific challenge and main aim for this WG is thus to propose consistent and reliable methods, together with the necessary data, for choosing investment products ex-ante and evaluating ex-post their performance.

1.2 PROGRESS BEYOND THE STATE-OF-THE-ART

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

This Action will improve upon the state-of-the-art in all the three subfields of our research agenda.

WG1 –Transparency in FinTech

To increase transparency about both risks and opportunities, the WG will first assemble databases on the main FinTech activities, especially ICOs and by P2P lending. Regarding ICOs, the database will

contain data about past ICOs, their pre-ICO documentation and the post-ICO performance. The pre-ICO documentation will be obtained directly from issuers and the post-ICO performance data will be obtained from crypto exchanges, as well as from existing databases of specialized data providers. The database on crowdfunding/P2P platforms will include data on custodian and settlement arrangements and practices, on the governance structure and other features useful to predict fraudulent behaviour.

Based on these databases, criteria to evaluate ICOs and crowdfunding/P2P lending platforms will be identified using both quantitative and qualitative inputs and methods with different degree of formalization (e.g., from judgemental forecasting, drawing on the insight of experienced stakeholders, to formal ML classifiers). Insight from diverse sources of information and methods will be blended using and extending methodologies that rely on Bayesian learning (e.g., Figini and Giudici (2011)). In this setting, expert judgemental forecasting will be given more weight (as more useful/reliable) when available databases are small (e.g., short time series) whereas a quantitative rating approach using supervised learning methods will become increasingly informative as the databases grow.

The Action will also apply and extend text mining analytics methods that use network models to reduce the curse of dimensionality. For example, most recent statistics show that 99% of all ICOs use Telegram as a channel for interacting with communities of investors. By collecting data from the Telegram ICOs (including the corresponding white papers) and discussions on Telegram chats regarding the value and prospects of the projects in question, it will be possible to build, train and test supervised models to discriminate and classify ICOs by their probability of fraud.

Furthermore, the public availability of blockchain data makes it possible to apply network-based community detection models in the context of anti-money laundering (AML). These models exploit the transactional network topology for the purpose of identifying communities of users and, in particular, to identify communities of money launderers, using the transactions between them. The method that will be applied for money laundering detection is therefore a network cluster analysis algorithm that takes as inputs the set of users (“nodes” in network terminology) and the trades between users (“edges” or “links” in network terminology) (Foley et al., 2018). The output of the algorithm is an assignment of users to communities such that the “modularity” of the communities (density of links within communities and sparsity of links between communities) is maximized (Foley et al., 2018).

WG2 – Transparent versus Black Box Models in the Financial Industry

With regard to all three challenges faced by WG2 (listed in sub-section 1.1.2), key insight will come from research on the nexus between causality and prediction, which is currently being explored in pioneering literature at the cross-roads of econometrics and data science, such as the work of Victor Chernozhukov (e.g., Belloni et al. (2017)) and of Susan Athey and Guido Imbens (e.g., Athey (2017), Athey and Imbens (2019)). The Action will build on and expand this line of research, leveraging on the multidisciplinary nature of the network (economists and financial economists working alongside applied mathematicians, statisticians and computer scientists).

During this Action, the working group will develop prototypes to demonstrate the application of quantitative methods to improve transparency for the described "black box" models. The working group will also publish policy papers to suggest new regulation and guidelines for industry. The objective is to lower, to the extent possible, the barriers to use more advanced methods.

In addition, the work will also address the issues of limited data and small-sample problems that arise in situations when the events of interest occur infrequently (e.g., defaults, fraud, etc.), providing solutions that will augment existing methods used in the financial industry. The WG will employ methods drawn from econometrics and statistics to transparently quantify and, to the extent possible, alleviate the impact of this problem on inference and prediction for financial decision making. This can be done, for example, by explicitly modelling the probability of data unavailability (e.g., using penalized logistic regressions and/or censored regressions), or by using estimation methods that allow for missing data (unbalanced panel data models).

