



FinTech HO2020 Project

Deliverable - D1.2 - Technical output

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Document Information

University of Pavia based on the material prepared during the duration of the project present the following deliverables. The main objective of the present is to integrate all project deliverables for the M1 - M30 Duration of the project (01.01.2010 - 31.06.2021). The deliverables are presented in order of Work Packages.

Deliverable information

WP NO.	WP1
DEL. REL. NO.	D1.2
DEL. NO.	D2
TITLE	Technical Output
DESCRIPTION	Integration of deliverables into a unique document.
NATURE	Document
EST. DEL. DATE	June 30 2021

Document information

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WRITTEN BY	UNIPV
APPROVED BY	PAOLO GIUDICI (PC)

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CHAPTER 1

WP1 - Management

1.1 D1.1 - Network Establishment

Deliverable information

WP NO.	WP1
DEL. REL.	D1.1
DEL. NO.	D1
TITLE	Network establishment
DESCRIPTION	Establishment of the FIN-TECH network and of the Advisory Board
NATURE	Report
EST. DEL. DATE	31 January 2019

Document information

DATE	7 March 2019
WRITTEN BY	Arianna Agosto (University of Pavia)
APPROVED BY	Paolo Giudici (University of Pavia)

Actions and achieved results

The aim of the FIN-TECH H2020 project is to build a **fintech risk management platform** which measures risks to make fintech innovations sustainable. The platform will provide shared risk management models that automatize compliance of Fintech companies (*RegTech*) and, at the same time, increase the efficiency of supervisory activities (*SupTech*).

This aim will be achieved creating a **knowledge exchange hub** which will eventually lead to a *European sandbox research laboratory* aimed at developing and testing fintech risk management models.

The knowledge exchange hub is based on a network that includes:

- i) 8 experts from *international regulators* (FSB, BIS, IMF, OECD, EBA, ESMA, EIOPA, ECB), who will prioritise fintech risk model research;
- ii) 24 research partners, who will develop fintech risk models, and discuss them with regulators and validators in *research workshops*;
- iii) the national supervisors of all 28 EU countries, who will provide feedback on the models in *suptech workshops*;
- iv) 6 European fintech hubs, whose fintechs will provide feedback on the models in *regtech workshops*;
- v) 10 *validators*: 5 European banks risk managers and 5 advisory board members, who will validate the developed models.

The activity of the knowledge exchange hub will take place according to the following structural flow:

1. **Research framework:** based on the regulators' priorities, all partners of the project will develop research papers on fintech risk management models and submit them to the research workpackage leaders (WP2, WP3, WP4), who decide, jointly with the project coordinator (leader of WP1 and WP5):
 - o to publish them in the FIN-TECH portal repository (in coordination with the WP6 leader) and/or to include them in the research workshops;
 - o to select them as *use-cases* to be inserted in the RegTech and SupTech workshops, to receive feedback and continuously improve, until the final validation.

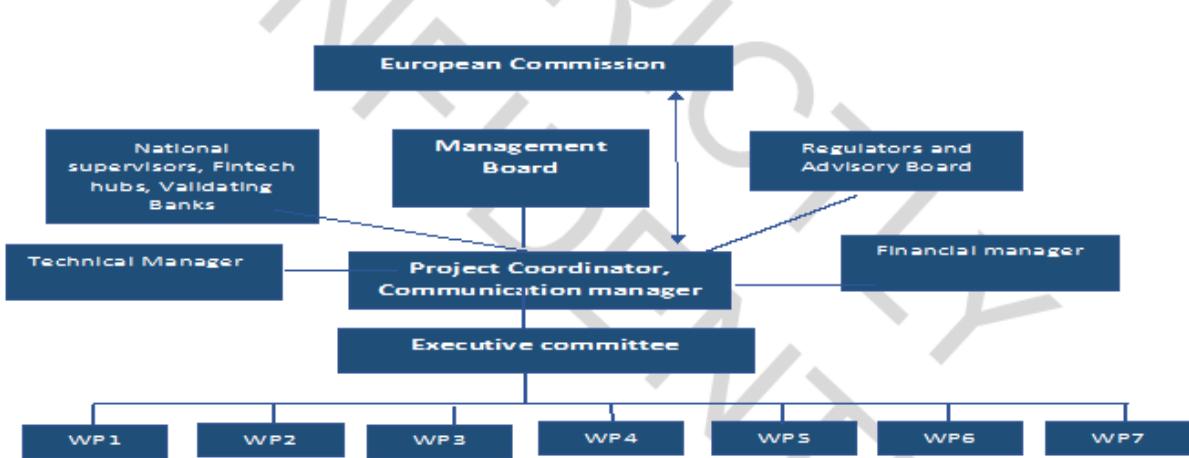
The research framework includes **six Research workshops** which all partners must attend. Three of them are horizontal on the three topics (Big data analytics, Artificial Intelligence and Blockchain

applications in finance), and are focused on the interaction with the international regulators; three of them are vertical and are focused on the interaction with the validators.

2. **Supervisory training framework:** each partner organises 3 *Suptech Workshops*, each of which consists of *16 hours of training* for the corresponding national supervisor, for a total of 48 hours. The contents of each suptech workshop must consist of slides drawn from the project's use-cases, plus personalised material. Collaborations between partners is encouraged, through cross-teaching and joint regional workshops.
 3. **Regulatory compliance framework:** the partners associated to a fintech hub organise **6 RegTech Workshops**, each of which consists of *6 hours of training*, for a total of 36 hours. In the regtech workshops, European fintechs can practically reproduce the proposed models, using the same slides presented in Suptech workshops, but in a hands-on-code-and data modality.
 4. **Validation framework:** the risk managers of the Banks that validate the project will be invited to participate in all RegTech workshops, and will prepare an intermediate and a final report. The Advisory board will also provide an overall evaluation report, based on all project's participation and feedback (collected in a repository organised by the WP7 leader).

Concerning the ***responsibility*** of the knowledge hub activities, each partner has precise tasks relative to the project workpackages which involve, in particular, the organisation of at least one suptech or regtech activity. Please refer to the attached document for a complete list of partners and responsibilities (slide 8-10, representing the *network map*) and for the workshop calendar (slide 11, containing the *event map*).

The **governance** of the FIN-TECH H2020 project is summarised in the figure below, in which nodes indicate stakeholders or workpackages, while edges indicate information flows between them.



From the Figure it is evident that the main governing body is the Management Board, which includes the representatives of all partners.

The Management Board interacts with the Coordinator, who is supported by a technical manager (for the project technical contents), by a financial manager (for the tasks related to financial reporting) and by a communication manager (for managing the relationships with the project's stakeholders). The interaction between the Management Board and the Coordinator is continuous. In addition, physical Management Board meetings are organized during the six research workshops, where all partners have to be present.

The Coordinator directly communicates with the Project Officer at the EC. He also interacts with the other stakeholders of the project: the international Regulators, the Advisory board members, the national Supervisors, the Fintech hubs and the Validating banks.

The Executive Committee includes the coordinator, the workpackage leaders and all responsible of Research workshops and Regtech activities, which are organized at a centralized European level. Its role is to

supervise the implementation of the project and the production of deliverables. The members of the Executive Committee are:

- Paolo Giudici, University of Pavia - Coordinator, WP1 and WP5
- Tomaso Aste, University College of London - WP2 and AI validation workshop
- Wolfgang Karl Härdle, Humboldt Berlin - WP3
- Christophe Henot, University of Paris 1 - WP4, RegTech 6 and Blockchain workshop
- Jochen Papenbrock, Firamis - WP6 and Reg-Tech 2
- Dave Remue, B-Hive - WP7 and Final Workshop
- Valentino Pediroda, MODEFINANCE – RegTech 1
- Joerg Osterrieder, ZHAW – RegTech 3 and Big data validation workshop
- Javier Arroyo, Complutense University of Madrid – RegTech 5
- Ronald Hochreiter, Vienna University of Economics and Business – RegTech 4
- Vasile Strat, Bucharest University – Mid-term workshop

Finally, a list of non-European expert advisors has been appointed for the external evaluation of the project, among those identified in the initial project proposal. The Advisory Board will receive all the deliverables of the project and all the received feedbacks, and will be invited to provide an independent overall evaluation. The members of the Advisory Board, who have confirmed their formal engagement with a written statement, are:

- Bihong Huang, Asian Development Bank (Japan)
- Shatha Qamhieh, Nablus University (Palestine)
- Gabriel Aparici, Central bank of Chile (Chile)
- Chen Ying, National University of Singapore (Singapore)
- Daniel Heller, Blockchain advisor (USA)

In addition to the above “formal” advisory board, one representative from all eight previously cited international regulators have accepted to “informally” act as advisor, by participating to the kick-off, midterm and final workshop, so as to give guidelines on which risk models to prioritise. The informal advisors are:

Jon Frost (FSB)
Leonardo Gambacorta (BIS)
Ashraf Khan (IMF)
Carlone Malcom (OECD)
Slavka Eley (EBA)
Patrick Armstrong (ESMA)
Andrea Lehtmets (EIOPA)
Giacomo Caviglia (ECB)

Attached documents

The attached document presents the project structure and workflow in more detail. The document has been shared by the Coordinator with all the partners, after the kick-off workshop of Pavia on February 1st 2019, during which an informal meeting of the WP leaders with the Project Officer took place. After discussion and feedback exchange, all partners have finally approved the proposal.