WG3 – Transparency into Investment Product Performance for Clients

First, this WG will address the data availability challenge. The WG will collect time series data on investment funds, insurance-linked investment products and banks' products, their underlying assets and relevant market conditions (risk factors). This will be done with the objective of directly estimate the risk-adjusted performance, whether directly or, when this will not possible (please see discussion of the challenge), by first calculating indices that replicate the payoffs of the products and estimating their

execution and liquidation costs over time. Some of the data will be directly collected from exchanges and websites and it will be possible to freely exchange it within the network. Other parts of the data will be protected by IP from data vendors. Therefore, a strategy to develop algorithms, distribute these within the working group and then run them on the de-centrally stored data will be developed.

Despite this data collection effort, the WG will face a limited data availability problem for some products and/or markets and performance attribution factors. To mitigate this problem, the WG will draw from methods developed by WG2 and contribute to their development.

Once the data availability challenge is addressed, the analytic challenge will be tackled. Researchers in the WG, like in many real-world settings, will not have access to the "failed trials" of the product developers, which implies that it will not be possible to apply the methods from the literature reviewed and systematized by Bailey and Lopez de Prado (2014), Bailey et al. (2015) and Lopez de Prado and Lewis (2018). A mitigation measure will be to simulate the development process of rule-based financial products by using generic versions of published factors and then to derive tweaked versions of these implementations until the performance characteristics of published backtested time series of real investment products are matched. The WG will work to automatize this "tweaking" process with machine learning approaches. The artificially generated "failed trials" then serve as input to use the published methodologies of Bailey and Lopez des Prado to quantify the "overfitting bias".

1.2.2 OBJECTIVES

1.2.2.1 Research Coordination Objectives

The main objectives of each of the three working group are as follows.

WG1 –Transparency in FinTech

The main objectives of the working group are the following:

- To develop blended approaches to evaluate innovative financial services and their providers, especially in the FinTech domain (primarily but not exclusively ICOs, P2P lending platforms and crowdfunding initiatives), building on machine learning methods for preemptive risk analysis and rating. The focus will be on prediction (early warning) of operational fragility, fraudulent and illegal behaviour ranging from appropriation of loaned funds (including through Ponzi-type schemes) to money-laundering activities. Pursuit of this objective will be assisted by compiling dedicated structured databases (as described in section 1.2.1) to support the large-scale application of the above- mentioned methods.

The long-term goal is to improve the quality and transparency of FinTech and of the digital assets space especially in Europe, to facilitate their growth in the interest of European investors and of the European economy more widely.

WG2 – Transparent versus Black Box Models in the Financial Industry

The main objectives of the working group are

- The development of conceptual and methodological tools for establishing when black-box models are admissible and, to the extent possible, making them more transparent and/or replacing them with interpretable and explainable models. This will require (i) the classification of algorithms from a range of disciplinary domains (especially ML, Econometrics) according to the predictability of the variables being modelled/forecast, (ii) the identification of methods for mapping results of black-box models to explainable and interpretable ones, at least ex-post, (iii) a better understanding of the conceptual and empirical nexus between identification of causality within models and the interpretability/explainability of the models.
- To receive input from regulators and practitioners' communities and to validate results with regard to increasing transparency of artificial intelligence applications.

WG3 – Transparency into Investment Product Performance for Clients

The main objectives of the working group are:

- Pruning and improvement of the vast array of performance attribution models by contributing to the development of methodologies for reducing the false discovery rate in financial research and applied financial investment management (long-term scientific impact)
- Creation of the first European platform comparing the out-of-sample performance of banks' investment products, insurance-linked investment products and asset management products available to the general public (industry impact).
- Disseminate to the public and share with regulators the results on investment product performance evaluation.

1.2.2.2 Capacity-building Objectives

The capacity-building aim of the three working groups is to offer an opportunity for researchers at different stages to collaborate and network with other researchers and practitioners from regulatory bodies and the financial industry. It is intended that all three working groups will develop into long- term stakeholder platforms, coordinating efforts to improve transparency of financial markets (especially FinTech activities) through AI. The precise objectives are:

- Create an excellent network of researchers in Europe with lasting collaboration beyond the lifetime the Action
- Bringing technological, quantitative and economic researchers together, to tackle future research that can only be done in an interdisciplinary setting, and getting actively involved in the blockchain and FinTech communities across Europe, to constantly monitor developments, get input and disseminate results
- Bridging the gap between practitioners from the finance industry, academics and regulators by setting up a common knowledge exchange platform
- Transfer knowledge in terms of expertise, scientific tools and human resources across the different disciplines and between academia and industry
- Establish an inclusive community of researchers on methodological and technological themes in Machine Learning and Artificial Intelligence, to promote Early Career Investigators and increase their visibility
- Overcome the 'siloing' of research topics by country and achieve geographical and demographical diversity, with a special attention to COST Inclusiveness Target countries
- Prepare competitive EU researchers for a fruitful career in an international environment through intensive use of Short Term Scientific Missions (STSM) and joint educational programs with industrial partners
- Maximize the job opportunities for PhD students and Early Career Investigators
- Disseminate the results of the Action activities to the scientific community, European institutions and to the general public
- Significantly improve the gender equality in the fields of the Action

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

This Action network is unique in its composition, through which it can actively achieve a wide scope in terms of research expertise and international and sectoral diversity, so that it can address Fintech in a way that can maximally benefit society and the European economy.

The main focus is the transparency of the new methods and of investment products, which is an under-researcher topic. There is no scientific network at the European level focussing on it. Compared to the ITN “Training for Big Data in Financial Research and Risk Management”, which explores the application of Data Science to financial decision making, this Action has a much broader scope. This is because the Action concerns itself with the overall financial industry and all its stakeholders in a very interdisciplinary setting rather than focussing only on investment and risk management. A further

difference is that the Action will explore the application of the entirety of data science methods in a financial domain, rather than only in settings involving big data. This is important because the novelty of recent data science methods also arises from the applicability to unconventional datasets (e.g., unstructured and mixed quantitative/qualitative data), which are not necessarily large. To some degree related to this Action is also the COST Action CA15109 European Cooperation for Statistics of Network Data Science (COSTNET) but it does not address financial industry issues specifically.

Very importantly, the European Commission has released a FinTech Action plan in March 2018 and a European initiative on Artificial Intelligence in April 2018. The Action aims, to address the issues and goals by the European Commission. In addition, there are important synergies between the Commission's Digital Single Market Strategy, the EU's cybersecurity strategy, the eIDAS Regulation and financial services initiatives such as the Consumer Financial Services Action Plan and the Capital Markets Union (CMU) mid-term Review. In February 2018, the EU has also launched the EU blockchain observatory and forum. It will highlight key developments of the blockchain technology, promote European actors and reinforce European engagement with multiple stakeholders involved in blockchain activities. The Action builds on these initiatives and contributes and is complementary to them.

2.2 ADDED VALUE OF NETWORKING IN IMPACT

2.2.1 SECURING THE CRITICAL MASS AND EXPERTISE

The core strength of the Action lies in its network, which has a diverse yet carefully calibrated composition both across disciplines and across sectors. In terms of disciplines, the team is balanced between Economics and Business, Computer and Information Sciences, and Mathematics. In addition, the Action benefits from participation of specialists in Electrical engineering, Electronic engineering, Information engineering and Financial Law. Many of the participants have themselves a multidisciplinary background. For example, many of the participants with a Finance background based at Business/Management schools or departments also have a legal and accounting background (as traditionally the case in Finance departments at Business Schools in many countries in continental Europe). Many of them work in departments alongside colleagues from Law (e.g., in Management and Law departments) and will be able to draw additional legal expertise (involving Law colleagues in the network) as needed.

In terms of sectors, the team includes participants from academia, industry and the public sector (legal and regulatory entities). Within industry, the partners are drawn from the financial sector and the ICT sector, and the majority are Small and Medium Size Enterprises (SMEs). Many of the network proposers (whether from academia or industry) are internationally recognized experts in their fields.

In forming the network, special attention has been paid to ensure that each node has critical mass to engage productively with the remaining nodes and exert 'gravitational pull' in the country and sector to which the node belongs. While there are no obvious gaps in the Action network in terms of expertise, sectoral and geographical exposure, the Action will actively seek to involve new members throughout its life. This can easily be achieved thanks to the open architecture of the Action, relying on the established connections to different stakeholder groups of the network proposers.