FIN-TECH
presentation_final.pdf

CHAPTER 2

WP2 - Big Data Analytics Research

2.1 D2.1 - Repository of research consortium papers (BDA)

Document Information

Deliverable information	
WP NO.	WP2
DEL. REL. NO.	D2.1
DEL. NO.	D4
TITLE	Repository of papers in big data analytics
DESCRIPTION	Repository of papers in big data analytics produced by consortium partners throughout the duration of the project.
NATURE	Document
EST. DEL. DATE	June 30 2021

Document information	
DATE	28/05/2021
WRITTEN BY	UNIPV and UBER
APPROVED BY	PAOLO GIUDICI

1

Repository of papers in big data analytics

The University of Pavia and the Humboldt University of Berlin , with the support of all the project partners, has developed the repository of papers related to Big Data Analytics. The repository contains all research papers outputted regarding big data analytics. The material has been developed by individual partners and by collaborations from within the consortium. The papers have been presented at various academic conferences and have been published in Open Access Journals or have been archived by the authors to maintain an open access copy in an Open Access Repository e.g. Arxiv, SSRN.

Specifically, the final repository contains the following information about the papers.

- Title
- Authors
- Abstract
- Partners
- Journal
- Date
- Link (doi for open access articles and also SSRN for those not open access)

Highlights

Financial technology (FinTech) solutions that employ Big Data analytics are being introduced at an extraordinary rate, particularly in credit markets, where peer-to-peer lending is emerging as a new financial service. While the application of big data analytics in peer to peer lending may reduce cost of lending, improve financial inclusion and improve user experience, it may also increase credit risks, caused by financial contagion between borrowers that derives from using a common platform.

The measurement of the additional source of credit risk due to platform contagion is of key interest to regulators and supervisors. The EU-funded FIN-TECH has developed research aimed at measuring such risk. Eleven papers have been selected for inclusion in the project's BDA research repository; three of them have been selected as use cases to be shared with regulators, supervisors, banks and fintechs. Among them, the paper "Network based scoring models to improve credit risk management in peer to peer lending platforms" has received the best feedback.

The main contribution of the paper is the proposition of a methodology based on correlation networks that can measure the contagion risk of a borrower, in terms of its network centrality, and add such risk to a classical default scoring model, based on logistic regression. The use case and the feedback from the project's stakeholders reveal that the proposed method is predictively accurate, robust, and interpretable. It can thus be suggested as a standard credit risk measurement practice for peer to peer lending applications.

Seven of the other papers selected for the project's research repository deal with the construction of credit scoring for peer to peer lending applications: employing neural network models, textual analysis, autoregressive models, spatial regression models, factor models, nearest neighbor models, ensemble models. Two papers examine the challenges and the future perspectives for peer to peer lending startups and markets, and one focuses on the broader issue of fintech risk management, from a supervisory viewpoint.

Title

Fintech Risk Management: A Research Challenge for Artificial Intelligence in Finance

Authors

Paolo Giudici

Extract

The Financial Stability Board (2017b) defines FINancial TECHnology as “technologically enabled financial innovations that could result in new business models, applications, processes, or products with an associated material effect on financial markets and institutions and on the provision of financial services.”

While innovation in finance is not a new concept, the focus on technological innovations and its pace have increased significantly. Fintech solutions that make use of big data analytics, artificial intelligence and blockchain technologies are currently introduced at an unprecedented rate. These new technologies are changing the nature of the financial industry, creating many opportunities that offer a more inclusive access to financial services. The advantages notwithstanding, FinTech solutions leave the door open to many risks, that may hamper consumer protection and financial stability. Relevant examples of such risks are underestimation of creditworthiness, market risk uncompliance, fraud detection, and cyber-attacks. Indeed fintech risk management represent a central point of interest for regulatory authorities, and require research and development of novel measurements.

Partners

- University of Pavia

Journal

Frontiers in Artificial Intelligence

Data

27 November 2018

Link

<https://doi.org/10.3389/frai.2018.00001>

Title

Latent factor models for credit scoring in P2P systems

Authors

Daniel Felix Ahelegbey, Paolo Giudici and Branka Hadji-Misheva

Abstract

Peer-to-Peer (P2P) FinTech platforms allow cost reduction and service improvement in credit lending. However, these improvements may come at the price of a worse credit risk measurement, and this can hamper lenders and endanger the stability of a financial system. We approach the problem of credit risk for Peer-to-Peer (P2P) systems by presenting a latent factor-based classification technique to divide the population into major network communities in order to estimate a more efficient logistic model. Given a number of attributes that capture firm performances in a financial system, we adopt a latent position model which allow us to distinguish between communities of connected and not-connected firms based on the spatial position of the latent factors. We show through empirical illustration that incorporating the latent factor-based classification of firms is particularly suitable as it improves the predictive performance of P2P scoring models.

Partners

- University of Pavia

Journal

Physica A: Statistical Mechanics and its Applications

Data

10 February 2019

Link

<https://doi.org/10.1016/j.physa.2019.01.130>

Title

Spatial Regression Models to Improve P2P Credit Risk Management

Authors

Arianna Agosto, Paolo Giudici and Tom Leach

Abstract

Calabrese et al. (2017) have shown how binary spatial regression models can be exploited to measure contagion effects in credit risk arising from bank failures. To illustrate their methodology, the authors have employed the Bank for International Settlements' data on flows between country banking systems. Here we apply a binary spatial regression model to measure contagion effects arising from corporate failures. To derive interconnectedness measures, we use the World Input-Output Trade (WIOT) statistics between economic sectors. Our application is based on a sample of 1,185 Italian companies. We provide evidence of high levels of contagion risk, which increases the individual credit risk of each company.

Partners

- University of Pavia

Journal

Frontiers in Artificial Intelligence

Data

16 May 2019

Link

<https://doi.org/10.3389/frai.2019.00006>

Title

Network Based Scoring Models to Improve Credit Risk Management in Peer to Peer Lending Platforms

Authors

Paolo Giudici, Branka Hadji-Misheva and Alessandro Spelta

Abstract

Financial intermediation has changed extensively over the course of the last two decades. One of the most significant change has been the emergence of FinTech. In the context of credit services, fintech peer to peer lenders have introduced many opportunities, among which improved speed, better customer experience, and reduced costs. However, peer-to-peer lending platforms lead to higher risks, among which higher credit risk: not owned by the lenders, and systemic risks: due to the high interconnectedness among borrowers generated by the platform. This calls for new and more accurate credit risk models to protect consumers and preserve financial stability. In this paper we propose to enhance credit risk accuracy of peer-to-peer platforms by leveraging topological information embedded into similarity networks, derived from borrowers' financial information. Topological coefficients describing borrowers' importance and community structures are employed as additional explanatory variables, leading to an improved predictive performance of credit scoring models.

Partners

- University of Pavia
- Zurich University of Applied Sciences

Journal

Frontiers in Artificial Intelligence

Data

24 May 2019

Link

<https://doi.org/10.3389/frai.2019.00003>

Title

On the Improvement of Default Forecast Through Textual Analysis

Authors

Paola Cerchiello and Roberta Scaramozzino

Abstract

Textual analysis is a widely used methodology in several research areas. In this paper we apply textual analysis to augment the conventional set of account defaults drivers with new text based variables. Through the employment of ad hoc dictionaries and distance measures we are able to classify each account transaction into qualitative macro-categories. The aim is to classify bank account users into different client profiles and verify whether they can act as effective predictors of default through supervised classification models.

Partners

- University of Pavia

Journal

Frontiers in Artificial Intelligence

Data

07 April 2020

Link

<https://doi.org/10.3389/frai.2020.00016>

Title

Peer-to-peer loan acceptance and default prediction with artificial intelligence

Authors

J. D. Turiel and T. Aste

Abstract

Logistic regression (LR) and support vector machine algorithms, together with linear and nonlinear deep neural networks (DNNs), are applied to lending data in order to replicate lender acceptance of loans and predict the likelihood of default of issued loans. A two-phase model is proposed; the first phase predicts loan rejection, while the second one predicts default risk for approved loans. LR was found to be the best performer for the first phase, with test set recall macro score of 77.4%. DNNs were applied to the second phase only, where they achieved best performance, with test set recall score of 72%, for defaults. This shows that artificial intelligence can improve current credit risk models reducing the default risk of issued loans by as much as 70%. The models were also applied to loans taken for small businesses alone. The first phase of the model performs significantly better when trained on the whole dataset. Instead, the second phase performs significantly better when trained on the small business subset. This suggests a potential discrepancy between how these loans are screened and how they should be analysed in terms of default prediction.

Partners

- University College London

Journal

Royal Society Open Science

Date of Publication

10 June 2020

Link

<https://doi.org/10.1098/rsos.191649>

Title

Default count-based network models for credit contagion

Authors

Arianna Agosto Daniel Felix Ahelegbey

Abstract

Interconnectedness between economic institution and sectors, already recognised as a trigger of the great financial crisis in 2008–2009, is assuming growing importance in financial systems. In this article, we study contagion effects between corporate sectors using financial network models, in which the significant links are identified through conditional independence testing. While the existing financial network literature is mostly focused on Gaussian processes, our approach is based on discrete data. We indeed test dependence in the conditional mean (and volatility) of default counts in different economic sector estimated from Poisson autoregressive models, and in their shocks. Our empirical application to Italian corporate defaults in the 1996–2018 period reveals evidence of a high inter-sector vulnerability, especially at the onset of the global financial crisis in 2008 and in the following years. Many contagion effects between corporate sectors are indeed found in the shock component of the default count dynamics.