2.2.2 INVOLVEMENT OF STAKEHOLDERS

The Action will engage the following stakeholder groups:

- Researchers, scholars and experts from universities, research institutes and companies, both from within the core group of proposers and beyond, to carry out state-of-the-art research and provide world-class solutions
- Policy makers, regulatory and supervisory authorities at the EU, national and local level. They will be invited to participate in the network and take part to its events, including special joint workshops, to establish a mutually beneficial dialogue that can help improve the understanding and regulation of the Fintech sector
- Industry players, including
  - firms involved in credit risk modelling, financial software development and risk management
  - Fintech companies, with a special attention to Small and Medium-Sized Enterprises (SMEs), as providers of financial services related to FinTech, such as research, algorithm development, legal and financial consulting,

- banks, asset manager and insurance companies, to help the network identify the key problems they face and how they are impacted by the rise of FinTech.

They will be involved to allow them to exchange knowledge with academia and regulators and for the network to receive feedback on ongoing initiatives, findings and research

- NGOs, citizens engaged in science and citizen science organizations. They will be regularly involved and updated on the progress of the Action and its research output, which will be essential for the network to receive feedback on the deliverables, in terms of their public acceptance and level of understanding.

The consortium of participants for this Action is very large, not only geographically, but also in terms of disciplinary spread and type of stakeholders. Therefore, at the beginning of this Action, the Management Committee (MC henceforth) will prepare a detailed stakeholder engagement strategy which will be carefully maintained and updated on an annual basis, to ensure a high involvement of the most relevant stakeholders.

As part of the same strategy, from the beginning of FinAI and throughout its duration, the MC will identify the target stakeholder groups for which there are a lower number of initial participants and will prepare an engagement plan, which will be continuously updated and maintained to monitor progress, take corrective actions and identify new and upcoming relevant stakeholders. The objective will be to ensure that at any time the most relevant stakeholders are involved in FinAI as work group members and through participation in the different activities, such as workshops, industry days, conferences, etc. The overall stakeholder engagement strategy will be inter-disciplinary and strongly inclusive, complemented by fair gender balance, ensuring balanced involvement of stakeholders from different stakeholder groups from COST Member Countries, Near Neighbouring Countries and International Partner Countries . Though the geographical spread of our Action network is very broad, our engagement plan will also aim to extend it to the remaining European countries.

Researchers at universities and research institutes will be reached by established mechanisms such as papers in high impact, peer-reviewed international journals (open access journals), presentations at international conferences and workshops and "white papers" on best practice guidelines. Moreover, the Action intends to involve numerous Early Career Investigators (ECI) and provide them with networking and exchange opportunities. The goal is to facilitate the exchange of young researchers to give them access to senior researchers throughout the network, receive feedback on their research work, get involved in new cross-country projects and gain international visibility for their research. This will be done through a range of measures, including research visits and participation in conferences and workshops.

A high inclusion of industry members, including Fintech companies and investors, business angels, target incubators, innovation hubs and fintech districts, sand boxes, will be achieved by actively using the full range of available networking tools (e.g., workshops, conferences, brainstorming sessions, joint research and R&D projects, etc.) within the stakeholder engagement strategy.

Major policy makers at the EU, national and local level will be provided with policy briefs (position papers) on the key outcomes of our Action and their possible implications for society. Additionally, they will be invited to attend the major conferences organized within the Action. The Action will also have dedicated workshops, combining academia, industry and national and European authorities.

Our Action will also reach citizens and citizen science organizations through social media such as Facebook, Twitter and LinkedIn. Moreover, numerous articles will be published in the press and scientific magazines.

Involving stakeholders will be a top priority of the MC of this Action. Here below is an overview of the stakeholders' engagement by working group.

Degree of involvement of stakeholders by WG:

Stakeholders / WGs	**WG1**	**WG2**	**WG3**
Universities and research institutes	+++	+++	+++
Industry partners	++	+++	+++
Policy makers and regulators	++	+++	++
Citizens and citizen science organizations	+++	+	+++

Last but not least, the Action seeks to achieve the optimal gender balance among participants with the aim that 50% of the core group members will be female.

2.2.3 MUTUAL BENEFITS OF THE INVOLVEMENT OF SECONDARY PROPOSERS FROM NEAR NEIGHBOUR OR INTERNATIONAL PARTNER COUNTRIES OR INTERNATIONAL ORGANISATIONS

The secondary proposers and partners from near-neighbouring and international countries are important due to two reasons. The first one is that the financial industry is global in nature due to the mobility of capital in the current historical context and, therefore, research must have a global perspective as well as a concern for local circumstances. The second one is that research communities and the financial industry represented by nodes of the network at different locations specialize, at least to some extent, on different topics, which are all essential to the success of the Action. For the same reasons, the Action will further expand its international reach on an ongoing basis, exploiting its open architecture to include further partners from outside Europe, especially but not exclusively near neighbour ones, and international organizations.

3 IMPACT

3.1 IMPACT TO SCIENCE, SOCIETY AND COMPETITIVENESS, AND POTENTIAL FOR INNOVATION/BREAK-THROUGHS

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

The expected impacts from the project are both scientific and practical (with direct industry applicability) in nature.

Scientific impact – Short term

- Novel methodologies for classification and rating of FinTech activities, especially ICOs and crowdfunding/P2P lending platforms, and evaluation of both novel and existing methods with out-of-sample tests, including in cases in which limited data is available
- White papers with policy and methodological guidelines to bring transparency to currently intransparent financial market activities, especially at the intersection of FinTech and shadow banking
- New methods to compare the out-of-sample performance of rule-based investment products offered by asset managers, insurances and banks, relying on machine learning and AI
- Published results in edited volumes and top-tier peer-reviewed journal articles

Scientific impact – Long term:

- Foundation of new research centrers at universities across disciplines
- The capacity to guide future innovative research, thanks to a common scientific framework, coordinated research efforts, and pan-European dissemination
- The global leadership of the European Research Area on blended AI-aided methods for monitoring and enforcing transparency in financial markets

Socio-economic impact – Short term

Engagement of EU institutions, NGOs, Fintech startup disruptors and established financial service providers.

- Engagement of stakeholders at the local, regional, national, European levels and internationally. Network members have various existing contacts in these areas from earlier and ongoing projects; new ones will be added
- Training for EU institutions and NGOs that assist in analysing and evaluating the needs of European citizens as users of financial services and of the financial industry, focusing on transparency
- Short-Term-Scientific Missions (STSMs) and training schools that disseminate scientific skills and competencies and strengthen the networking capacity of ECIs and graduate students, enhancing their employability within and beyond academia.
- Dissemination among stakeholders of research results and practical tools for assessing and improving transparency of financial services

- Development and attraction of talents in research, in the financial industry and academia.

Socio-economic impact – Long term

- A common platform and European network for academics, industry and policy makers
- Raise political and social awareness of the need for transparent financial markets and FinTech
- Provide concept and tool that can help preserve the integrity of financial markets while allowing for financial innovation, especially the growth of innovative FinTech applications
- Contribute to economic development in Europe by promoting transparent and hence sustainable innovation, especially in the area of FinTech, that can help significantly complete financial markets
- Contribute towards the targets set in the white papers for the future of the European Digital
- Financial Market
- Improve the position of the European financial industry (both Fintech startup disruptors and traditional financial service providers) by improving their product quality and transparency

Technological impact – Short term:

- Open-source libraries for tackling transparency issues in the industry, that are accessible for researchers, industry practitioners and policy makers
- Rating tools accessible by regular citizens for better understanding the risks and rewards of relatively novel investment opportunities, such as initial coin offerings (ICOs) and P2P lending
- Rating tools accessible by regular citizens to compare investment products offered by asset managers, insurance companies and banks

Technological impact – Long term:

- Maintain Europe at the forefront of developments in both FinTech and AI
- Startup companies to develop and implement the innovations and results from the project
- Development of scalable software platforms accessible to more users based on the technical prototype tools

3.2 MEASURES TO MAXIMISE IMPACT

3.2.1 KNOWLEDGE CREATION, TRANSFER OF KNOWLEDGE AND CAREER DEVELOPMENT

The Action will actively reach industrial stakeholders by implementing an extensive dissemination plan. In particular, the Action's dissemination plan provides for regular meetings of Action's participants with industry practitioners. Numerous companies from the fields of finance, legal, finance and technology have confirmed their participation in research and knowledge-sharing activities of the Action. They will be reached mainly through invitations to organized conferences, workshops and regular meetings with industry, where they will have an opportunity to present their companies' profiles as direct participants of the Action.