Partners

- University of Pavia

Journal

Journal of the Operational Research Society

Date of Publication

22 June 2020

Link

<https://doi.org/10.1080/01605682.2020.1776169>

Title

Comparing Performance of Machine Learning Algorithms for Default Risk Prediction in Peer to Peer Lending

Authors

Yanka Aleksandrova

Abstract

The purpose of this research is to evaluate several popular machine learning algorithms for credit scoring for peer to peer lending. The dataset to fit the models is extracted from the official site of Lending Club. Several models have been implemented, including single classifiers (logistic regression, decision tree, multilayer perceptron), homogeneous ensembles (XGBoost, GBM, Random Forest) and heterogeneous ensemble classifiers like Stacked Ensembles. Results show that ensemble classifiers outperform single ones with Stacked Ensemble and XGBoost being the leaders.

Partners

University of Economics - Varna

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Journal

TEM Journal

Date of Publication

16 February 2021

Link

<https://doi.org/10.1016/j.najef.2020.101318>

Title

Will They Repay Their Debt? Identification of Borrowers Likely to Be Charged Off

Authors

Raluca Caplescu, Ana-Maria Panaite, Daniel Traian Pele, Vasile Alecsandru Strat

Abstract

Recent increase in P2P lending prompted for development of models to separate good and bad clients to mitigate risks both for lenders and for the platforms. The rapidly increasing body of literature provides several comparisons between various models. Among the most frequently employed ones are logistic regression, SVM, neural networks and decision tree-based ones. Among them, logistic regression has proved to be a strong candidate both because its good performance and due to its high explainability. The present paper aims to compare four pairs of models (for imbalanced and under-sampled data) meant to predict charged off clients by optimizing f1 score. We found that, if the data is balanced, Logistic Regression, both simple and with Stochastic Gradient Descent, outperforms LightGBM and K-Nearest Neighbors in optimizing f1 score. We chose this metric as it provides balance between the interests of the lenders and those of the platform. Loan term, DTI and number of accounts were found to be important positively related predictors of risk of charge off. At the other end of the spectrum, by far the strongest impact on charge off probability is that of the FICO score. The final number of features retained by the two models differs very much, because, although both models use Lasso for feature selection, Stochastic Gradient Descent Logistic Regression uses a stronger regularization. The analysis was performed using Python (numpy, pandas, sklearn and imblearn).

Partners

- Bucharest University

Journal

Management & Marketing

Date of Publication

29 August 2020

Link

<https://ssrn.com/abstract=3658606>

Title

Fin vs. tech: are trust and knowledge creation key ingredients in fintech start-up emergence and financing?

Authors

Theodor Florian Cojoianu, Gordon L. Clark, Andreas G. F. Hoepner, Vladimir Pažitka & Dariusz Wójcik

Abstract

We investigate how the emergence of fintech start-ups and their financing is shaped by regional knowledge creation and lack of trust in financial services incumbents across 21 OECD countries, 226 regions and over the 2007–2014 period. We find that knowledge generated in the IT sector is much more salient for fostering new fintech start-ups than knowledge generated in the financial services sector. Additionally, the importance of new knowledge created in the financial services sector (IT sector) increases (decreases) as fintech start-ups grow and seek financing. When the level of trust in financial services incumbents falls within a region, this is followed by an increase in the financing provided to fintech start-ups. Nevertheless, regions with historically low average levels of trust in financial services incumbents attract less fintech investment overall.

Partners

- University College Dublin

Journal

Small Business Economics

Date of Publication

13 June 2020

Link

<https://doi.org/10.1007/s11187-020-00367-3>

Title

Risk-return modelling in the p2p lending market: Trends, gaps, recommendations and future directions

Authors

Miller-Janny Ariza-Garzón; María-Del-Mar Camacho-Miñanoc; María-Jesús Segovia-Vargas; Javier Arroyo

Abstract

Peer-to-peer (P2P) lending is a market with significant growth in recent years. We review the academic literature published during the last decade on P2P lending to identify the main research trends and find potential gaps that limit stakeholders' use of research proposals. We perform both a bibliometric and systematic analysis. The bibliometric analysis will identify the most influential papers and the relationship and evolution of the main topics. In the systematic analysis, we categorized the documents according to methodological elements and business aspects. Remarkably, many proposals include artificial intelligence or machine learning algorithms. However, many of them lack a proper understanding of the application context, the definition of potential variables in a business framework, explainability, etc. Such elements should be recognized as essential elements to exploit their benefits. In this respect, we provide some recommendations and show future research directions.

Partners

- Universidad Complutense de Madrid

Journal

Electronic Commerce Research and Applications

Date of Publication

September–October 2021

Link

<https://doi.org/10.1016/j.elerap.2021.101079>

Annex - List of publications

Title	Authors	Journal	Keywords
Network Based Scoring Models to Improve Credit Risk Management in Peer to Peer Lending Platforms	Paolo Giudici, Branka Hadji-Misheva, Alessandro Spelta	Frontiers in Artificial Intelligence	Peer to peer lending, network based scoring models, credit risk management
Spatial Regression Models to Improve P2P Credit Risk Management	Arianna Agosto, Paolo Giudici, Tom Leach	Frontiers in Artificial Intelligence	Peer to peer lending, spatial regression models, credit risk management
Fintech Risk Management: A Research Challenge for Artificial Intelligence in Finance	Paolo Giudici	Frontiers in Artificial Intelligence	Fintech risk management, peer to peer lending, robot advisory
Will they repay their debt? Identification of borrowers likely to be charged off	Caplescu, RD., Panaite, AM., Pele, DT, Strat, VA.	Management & Marketing.	Peer to peer lending, KNN and LightGBM models, creditworthiness
Fin vs. tech: are trust and knowledge creation key ingredients in fintech start-up emergence and financing?	Theodor Florian Cojocanu, Gordon L. Clark, Andreas G. F. Hoepner, Vladimir Pažitka, Dariusz Wójcik	Small Business Economics	Fintech companies,, trust and knowledge, start-ups evolution
Peer-to-peer loan acceptance and default prediction with artificial intelligence	J. D. Turiel, T. Aste	Royal Society Open Science	Peer to peer lending, Machine learning models, loan acceptance and default prediction
On the Improvement of Default Forecast Through Textual Analysis	Paola Cerchiello, Roberta Scaramozzino	Frontiers in Artificial Intelligence	Peer to peer lending, textual analysis, credit worthiness
Latent factor models for credit scoring in P2P systems	Daniel Felix Ahelegbey, Paolo Giudici, Branka Hadji-Misheva	Physica A: Statistical Mechanics and its Applications	Peer-to-peer lending, scoring models, factor analysis models,
Default count-based network models for credit contagion	Arianna Agosto, Daniel Felix Ahelegbey	Journal of the Operational Research Society	Default prediction, financial network models, poisson autoregressive models

Comparing Performance of Machine Learning Algorithms for Default Risk Prediction in Peer to Peer Lending	Yanka Aleksandrova	TEM Journal	Peer to peer lending, Ensemble models, credit scoring
Risk-return modelling in the p2p lending market: Trends, gaps, recommendations and future directions	Miller-Janny Arizaga-Garzón, María-Del-Mar Camacho-Miñano, María-Jesús Segovia-Vargas, Javier Arroyo	Electronic Commerce Research and Applications	Peer to peer lending, risk-return modelling, future evolution

CHAPTER 3

WP3 - Artificial Intelligence Research

3.1 D3.1 - Repository of research consortium papers (AI)

Document Information

Deliverable information

WP NO.	WP3
DEL. REL. NO.	D3.1
DEL. NO.	D7
TITLE	Repository of papers in artificial intelligence
DESCRIPTION	Repository of papers in artificial intelligence produced by consortium partners throughout the duration of the project.
NATURE	Document
EST. DEL. DATE	June 30 2021

Document information

DATE	28/05/2021
WRITTEN BY	UCL and UNIPV
APPROVED BY	PAOLO GIUDICI (PC)

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Repository of papers in artificial intelligence

The University of Pavia and the University College of London as WP3 Leader, with the support of all the Consortium, has developed the repository of papers related to artificial intelligence under the WP3. The repository of all research papers outputted regarding artificial intelligence. The material has been developed by individual partners and by collaborations from within the consortium. The papers have been presented at various academic conferences and have been published in Open Access Journals or have been archived by the authors to maintain an open access copy in an Open Access Repository e.g. Arxiv, SSRN.

Specifically, the final repository contains the following information about the papers.

- Title
- Authors
- Abstract
- Partners
- Journal
- Date
- Link (doi for open access articles and also SSRN for those not open access)

Highlights

Financial technology (FinTech) solutions that employ Artificial Intelligence solutions are growing steadily, both in investment lending, driven by peer to peer lending, and in asset management, where robot advisory is emerging as a new financial service. While the application of machine learning methods and AI may reduce transaction costs, improve financial inclusion and improve user experience and risk profile matching, it may also increase financial risks, coming from the strong interconnections between investments and assets that derive from a common asset management platform.

The measurement of the additional source of financial risk due to platform contagion is of key interest to regulators and supervisors. The EU-funded FIN-TECH has developed research aimed at measuring this risk. Twelve papers have been selected for inclusion in the project's AI research repository; three of them have been selected as use cases to be shared with regulators, supervisors, banks and fintechs. Among them, the paper "Explainable machine learning in credit risk management in peer to peer lending platforms" has received the best feedback.