The Action will have a dedicated Stakeholder Coordinator, responsible for managing the stakeholder's involvement. In collaboration with the Stakeholder Coordinator, the most appropriate MC members (considering the geographical location, institutional connections and field of work) will establish communication with members of selected stakeholders' groups, inviting them to participate in the Action.

Stakeholders will participate in international conferences, in particular in dedicated sessions for sharing expertise, identifying common challenges and requirements, and familiarizing stakeholders with early results of the Action. Stakeholders will cooperate and interact with each other in the Action via workshops, seminars and training schools. STSMs will be the means to connect different stakeholders. Through a regularly updated website and social profiles, as described below, a transparent and frequent dissemination of the Action's activities will facilitate informing current and potential stakeholders.

The Action will involve numerous Early Career Investigators (ECI) and provide them with networking and exchange opportunities through STSMs. Most participants supervise or co-operate with PhD candidates and post-doc researchers and the goal is to facilitate the exchange of young researchers including research stays abroad .

Within the first year of the start of the Action, a knowledge exchange and collaboration platform will be introduced, where the draft documents will be developed, and data and software will be shared.

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

The Action will appoint a dedicated Science Communication Manager. She/he will be asked to create a detailed dissemination and exploitation plan, which will be regularly updated. The Action will create its own graphical identity and interactive, mobile-friendly website within the first nine months, which will be the front-end of a platform for informing the general public, policy makers, citizen science organizations and companies about current activities and planned future activities. This platform will be distinct from the knowledge exchange and collaboration platform (see just above, in section 3.2.1) but the two platforms will be able to securely interact. A contact form will be available on the web-site to obtain feedback from the public. A mailing list will also be formed to inform the interested parties about new publications on the website and invitations for supported events participation.

FinAI will further increase its online presence by creating social network profiles to keep interested parties and the general public informed. ResearchGate, Twitter and LinkedIn will be initially targeted and after that, the presence will be increased on other social networks if needed. Representative materials such as posters, banners and others, will be created based on the graphical identity and will be provided to the participating institutions and partners to promote the Action.

Meetings with regulators will be held on a regular basis, in order to receive early feedback on the usefulness and feasibility of the methods, results and deliverables prior to their public release, and ensure the acceptance of the project by the regulators.

The Action will organize several workshops and conferences to present ongoing research activities and developments. Policy makers and industry practitioners will be invited to participate in the conferences and workshops and will be encouraged to give guest presentations and keynotes. For each event organized by the Action, the local media will be invited to cover the events and the local public will be informed about the Action goals, achievements and ongoing activities.

The Action will organize at least four public panel discussions and invite experts and policy makers from public institutions and industry, as well as academia, where feedback from the public will be obtained and the objectives of the Action will be discussed.

In addition to workshops, conferences and public panels, expert panel discussions will be organized with the purpose to summarize the findings, inputs and conclusions from all activities.

Each working group of the Action will publish a yearly report that will be available on the website of the Action. At the end of the Action a final report will contain the conclusions from the work done within the activities of the Action and give recommendations for further developments.

4 IMPLEMENTATION

4.1 COHERENCE AND EFFECTIVENESS OF THE WORK PLAN

4.1.1 DESCRIPTION OF WORKING GROUPS, TASKS AND ACTIVITIES

To accomplish the Action's objectives, three working groups (WGs) will be formed. Close cooperation and exchange of knowledge between the WGs will be essential. All three WGs will have the common goal of creating an attractive and transparent forum to engage with stakeholders, facilitate knowledge and experience sharing and stimulate reflection on transparency-related issues in financial markets. The research objectives of each WP have been described in section 1.2.2.1. The main tasks and activities are described below.

WG1 –Transparency in FinTech

Tasks:

- Review and extend/develop blended AI-aided models and methods to evaluate and rate innovative financial services and their providers, especially in the FinTech domain
- Compile appropriate databases to evaluate and implement the above criteria and methods
- Find solutions to data management and storage needs
- Interact with stakeholder to raise awareness of the research questions and discuss solutions
- Create a handbook or wiki page describing approaches to address transparency needs in
- FinTech by implementing/using insight from the research
- Monitor and analyse developments in the FinTech domain

Activities: WG meetings, joint-peer reviewed publications, specific workshops at major conferences, interdisciplinary workshops with industry partners and regulators, Action workshop, STSMs, Industry weeks, handbook, guidelines, best practices for transparent financial markets

WG2: Transparent versus Black Box Models in the Financial Industry

Tasks:

- Review the existing literature on AI (including machine learning) approaches as they are used in the finance industry and identify the most important applications
- Develop prototypes to demonstrate quantitative methods to improve transparency (including explainability and interpretability) of the "black-box" models or to provide alternatives
- Interact with stakeholders, in particular regulators, to raise awareness of the research questions and discuss potential solutions
- Develop a roadmap for including the results in European regulation and policies, in cooperation with regulators
- Publish policy papers to suggest new regulation
- Development of a handbook or wiki page describing the prototypes above

Activities: WG meetings, joint-peer reviewed publications and policy papers, specific workshops with the regulator and industry, Action workshop, STSMs

WG3: Transparency into Investment Product Performance for Clients

Tasks:

- Identify risk factors for ex-ante performance analysis (back-testing) and ex-post performance evaluation/attribution
- Create a database with data on the composition, underlying assets and relevant risk factors of investment products
- Develop and implement methodologies for ex-ante performance analysis (back-testing) and ex-post performance evaluation/attribution
- Set up the dialogue with regulators (through conferences, workshops and research collaboration) and citizen science organizations (through a forum and social media, including Linked-in and Twitter) to discuss the research results and gain feedback and further input
- Disseminate (including to investors) expertise on client-focused investment performance analysis through a dedicated website with resources for both advanced and less advanced users, including a handbook or wiki page describing the approaches for analysing the performance of investment products

Activities: WG meetings, joint-peer reviewed publications, specific workshops at major conferences with regulators and citizen science organizations, Action workshop, STSMs

4.1.2 DESCRIPTION OF DELIVERABLES AND TIMEFRAME

WG1: Transparency in FinTech

- A database which contains pre-ICO documentation and post-ICO performance (ROI and lifespan) (GANTT 4a)
- A database which contains data on crowdfunding/P2P platform features useful for rating platform integrity and predict fraud (GANTT 4a)
- Software (codes, packages) for evaluating/rating ICOs and crowdfunding/P2P platforms and for detection/early warning about fraud/illegal behaviour, with emphasis on the application of ML and other AI tools (GANTT 4a)
- Discussion papers (DP) on the methodology for evaluating/rating ICOs and crowdfunding/P2P platforms and for detection/early warning about fraud/illegal behaviour, with emphasis on the application of AI tools (GANTT 4b)
- A position paper and roadmap on mitigating risks connected with the increased use of digital assets (GANTT 4f)
- A handbook or wiki page describing potential approaches to tackle risk management issues related to blockchain assets and crowdfunding/P2P lending (GANTT 4e)

WG2: Transparent versus Black Box Models in the Financial Industry

- Software (codes, packages) to conduct robustness checks of ML models used by financial institutions, mostly for regulators and the industry (GANTT 4a)
- A discussion paper for possible approaches to building a statistically valid back-testing framework (GANTT 4b)
- Methodological discussion paper on the design of stress tests for the evaluation of AI and ML models under shifting financial conditions to improve the robustness of models (GANTT 4b)
- Position papers, aimed at regulators and policy-makers, on methodology (with examples of formal criteria) for testing AI techniques in real-time (GANTT 4f)

WG3: Transparency into Investment Product Performance for Clients

- An internal database of collected (scraped) financial time series from exchanges and regional consolidation platforms optimised for accessibility to all partners (GANTT 4a)
- Software (codes, packages) on simulation of “failed trials” and developed quantitative strategies (GANTT 4a)
- Methodological discussion papers on AI models to generate “failed trials” of investment product producers and on quantitative strategies with the usage of the promising field of network data analysis (GANTT 4b)

All WGs:

- Scientific peer-reviewed papers in top academic journals (GANTT 4b)
- Report on good examples and best practices for a transparent finance industry with guidelines to improve transparency (GANTT 4f)
- An edited volume containing scientific achievements of the Action (GANTT 4h)
- A stakeholder engagement strategy (GANTT 5d)
- Four annual reports (for lay audience) distributed via local and national media (GANTT 5f)

4.1.3 RISK ANALYSIS AND CONTINGENCY PLANS

The core team that includes the Action Chair and the WG leaders will closely monitor the progress of reaching the Action objectives and mitigate any risks to ensure timely provision of the deliverables. The following table shows the major identified risks and the corresponding mitigating Actions and contingency plans.