The main contribution of the paper is the proposition of a methodology based on clustered Shapley values which, applied to the predictions that derive from a complex machine learning model, make it explainable, in terms of the features that mostly determine each single prediction. The use case and the feedback from the project's stakeholder reveal that the proposed method is, at the same time, highly predictively accurate and interpretable. It can thus be suggested as a standard risk measurement practice in the application of machine learning models to finance.

Following the EU proposed regulation of AI, much research activity has been dedicated to the topic of building trustworthy and explainable AI models. Besides the best paper, six other propose explainable AI models: two for credit lending, three for asset management, and one proposed an alternative to the mainstream XAI model, based on the combination between Shapley values and Lorenz zonoids, which produces an easy to interpret normalised measure of explainability. The remaining five papers concern the construction of robot advisory models for asset management: respectively for bond markets, currency markets, financial markets, venture capital investments and digital investments.

Title

Assessment of Machine Learning Performance for Decision Support in Venture Capital Investments

Authors

Javier Arroyo; Francesco Corea; Guillermo Jimenez-Diaz; Juan A. Recio-Garcia

Abstract

The venture capital (VC) industry offers opportunities for investment in early-stage companies where uncertainty is very high. Unfortunately, the tools investors currently have available are not robust enough to reduce risk and help them managing uncertainty better. Machine learning data-driven approaches can bridge this gap, as they already do in the hedge fund industry. These approaches are now possible because data from thousands of companies over the world is available through platforms such as Crunchbase. Previous academic efforts have focused only on predicting two classes of exits, i.e., being acquired by other company or offering shares to the public, using only one or a few subsets of explanatory variables. These events are typically related to high returns, but also higher risk, making hard for a venture fund to get repeatable and sustainable returns. On the contrary, we will try to predict more possible outcomes including a subsequent funding round or the closure of the company using a large set of signals. In this way, our approach would provide VC investors with more information to set up a portfolio with lower risk that may eventually achieve higher returns than those based on finding unicorns (i.e., companies with a valuation higher than one billion dollars). We will analyze the performance of several machine learning methods in a dataset of over 120,000 early-stage companies in a realistic setting that tries to predict their progress in a 3-year time window. Results show that machine learning can support venture investors in their decision-making processes to find opportunities and better assessing the risk of potential investments.

Partners

- Universidad Complutense de Madrid

Journal

IEEE

Date of Publication

30 August 2019

Link

<https://doi.org/10.1109/ACCESS.2019.2938659>

Title

Sentiment Analysis of European Bonds 2016–2018

Authors

Peter Schwendner, Martin Schüle and Martin Hillebrand

Abstract

We revisit the discussion of market sentiment in European sovereign bonds using a correlation analysis toolkit based on influence networks and hierarchical clustering. We focus on three case studies of political interest. In the case of the 2016 Brexit referendum, the market showed negative correlations between core and periphery only in the week before the referendum. Before the French presidential elections in 2017, the French bond spread widened together with the estimated Le Pen election probability, but the position of French bonds in the correlation blocks did not weaken. In summer 2018, during the budget negotiations within the new Italian coalition, the Italian bonds reacted very sensitively to changing political messages but did not show contagion risk to Spain or Portugal for several months. The situation changed during the week from October 22 to 26, as a spillover pattern of negative sentiment also to the other peripheral countries emerged.

Partners

- Zurich University of Applied Sciences

Journal

Frontiers in Artificial Intelligence

Date of Publication

15 October 2019

Link

<https://doi.org/10.3389/frai.2019.00020>

Title

COVID-19 contagion and digital finance

Authors

Arianna Agosto & Paolo Giudici

Abstract

Digital finance is going to be heavily affected by the COVID-19 outbreak. We present a statistical model which can be employed to understand the contagion dynamics of the COVID-19, so that its impact on finance can possibly be anticipated, and digitally monitored. The model is a Poisson autoregression of the daily new observed cases, and considers both short-term and long-term dependence in the infections counts. Model results are presented for the observed time series of China, the first affected country, but can be easily reproduced for all countries.

Partners

- University of Pavia

Journal

Digital Finance

Date of Publication

11 May 2020

Link

<https://doi.org/10.1007/s42521-020-00021-3>

Title

Analysing Social Media Forums to Discover Potential Causes of Phasic Shifts in Cryptocurrency Price Series

Authors

Andrew Burnie, Emine Yilmaz and Tomaso Aste

Abstract

The recent extreme volatility in cryptocurrency prices occurred in the setting of popular social media forums devoted to the discussion of cryptocurrencies. We develop a framework that discovers potential causes of phasic shifts in the price movement captured by social media discussions. This draws on principles developed in healthcare epidemiology where, similarly, only observational data are available. Such causes may have a major, one-off effect, or recurring effects on the trend in the price series. We find a one-off effect of regulatory bans on bitcoin, the repeated effects of rival innovations on ether and the influence of technical traders, captured through discussion of market price, on both cryptocurrencies. The results for Bitcoin differ from Ethereum, which is consistent with the observed differences in the timing of the highest price and the price phases. This framework could be applied to a wide range of cryptocurrency price series where there exists a relevant social media text source. Identified causes with a recurring effect may have value in predictive modelling, whilst one-off causes may provide insight into unpredictable black swan events that can have a major impact on a system.

Partners

- University College London

Journal

Frontiers in Blockchain

Date of Publication

28 January 2020

Link

<https://doi.org/10.3389/fbloc.2020.00001>

Title

Network Models to Enhance Automated Cryptocurrency Portfolio Management

Authors

Paolo Giudici, Paolo Pagnottoni and Gloria Polinesi

Abstract

The usage of cryptocurrencies, together with that of financial automated consultancy, is widely spreading in the last few years. However, automated consultancy services are not yet exploiting the potentiality of this nascent market, which represents a class of innovative financial products that can be proposed by robo-advisors. For this reason, we propose a novel approach to build efficient portfolio allocation strategies involving volatile financial instruments, such as cryptocurrencies. In other words, we develop an extension of the traditional Markowitz model which combines Random Matrix Theory and network measures, in order to achieve portfolio weights enhancing portfolios' risk-return profiles. The results show that overall our model overperforms several competing alternatives, maintaining a relatively low level of risk.

Partners

- University of Pavia

Journal

Frontiers in Artificial Intelligence

Date of Publication

24 April 2020

Link

<https://doi.org/10.3389/frai.2020.00022>

Title

Shapley-Lorenz eXplainable Artificial Intelligence

Authors

Paolo Giudici and Emanuela Raffinetti

Abstract

Explainability of artificial intelligence methods has become a crucial issue, especially in the most regulated fields, such as health and finance. In this paper, we provide a global explainable AI method which is based on Lorenz decompositions, thus extending previous contributions based on variance decompositions. This allows the resulting Shapley-Lorenz decomposition to be more generally applicable, and provides a unifying variable importance criterion that combines predictive accuracy with explainability, using a normalised and easy to interpret metric. The proposed decomposition is illustrated within the context of a real financial problem: the prediction of bitcoin prices.

Partners

- University of Pavia

Journal

Expert Systems with Applications

Date of Publication

1 April 2021

Link

<https://doi.org/10.1016/j.eswa.2020.114104>

Title

Neural networks and arbitrage in the VIX

Authors

Joerg Osterrieder, Daniel Kucharczyk, Silas Rudolf and Daniel Wittwer

Abstract

The Chicago Board Options Exchange Volatility Index (VIX) is considered by many market participants as a common measure of market risk and investors' sentiment, representing the market's expectation of the 30-day-ahead looking implied volatility obtained from real-time prices of options on the S&P 500 index. While smaller deviations between implied and realized volatility are a well-known stylized fact of financial markets, large, time-varying differences are also frequently observed throughout the day. Furthermore, substantial deviations between the VIX and its futures might lead to arbitrage opportunities on the VIX market. Arbitrage is hard to exploit as the potential strategy to exploit it requires buying several hundred, mostly illiquid, out-of-the-money (put and call) options on the S&P 500 index. This paper discusses a novel approach to predicting the VIX on an intraday scale by using just a subset of the most liquid options. To the best of the authors' knowledge, this is the first paper, that describes a new methodology on how to predict the VIX (to potentially exploit arbitrage opportunities using VIX futures) using most recently developed machine learning models to intraday data of S&P 500 options and the VIX. The presented results are supposed to shed more light on the underlying dynamics in the options markets, help other investors to better understand the market and support regulators to investigate market inefficiencies.

Partners

- Zurich University of Applied Sciences

Journal

Digital Finance

Date of Publication

13 August 2020

Link

<https://doi.org/10.1007/s42521-020-00026-y>

Title

Explainability of a Machine Learning Granting Scoring Model in Peer-to-Peer Lending

Authors

Miller Janny Ariza-Garzón; Javier Arroyo; Antonio Caparrini; María-Jesús Segovia-Vargas

Abstract

Peer-to-peer (P2P) lending demands effective and explainable credit risk models. Typical machine learning algorithms offer high prediction performance, but most of them lack explanatory power. However, this deficiency can be solved with the help of the explainability tools proposed in the last few years, such as the SHAP values. In this work, we assess the well-known logistic regression model and several machine learning algorithms for granting scoring in P2P lending. The comparison reveals that the machine learning alternative is superior in terms of not only classification performance but also explainability. More precisely, the SHAP values reveal that machine learning algorithms can reflect dispersion, nonlinearity and structural breaks in the relationships between each feature and the target variable. Our results demonstrate that it is possible to have machine learning credit scoring models be both accurate and transparent. Such models provide the trust that the industry, regulators and end-users demand in P2P lending and may lead to a wider adoption of machine learning in this and other risk assessment applications where explainability is required.

Partners

- Universidad Complutense de Madrid

Journal

IEEE

Date of Publication

30 March 2020

Link

<https://doi.org/10.1109/ACCESS.2020.2984412>

Title

Explainable Machine Learning in Credit Risk Management

Authors

Niklas Bussmann, Paolo Giudici, Dimitri Marinelli and Jochen Papenbrock

Abstract

The paper proposes an explainable Artificial Intelligence model that can be used in credit risk management and, in particular, in measuring the risks that arise when credit is borrowed employing peer to peer lending platforms. The model applies correlation networks to Shapley values so that Artificial Intelligence predictions are grouped according to the similarity in the underlying explanations. The empirical analysis of 15,000 small and medium companies asking for credit reveals that both risky and not risky borrowers can be grouped according to a set of similar financial characteristics, which can be employed to explain their credit score and, therefore, to predict their future behaviour.

Partners

- University of Pavia
- Firamis

Journal

Computational Economics

Date of Publication

25 September 2020

Link

<https://doi.org/10.1007/s10614-020-10042-0>

Title

Predictability and pricing efficiency in forward and spot, developed and emerging currency markets

Authors

Valerio Potì, Richard Levich, Thomas Conlon

Abstract

We study the predictability of forward and spot exchange rates of currencies of emerging and developed economies from 1994 to 2016. Our purpose is to shed light on the efficiency of currency markets and how and why it has evolved over this time. For the currencies of emerging economies, our analysis of rates of return on forward contracts finds some evidence of excess-predictability, especially in the earlier parts of the sample period, consistent with the view that this portion of the foreign exchange market has only become efficient in recent times. When we turn our attention to excess-returns computed from spot exchange rates and spot interest rates, however, we find much less predictability. In particular, over our full sample period, we find no evidence of excess-predictability, in contrast with the results reported by Hsu et al. (2016) but in agreement with Kuang et al. (2014). The different predictability of spot excess-returns and rates of return on forward contracts is a manifestation of the widespread violation of covered interest parity which emerged with the onset of the 2008 financial crisis.

Partners

- University College Dublin

Journal

Journal of International Money and Finance

Date of Publication

October 2020

Link

<https://doi.org/10.1016/j.jimonfin.2020.102223>

Title

Significance, relevance and explainability in the machine learning age: an econometrics and financial data science perspective

Authors

Andreas G. F. Hoepner, David McMillan, Andrew Vivian & Chardin Wese Simen

Abstract

Although machine learning is frequently associated with neural networks, it also comprises econometric regression approaches and other statistical techniques whose accuracy enhances with increasing observation. What constitutes high quality machine learning is yet unclear though. Proponents of deep learning (i.e. neural networks) value computational efficiency over human interpretability and tolerate the ‘black box’ appeal of their algorithms, whereas proponents of explainable artificial intelligence (xai) employ traceable ‘white box’ methods (e.g. regressions) to enhance explainability to human decision makers. We extend Brooks et al.’s [2019. ‘Financial Data Science: The Birth of a New Financial Research Paradigm Complementing Econometrics?’ European Journal of Finance 25 (17): 1627–36.] work on significance and relevance as assessment critieria in econometrics and financial data science to contribute to this debate. Specifically, we identify explainability as the Achilles heel of classic machine learning approaches such as neural networks, which are not fully replicable, lack transparency and traceability and therefore do not permit any attempts to establish causal inference. We conclude by suggesting routes for future research to advance the design and efficiency of ‘white box’ algorithms.

Partners

- University College Dublin

Journal

The European Journal of Finance

Date of Publication

03 Dec 2020

Link

<https://doi.org/10.1080/1351847X.2020.1847725>

Title

Interpretable Machine Learning for Diversified Portfolio Construction

Authors

Markus Jaeger, Stephan Krügel, Dimitri Marinelli, Jochen Papenbrock and Peter Schwendner

Abstract

In this article, the authors construct a pipeline to benchmark hierarchical risk parity (HRP) relative to equal risk contribution (ERC) as examples of diversification strategies allocating to liquid multi-asset futures markets with dynamic leverage (volatility target). The authors use interpretable machine learning concepts (explainable AI) to compare the robustness of the strategies and to back out implicit rules for decision-making. The empirical dataset consists of 17 equity index, government bond, and commodity futures markets across 20 years. The two strategies are back tested for the empirical dataset and for about 100,000 bootstrapped datasets. XGBoost is used to regress the Calmar ratio spread between the two strategies against features of the bootstrapped datasets. Compared to ERC, HRP shows higher Calmar ratios and better matches the volatility target. Using Shapley values, the Calmar ratio spread can be attributed especially to univariate drawdown measures of the asset classes.

Partners

- Firamis
- ZHAW

Journal

Journal of Financial Data Science

Date of Publication

August 2021

Link

<https://doi.org/10.3905/jfds.2021.1.066>

Title

Matrix Evolutions: Synthetic Correlations and Explainable Machine Learning for Constructing Robust Investment Portfolios

Authors

Jochen Papenbrock, Peter Schwendner, Markus Jaeger and Stephan Krügel

Abstract

In this article, the authors present a novel and highly flexible concept to simulate correlation matrixes of financial markets. It produces realistic outcomes regarding stylized facts of empirical correlation matrixes and requires no asset return input data. The matrix generation is based on a multiobjective evolutionary algorithm, so the authors call the approach matrix evolutions. It is suitable for parallel implementation and can be accelerated by graphics processing units and quantum-inspired algorithms. The approach is useful for backtesting, pricing, and hedging correlation-dependent investment strategies and financial products. Its potential is demonstrated in a machine learning case study for robust portfolio construction in a multi-asset universe: An explainable machine learning program links the synthetic matrixes to the portfolio volatility spread of hierarchical risk parity versus equal risk contribution.

Partners

- Firamis
- ZHAW

Journal

Journal of Financial Data Science

Date of Publication

April 2021

Link

<https://doi.org/10.3905/jfds.2021.1.056>

Title

Evaluation of multi-asset investment strategies with digital assets

Authors

Alla Petukhina Erin Sprünken

Abstract

The drastic growth of the cryptocurrencies market capitalization boosts investigation of their diversification benefits in portfolio construction. In this paper with a set of classical and modern measurement tools, we assess the out-of-sample performance of eight portfolio allocation strategies relative to the naive $1/N$ rule applied to traditional and crypto-assets investment universe. Evaluated strategies include a range from classical Markowitz rule to the recently introduced LIBRO approach (Trimborn et al. in Journal of Financial Econometrics 1–27, 2019). Furthermore, we also compare three extensions for strategies with respect to input estimators applied. The results show that in the presence of alternative assets, such as cryptocurrencies, mean–variance strategies underperform the benchmark portfolio. In contrast, CVaR optimization tends to outperform the benchmark as well as geometric optimization, although we find a strong dependence of the former’s success on trading costs. Furthermore, we find evidence that liquidity-bounded strategies tend to perform very well. Thus, our findings underscore the non-normal distribution of returns and the necessity to control for liquidity constraints at alternative asset markets.

Partners

- Humboldt University Berlin

Journal

Digital Finance

Date of Publication

4 April 2021

Link

<https://doi.org/10.1007/s42521-021-00031-9>

Annex List of publications

Title	Authors	Journal	Keywords
Sentiment Analysis of European Bonds 2016–2018	Peter Schwendner, Martin Schüle, Martin Hillebrand	Frontiers in Artificial Intelligence	Bond market models, Correlation network models, Machine learning econometrics
Explainability of a Machine Learning Granting Scoring Model in Peer-to-Peer Lending	Miller Janny Ariza-Garzon, Javier Arroyo, Antonio Caparrini, Maria-Jesus Segovia-Vargas	IEEE Access	Explainable AI, credit scoring, lending decisions
Assessment of Machine Learning Performance for Decision Support in Venture Capital Investments	Javier Arroyo, Francesco Corea, Guillermo Jimenez-Diaz, Juan A. Recio-Garcia	IEEE Access	Investment models, machine learning models, predictive accuracy
Explainable Machine Learning in Credit Risk Management	Niklas Bussmann, Paolo Giudici, Dimitri Marinelli, Jochen Papenbrock	Computational Economics	Explainable AI, peer to peer lending, clustering models
COVID-19 contagion and digital finance	Arianna Agosto, Paolo Giudici	Digital Finance	Financial market models, covid-19 contagion, predictive models
Significance, relevance and explainability in the machine learning age: an econometrics and financial data science perspective	Andreas G. F. Hoepner, David McMillan, Andrew Vivian, Chardin Wese Simen	The European Journal of Finance	Financial market models, Machine learning models, econometric models
Neural networks and arbitrage in the VIX	Joerg Osterrieder, Daniel Kucharczyk, Silas Rudolf, Daniel Wittwer	Digital Finance	Financial market models, Neural networks, volatility models
Shapley-Lorenz eXplainable Artificial Intelligence	Paolo Giudici, Emanuela Raffinetti	Expert Systems with Applications	Explainable AI, Shapley method, Rank-based performance
Interpretable Machine Learning for Diversified Portfolio Construction	Markus Jaeger, Stephan Krügel, Dimitri Marinelli, Jochen Papenbrock, Peter Schwendner	The Journal of Financial Data Science	Explainable AI, portfolio allocation, machine learning models

CHAPTER 4

WP4 - Blockchain Research

4.1 D4.1 - Repository of research consortium papers (BC)

Document Information

Deliverable information

WP NO.	WP4
DEL. REL. NO.	D4.1
DEL. NO.	D10
TITLE	Repository of research consortium papers (BC)
DESCRIPTION	Repository of papers in blockchain produced by consortium partners throughout the duration of the project.
NATURE	Document
EST. DEL. DATE	June 30 2021

Document information

DATE	28/05/2021
WRITTEN BY	UP1 and UNIPV
APPROVED BY	PAOLO GIUDICI (PC)

1

Repository of papers in blockchain

The University of Pavia and the University of Paris I Pantheon-Sorbonne, with the support of all the project partners, has developed the repository of papers related to blockchain. The repository all research papers outputted regarding blockchain. The material has been developed by individual partners and by collaborations from within the consortium. The papers have been presented at various academic conferences and have been published in Open Access Journals or have been archived by the authors to maintain an open access copy in an Open Access Repository e.g. Arxiv, SSRN.