Risk description	Probability	Impact	Mitigating Action (1) / Contingency Plan (2)
Research not yielding expected results	Medium	High	(1.1) Increase cross-collaboration and communication (1.2) Re-align research targets (1.3) Increase the network, attract experts for particular research tasks (2) Redefine scope of research, onboard additional skill sets
Collaboration too sporadic because of geographical spread	Medium	Medium	(1.1) Set up (more) virtual communication channels, e.g. an online stream of workshops (1.2) Allocate more funds for STSMs (1.3) Set up knowledge exchange platform (online) (2) Reorganize work streams to be more geographically focused
Business partners too reluctant in onboarding and/or participation	High	Medium	(1.1) Redefine scope for potential business partners (1.2) More networking activities with a focus on industry partners (2) Drastically lower entrance hurdle for new business partners
Partners do not deliver	Medium	High	(1.1) Tools to track research input of all partners (1.2) Increase shared responsibility for every task (1.3) Involve MC to find solutions to increase the contribution of partners (2) Redundant skills are available in the network, substitute non- delivering partners
Limited involvement of Action members	Medium	Low	(1.1) Equip the Action with enough members so that no member is irreplaceable (1.2) Use advanced research collaboration tools (2) Elect and appoint new members for the under-covered positions
Lack of interest and involvement of regulatory bodies	Medium	Medium	(1.1) The importance of this Action is already acknowledged by policy makers and regulators. (1.2) Use the network to invite regulatory bodies from more countries (1.3) Increase focus on the regulatory applications of the research output (1.4) Organize dedicated knowledge-exchange sessions with regulators and industry (2) Formally invite regulators to Action events to increase interest and involvement
Gender imbalance	Low	Low	(1.1) Include female participants in core decisions and organization; reserve certain core functions to female participants (1.2) Re-allocate funds to increase and support the involvement of female researchers (2) Organize events and summer schools that have female researchers as target audience
Lack of involvement of European organisations	Low	High	(1.1) The MC will ensure the involvement of national policymakers (1.2) The Chair and Vice-Chair will have the responsibility to inform and involve EU level organisations (2) Formally invite European organisations to Action events to increase interest and involvement

4.1.4 GANTT DIAGRAM

Legend: ✓ contains a deliverable; × is a major event/once off activity and (blue) colouring denotes a protracted activity		**Year 1**				**Year 2**				**Year 3**				**Year 4**			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1	Traditional and social media outreach																
a	setup online infrastructure																
b	social media activity																
c	ResearchGate project activity																
d	newsletter		×		×		×		×		×		×		×		×
e	flyer				×				×				×				×
2	Action meetings and conferences																
a	kick-off meeting	×															
b	workshops and panel discussions		×		×		×		×		×		×		×		×
c	international conferences			×												×	
d	meetings with regulators					×					×					×	
e	synopsis meeting								×								×
f	MC meetings				×				×				×				×
3	Junior scientists' coaching																
a	ECI meetings				×				×				×				×
b	training schools			×				×				×				×	
4	Joint research																
a	databases and software								✓				✓				✓
b	joint research output (publications and DP)								✓				✓				✓
c	knowledge exchange platform																
d	STSM																
e	handbook on risk management of BCA												✓				
f	position papers and guidelines								✓				✓				✓
g	joint research grant applications								×				×				×
h	edited volume																✓
5	White papers and reports on FinAI development																
a	transparency of digital assets								×				×				
b	transparency vs black-box models in the FI								×				×				
c	transparency into investment products								×				×				
d	stakeholder engagement strategy		✓						×				×				
e	WG annual reports			×				×				×				×	
f	Action annual reports (for lay audience)				✓				✓				✓				✓

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