Specifically, the final repository contains the following information about the papers.

- Title
- Authors
- Abstract
- Partners
- Journal
- Date
- Link (doi for open access articles and also SSRN for those not open access)

Highlights

Financial technology (FinTech) solutions that employ the Blockchain are spreading rapidly, particularly in payment tools such as crypto coins and stable coins, which are also being used as financial assets. While the application of the Blockchain to payments may reduce transaction fees and improve financial inclusion, it may also increase operational risks, such as cyber risk and fraud risk, and increase financial risks, when coins are used as financial assets, in consideration of their high volatility.

The measurement of the additional types of risk that derive from the application of the blockchain are of key interest to regulators and supervisors. The EU-funded FINTECH has developed research aimed at measuring this risk. Seventeen papers have been selected for inclusion in the project's Blockchain research repository; six of them have been selected as use cases to be shared with regulators, supervisors, banks and fintechs. Among them, the paper "Initial Coin Offerings: risk or opportunity" has received the best feedback.

The main contribution of the paper is the proposition of a methodology based on natural language processing, sentiment analysis and regression models, aimed at understanding from telegram chats and other web based information which initial coin offerings are likely to be fraudulent. The use case and the feedback from the project's stakeholder reveal that the proposed method is, both predictively accurate and interpretable. It can thus be suggested as a standard risk measurement practice to measure risks deriving from the application of the blockchain to finance. Another possible standard is suggested from another paper in the repository which shows how to measure cyber risk, in the realistic situation of data available only at the ordinal level, for non disclosure issues.

The impact of the blockchain on financial services much depends on its regulation, which is evolving and, therefore, determine changes in research priorities. For this reason the papers in the blockchain repository cover different topics. The most investigated one concerns the measurement of financial risk that derives from considering crypto coins as assets and, in particular, the measurement of the contagion risk between coin prices (two papers) or between exchange markets (three papers). Another important stream of research has concerned the impact of news and sentiment on crypto prices (three papers). A different paper proposes a classification model to understand whether crypto coins can indeed be considered as alternative assets. Two papers have considered how to build optimal portfolio allocations for crypto coins considered as financial assets. Another one suggests the construction of a stable coin based on a basket of currencies, based on similar portfolio allocation considerations. While most papers deal with the application of the blockchain to crypto coins, three are more general and concern the operations of a blockchain. One paper estimates the duration of bitcoin mining, putting it in relation with the cost of energy. Other two papers consider the topic of designing a blockchain application that respects privacy and preserves digital identity.

Title

Can Cryptocurrencies Preserve Privacy and Comply With Regulations?

Authors

Geoff Goodell and Tomaso Aste

Abstract

Cryptocurrencies offer an alternative to traditional methods of electronic value exchange, promising anonymous, cash-like electronic transfers, but in practice they fall short for several key reasons. We consider the false choice between total surveillance, as represented by banking as currently implemented by institutions, and impenetrable lawlessness, as represented by privacy-enhancing cryptocurrencies as currently deployed. We identify a range of alternatives between those two extremes, and we consider two potential compromise approaches that offer both the auditability required for regulators and the anonymity required for users.

Partners

- University College London

Journal

Frontiers in Blockchain

Date of Publication

28 May 2019

Link

<https://doi.org/10.3389/fbloc.2019.00004>

Title

High Frequency Price Change Spillovers in Bitcoin Markets

Authors

Paolo Giudici and Paolo Pagnottoni

Abstract

The study of connectedness is key to assess spillover effects and identify lead-lag relationships among market exchanges trading the same asset. By means of an extension of Diebold and Yilmaz (2012) econometric connectedness measures, we examined the relationships of five major Bitcoin exchange platforms during two periods of main interest: the 2017 surge in prices and the 2018 decline. We concluded that Bitfinex and Gemini are leading exchanges in terms of return spillover transmission during the analyzed time-frame, while Bittrexs act as a follower. We also found that connectedness of overall returns fell substantially right before the Bitcoin price hype, whereas it leveled out during the period the down market period. We confirmed that the results are robust with regards to the modeling strategies.

Partners

- University of Pavia

Journal

Risks

Date of Publication

1 November 2019

Link

<https://doi.org/10.3390/risks7040111>

Title

A Decentralized Digital Identity Architecture

Authors

Geoff Goodell and Tomaso Aste

Abstract

Current architectures to validate, certify, and manage identity are based on centralized, top-down approaches that rely on trusted authorities and third-party operators. We approach the problem of digital identity starting from a human rights perspective, with a primary focus on identity systems in the developed world. We assert that individual persons must be allowed to manage their personal information in a multitude of different ways in different contexts and that to do so, each individual must be able to create multiple unrelated identities. Therefore, we first define a set of fundamental constraints that digital identity systems must satisfy to preserve and promote privacy as required for individual autonomy. With these constraints in mind, we then propose a decentralized, standards-based approach, using a combination of distributed ledger technology and thoughtful regulation, to facilitate many-to-many relationships among providers of key services. Our proposal for digital identity differs from others in its approach to trust in that we do not seek to bind credentials to each other or to a mutually trusted authority to achieve strong non-transferability. Because the system does not implicitly encourage its users to maintain a single aggregated identity that can potentially be constrained or reconstructed against their interests, individuals and organizations are free to embrace the system and share in its benefits.

Partners

- University College London

Journal

Frontiers in Blockchain

Date of Publication

05 November 2019

Link

<https://doi.org/10.3389/fbloc.2019.00017>

Title

Lead Behaviour in Bitcoin Markets

Authors

Ying Chen, Paolo Giudici, Branka Hadji Misheva and Simon Trimborn

Abstract

We aim to understand the dynamics of Bitcoin blockchain trading volumes and, specifically, how different trading groups, in different geographic areas, interact with each other. To achieve this aim, we propose an extended Vector Autoregressive model, aimed at explaining the evolution of trading volumes, both in time and in space. The extension is based on network models, which improve pure autoregressive models, introducing a contemporaneous contagion component that describes contagion effects between trading volumes. Our empirical findings show that transactions activities in bitcoins is dominated by groups of network participants in Europe and in the United States, consistent with the expectation that market interactions primarily take place in developed economies.

Partners

- University of Pavia
- Zurich University of Applied Sciences

Journal

Risks

Date of Publication

4 January 2020

Link

<https://doi.org/10.3390/risks8010004>

Title

Crypto price discovery through correlation networks

Authors

Paolo Giudici, Gloria Polinesi

Abstract

We aim to understand the dynamics of crypto asset prices and, specifically, how price information is transmitted among different bitcoin market exchanges, and between bitcoin markets and traditional ones. To this aim, we hierarchically cluster bitcoin prices from different exchanges, as well as classic assets, by enriching the correlation based minimum spanning tree method with a preliminary filtering method based on the random matrix approach. Our main empirical findings are that: (i) bitcoin exchange prices are positively related with each other and, among them, the largest exchanges, such as Bitstamp, drive the prices; (ii) bitcoin exchange prices are not affected by classic asset prices, but their volatilities are, with a negative and lagged effect.

Partners

- University of Pavia

Journal

Annals of Operations Research

Date of Publication

29 May 2019

Link

<https://doi.org/10.1007/s10479-019-03282-3>

Title

Cryptocurrency market structure: connecting emotions and economics

Authors

Tomaso Aste

Abstract

I study the dependency and causality structure of the cryptocurrency market investigating collective movements of both prices and social sentiment related to almost two thousand cryptocurrencies traded during the first six months of 2018. This is the first study of the whole cryptocurrency market structure. It introduces several rigorous innovative methodologies applicable to this and to several other complex systems where a large number of variables interact in a non-linear way, which is a distinctive feature of the digital economy. The analysis of the dependency structure reveals that prices are significantly correlated with sentiment. The major, most capitalised cryptocurrencies, such as bitcoin, have a central role in the price correlation network but only a marginal role in the sentiment network and in the network describing the interactions between the two. The study of the causality structure reveals a causality network that is consistently related with the correlation structures and shows that both prices cause sentiment and sentiment cause prices across currencies with the latter being stronger in size but smaller in number of significative interactions. Overall this study uncovers a complex and rich structure of interrelations where prices and sentiment influence each other both instantaneously and with lead-lag causal relations. A major finding is that minor currencies, with small capitalisation, play a crucial role in shaping the overall dependency and causality structure. Despite the high level of noise and the short time-series I verified that these networks are significant with all links statistically validated and with a structural organisation consistently reproduced across all networks.

Partners

- University College London

Journal

Digital Finance

Date of Publication

24 April 2019

Link

<https://doi.org/10.1007/s42521-019-00008-9>

Title

Analysing Social Media Forums to Discover Potential Causes of Phasic Shifts in Cryptocurrency Price Series

Authors

Andrew Burnie, Emine Yilmaz and Tomaso Aste

Abstract

The recent extreme volatility in cryptocurrency prices occurred in the setting of popular social media forums devoted to the discussion of cryptocurrencies. We develop a framework that discovers potential causes of phasic shifts in the price movement captured by social media discussions. This draws on principles developed in healthcare epidemiology where, similarly, only observational data are available. Such causes may have a major, one-off effect, or recurring effects on the trend in the price series. We find a one-off effect of regulatory bans on bitcoin, the repeated effects of rival innovations on ether and the influence of technical traders, captured through discussion of market price, on both cryptocurrencies. The results for Bitcoin differ from Ethereum, which is consistent with the observed differences in the timing of the highest price and the price phases. This framework could be applied to a wide range of cryptocurrency price series where there exists a relevant social media text source. Identified causes with a recurring effect may have value in predictive modelling, whilst one-off causes may provide insight into unpredictable black swan events that can have a major impact on a system.

Partners

- University College London

Journal

Frontiers in Blockchain

Date of Publication

28 January 2020

Link

<https://doi.org/10.3389/fbloc.2020.00001>

Title

Initial Coin Offerings: Risk or Opportunity?

Authors

Anca Mirela Toma and Paola Cerchiello

Abstract

Initial coin offerings (ICOs) are one of the several by-products in the world of the cryptocurrencies. Start-ups and existing businesses are turning to alternative sources of capital as opposed to classical channels like banks or venture capitalists. They can offer the inner value of their business by selling “tokens,” i.e., units of the chosen cryptocurrency, like a regular firm would do by means of an IPO. The investors, of course, hope for an increase in the value of the token in the short term, provided a solid and valid business idea typically described by the ICO issuers in a white paper. However, fraudulent activities perpetrated by unscrupulous actors are frequent and it would be crucial to highlight in advance clear signs of illegal money raising. In this paper, we employ statistical approaches to detect what characteristics of ICOs are significantly related to fraudulent behavior. We leverage a number of different variables like: entrepreneurial skills, Telegram chats, and relative sentiment for each ICO, type of business, issuing country, team characteristics. Through logistic regression, multinomial logistic regression, and text analysis, we are able to shed light on the riskiest ICOs.

Partners

- University of Pavia

Journal

Frontiers in Artificial Intelligence

Date of Publication

16 April 2020

Link

<https://doi.org/10.3389/frai.2020.00018>

Title

Rise of the machines? Intraday high-frequency trading patterns of cryptocurrencies

Authors

Alla A. Petukhina, Raphael C. G. Reule & Wolfgang Karl Härdle

Abstract

This research analyses high-frequency data of the cryptocurrency market in regards to intraday trading patterns related to algorithmic trading and its impact on the European cryptocurrency market. We study trading quantitatives such as returns, traded volumes, volatility periodicity, and provide summary statistics of return correlations to CRIX (CRyptocurrency IndeX), as well as respective overall high-frequency based market statistics with respect to temporal aspects. Our results provide mandatory insight into a market, where the grand scale employment of automated trading algorithms and the extremely rapid execution of trades might seem to be a standard based on media reports. Our findings on intraday momentum of trading patterns lead to a new quantitative view on approaching the predictability of economic value in this new digital market.

Partners

- Humboldt-Universität zu Berlin

Journal

The European Journal of Finance

Date of Publication

27 July 2020

Link

<https://doi.org/10.1080/1351847X.2020.1789684>

Title

The Cost of Bitcoin Mining Has Never Really Increased

Authors

Yo-Der Song and Tomaso Aste

Abstract

The Bitcoin network is burning a large amount of energy for mining. In this paper, we estimate the lower bound for the global mining energy cost for a period of 10 years from 2010 to 2020, taking into account changes in energy costs, improvements in hashing technologies and hashing activity. We estimate energy cost for Bitcoin mining using two methods: Brent Crude oil prices as a global standard and regional industrial electricity prices weighted by the share of hashing activity. Despite a 10-billion-fold increase in hashing activity and a 10-million-fold increase in total energy consumption, we find the cost relative to the volume of transactions has not increased nor decreased since 2010. This is consistent with the perspective that, in order to keep the Blockchain system secure from double spending attacks, the proof of work must cost a sizable fraction of the value that can be transferred through the network. We estimate that in the Bitcoin network this fraction is of the order of 1%.

Partners

- University College London

Journal

Frontiers in Blockchain

Date of Publication

22 October 2020

Link

<https://doi.org/10.3389/fbloc.2020.565497>

Title

Cyber risk ordering with rank-based statistical models

Authors

Paolo Giudici & Emanuela Raffinetti

Abstract

In a world that is increasingly connected on-line, cyber risks become critical. Cyber risk management is very difficult, as cyber loss data are typically not disclosed. To mitigate the reputational risks associated with their disclosure, loss data may be collected in terms of ordered severity levels. However, to date, there are no risk models for ordinal cyber data. We fill the gap, proposing a rank-based statistical model aimed at predicting the severity levels of cyber risks. The application of our approach to a real-world case shows that the proposed models are, while statistically sound, simple to implement and interpret.

Partners

- University of Pavia

Journal

AStA Advances in Statistical Analysis

Date of Publication

09 December 2020

Link

<https://doi.org/10.1007/s10182-020-00387-0>

Title

Libra or Librae? Basket based stablecoins to mitigate foreign exchange volatility spillovers

Authors

Paolo Giudici, Thomas Leach, Paolo Pagnuttoni

Abstract

The paper aims to assess, from an empirical viewpoint, the advantages of a stablecoin whose value is derived from a basket of underlying currencies, against a stablecoin which is pegged to the value of one major currency, such as the dollar. To this aim, we first find the optimal weights of the currencies that can comprise our basket. We then employ volatility spillover decomposition methods to understand which foreign currency mostly drives the others. We then look at how the stability of either stablecoin is affected by currency shocks by means of spillover networks built on VAR models. Our empirical findings show that our basket based stablecoin is less volatile than all single currencies. This result is fundamental for policy making, and especially for emerging markets with a high level of remittances: a Librae (basket based stablecoin) can preserve their value during turbulent times better than a Libra (single currency based stablecoin).

Partners

- University of Pavia

Journal

Finance Research Letters

Date of Publication

8 April 2021

Link

<https://doi.org/10.1016/j.frl.2021.102054>

Title

Key Roles of Crypto-Exchanges in Generating Arbitrage Opportunities

Authors

Audrius Kabašinskas and Kristina Šutienė

Abstract

The evolving crypto-currency market is seen as dynamic, segmented, and inefficient, coupled with a lack of regulatory oversight, which together becomes conducive to observing the arbitrage. In this context, a crypto-network is designed using bid/ask data among 20 crypto-exchanges over a 2-year period. The graph theory technique is employed to describe the network and, more importantly, to determine the key roles of crypto-exchanges in generating arbitrage opportunities by estimating relevant network centrality measures. Based on the proposed arbitrage ratio, Gatecoin, Coinfloor, and Bitsane are estimated as the best exchanges to initiate arbitrage, while EXMO and DSX are the best places to close it. Furthermore, by means of canonical correlation analysis, we revealed that higher volatility and the decreasing price of dominating crypto-currencies and CRIX index signal bring about a more likely arbitrage appearance in the market. The findings of research include pre-tax and after-tax arbitrage opportunities.

Partners

- Kaunas University of Technology

Journal

Entropy

Date of Publication

12 April 2021

Link

<https://doi.org/10.3390/e23040455>

Title

Investing with cryptocurrencies – evaluating their potential for portfolio allocation strategies

Authors

Alla Petukhina, Simon Trimborn, Wolfgang Karl Härdle & Hermann Elendner

Abstract

Cryptocurrencies (CCs) have risen rapidly in market capitalization over the past years. Despite striking volatility, their high average returns and low correlations have established CCs as alternative investment assets for portfolio and risk management. We investigate the benefits of adding CCs to well-diversified portfolios of conventional financial assets for different types of investors, including risk-averse, return-maximizing and diversification-seeking investors who may trade at different frequencies, namely, daily, weekly or monthly. We calculate out-of-sample performance and diversification benefits for the most popular portfolio-construction rules, including mean-variance optimization, risk-parity, and maximum-diversification strategies, as well as combined strategies. Our results demonstrate that CCs can improve the risk-return profile of portfolios, but their benefit depends on investor objectives. In particular, diversification strategies (maximizing the portfolio diversification index or equating risk contributions) draw appreciably on CCs and show, in line with spanning tests, CCs to be non-redundant extensions of the investment universe. However, when we introduce liquidity constraints via the LIBRO method to account for illiquidity of many CCs, out-of-sample performance drops considerably, while the diversification benefits persist. We conclude that the utility of CC investments strongly depends on investor characteristics.

Partners

- Humboldt-Universität zu Berlin

Journal

Quantitative Finance

Date of Publication

13 April 2021

Link

<https://doi.org/10.1080/14697688.2021.1880023>

Title

Information-theoretic measures for nonlinear causality detection: application to social media sentiment and cryptocurrency prices

Authors

Z. Keskin and T. Aste

Abstract

Information transfer between time series is calculated using the asymmetric information-theoretic measure known as transfer entropy. Geweke's autoregressive formulation of Granger causality is used to compute linear transfer entropy, and Schreiber's general, non-parametric, information-theoretic formulation is used to quantify nonlinear transfer entropy. We first validate these measures against synthetic data. Then we apply these measures to detect statistical causality between social sentiment changes and cryptocurrency returns. We validate results by performing permutation tests by shuffling the time series, and calculate the Z-score. We also investigate different approaches for partitioning in non-parametric density estimation which can improve the significance. Using these techniques on sentiment and price data over a 48-month period to August 2018, for four major cryptocurrencies, namely bitcoin (BTC), ripple (XRP), litecoin (LTC) and ethereum (ETH), we detect significant information transfer, on hourly timescales, with greater net information transfer from sentiment to price for XRP and LTC, and instead from price to sentiment for BTC and ETH. We report the scale of nonlinear statistical causality to be an order of magnitude larger than the linear case.

Partners

- University College London

Journal

Royal Society Open Science

Date of Publication

16 September 2020

Link

<https://doi.org/10.1098/rsos.200863>

Title

Are cryptos becoming alternative assets?

Authors

Daniel Traian Pele, Niels Wesselhofft, Wolfgang Karl Härdle, Michalis Kolossiatis Yannis G. Yatracos

Abstract

This research provides insights for the separation of cryptocurrencies from other assets. Using dimensionality reduction techniques, we show that most of the variation among cryptocurrencies, stocks, exchange rates, commodities, bonds, and real estate indexes can be explained by the tail, memory and moment factors of their log-returns. By applying various classification methods, cryptocurrencies are categorized as a separate asset class, mainly due to the tail factor. The main result is the complete separation of cryptocurrencies from the other asset types, using the Maximum Variance Components Split method. Additionally, we show that cryptocurrencies tend to exhibit similar characteristics over time and become more distinguished from other asset classes (synchronous evolution).

Partners

- Humboldt University Berlin
- ASE Bucharest

Journal

The European Journal of Finance

Date of Publication

21 August 2021

Link

<https://doi.org/10.1080/1351847X.2021.1960403>

Title

Network Models to Enhance Automated Cryptocurrency Portfolio Management

Authors

Paolo Giudici, Gloria Polinesi, Paolo Pagnottoni

Abstract

The usage of cryptocurrencies, together with that of financial automated consultancy, is widely spreading in the last few years. However, automated consultancy services are not yet exploiting the potentiality of this nascent market, which represents a class of innovative financial products that can be proposed by robo-advisors. For this reason, we propose a novel approach to build efficient portfolio allocation strategies involving volatile financial instruments, such as cryptocurrencies. In other words, we develop an extension of the traditional Markowitz model which combines Random Matrix Theory and network measures, in order to achieve portfolio weights enhancing portfolios' risk-return profiles. The results show that overall our model overperforms several competing alternatives, maintaining a relatively low level of risk.

Partners

- University of Pavia

Journal

Artificial Intelligence in Finance

Date of Publication

24 April 2020

Link

<https://doi.org/10.3389/frai.2020.00022>

Annex - List of publications

Title	Authors	Journal	Keywords
Can Cryptocurrencies Preserve Privacy and Comply With Regulations?	Geoff Goodell, Tomaso Aste	Frontiers in Blockchain	Crypto assets, Privacy, Regulation
Lead Behaviour in Bitcoin Markets	Ying Chen, Paolo Giudici, Branka Hadji Misheva, Simon Trimborn	Risks	Crypto prices, Lead-lag models, Clustering
High Frequency Price Change Spillovers in Bitcoin Markets	Paolo Giudici, Paolo Pagnottoni	Risks	Cryptocurrency exchanges, High frequency prices, Spillover models
A Decentralised Digital Identity Architecture	Goodell Geoff; Tomaso Aste	Frontiers in Blockchain	Blockchain architecture, Privacy, digital identity
Cryptocurrency market structure: connecting emotions and economics	Tomaso Aste	Digital Finance	Cryptocurrency markets, Sentiment analysis, Behavioral economics
Crypto price discovery through correlation networks	Paolo Giudici, Gloria Polinesi	Annals of Operations Research	Crypto exchanges, Correlation network models, Clustering
Analysing Social Media Forums to Discover Potential Causes of Phasic Shifts in Cryptocurrency Price Series	Andrew Burnie, Emine Yilmaz, Tomaso Aste	Frontiers in Blockchain	Crypto prices, Sentiment analysis, Cryptocurrency markets
Initial Coin Offerings: Risk or Opportunity?	Anca Mirela Toma, Paola Cerchiello	Frontiers in Artificial Intelligence	Fraud risk, initial coin offerings, alternative funding
Are cryptos becoming alternative assets?	Pele, D.T., Wesselhöft, N., Härdle, W.K., Kolossiatis, M., Yatracos, Y.	Journal of Empirical Finance	Crypto assets, classification models, factor models
Network Models to Enhance Automated Cryptocurrency Portfolio Management	Paolo Giudici, Paolo Pagnottoni, Gloria Polinesi	Frontiers in Artificial Intelligence	Crypto assets, portfolio allocation, Correlation network models
Information-theoretic measures for nonlinear causality detection: application to social media sentiment and cryptocurrency prices	Z. Keskin, Tomaso Aste	Royal Society Open Science	Crypto prices, Information theoretic models, sentiment analysis

Cyber risk ordering with rank-based statistical models	Paolo Giudici, Emanuela Raffinetti	AStA Advances in Statistical Analysis	Cyber risk, Ordinal models, Stochastic dominance
The Cost of Bitcoin Mining Has Never Really Increased	Yo-Der Song, Tomaso Aste	Frontiers in Blockchain	Bitcoin mining, energy costs, bitcoin pricing
Key Roles of Crypto-Exchanges in Generating Arbitrage Opportunities	Audrius Kabašinskas, Kristina Šutienė	Entropy	Crypto exchanges, arbitrage models, network models
Libra or Librae? Basket based stablecoins to mitigate foreign exchange volatility spillovers	Paolo Giudici, Thomas Leach, Paolo Pagnottoni	Finance Research Letters	Stable coins, Portfolio allocation, Basket based coins
Investing with cryptocurrencies – evaluating their potential for portfolio allocation strategies	Alla Petukhina, Simon Trimborn, Wolfgang Karl Härdle, Hermann Elender	Quantitative Finance	Crypto assets, Portfolio allocation, Crypto indexes
Rise of the machines? Intraday high-frequency trading patterns of cryptocurrencies	Alla A. Petukhina, Raphael C. G. Reule, Wolfgang Karl Härdle	The European Journal of Finance	Algorithmic trading, High-frequency trading, volatility models

CHAPTER 5

WP5 - SupTech Workshops

This chapter contains a summary of the repository of use cases and slides for each of the three workstreams: Big Data Analytics, Artificial Intelligence, and Blockchain. Given the size of the contents all slides, papers, codes and data can be found at the following link: https://github.com/danpele/FINTECH_HO_2020.

5.1 D5.1 - Repository of use cases and slides (BDA)

The following section contains a summary of the repository of use cases and slides used in the BDA workstream. Contents starts on next page.



Deliverable information

WP NO.	WP5
DEL. REL. NO.	D5.1
DEL. NO.	D13
TITLE	Repository of use cases and slides in big data analytics
DESCRIPTION	Repository of use cases (including paper, data and code) and slides in big data analytics shared during the SupTech and RegTech workshops.
NATURE	Website
EST. DEL. DATE	30/09/2019

Document information

DATE	25/11/2019
WRITTEN BY	Paolo Pagnottoni
APPROVED BY	Paolo Giudici

Actions and achieved results

The University of Pavia, with the support of all the project partners, has developed the repository of use cases and slides for the Big Data Analytics part. The repository includes research and teaching material, in the form of use cases, regarding big data analytics for credit risk management in peer to peer lending. The material has been developed first gathering contributions from the consortium and, then, evolving it according to the received feedbacks from all project's participants: partners, regulators, supervisors, banks, fintechs and international advisors.

The material has been prepared, shared and disseminated during:

1. The initial kick-off workshop (held in Pavia), in which European and international regulators presented priorities of work and research;
2. Suptech sessions, in which each partner discussed the developed use cases with their national Supervisors;
3. Two Regtech sessions (one in Milan and one in Frankfurt), in which FinTech companies and banks could replicate the use cases, with the provided software code;
4. a final Validation workshop (held in Winterthur), in which the project stakeholders including Regulators and the project Advisory Board exchanged feedback and views about the developed use cases.

At first, the material was updated based on internal discussion and Regulators' suggestions during the first kickoff workshop. Second, the partners from the consortium have collected feedbacks from their national Supervisors during the Suptech sessions organised in all European Union countries, and updated the material. Third, we have gathered feedbacks from participants during the Regtech sessions, mostly risk managers and IT developers from FinTechs and banks, and updated the material. Fourth, we have discussed the developed research with partners, Regulators, Advisory Board members and participants during the Validation workshop, and the material has been finalised. All intermediate outputs and the final one (attached to this report) have been made available to all the stakeholders on the project web platform.

Specifically, the final repository contains:

1. Final open source papers regarding each use case
2. Final codes related to each use case
3. Final data required for the empirical application of each use case
4. Final set of slides, gathering all use cases into one comprehensive training session.

From a technical viewpoint, the use cases selected by the partners and all the project's participants are four. A summary description of each of them is reported below.

USE CASE 1: NETWORK BASED SCORING MODELS TO IMPROVE CREDIT RISK MANAGEMENT IN PEER TO PEER LENDING PLATFORMS

(GIUDICI P.- UNIPV, HADJI-MISHEVA B- ZHAW., SPELTA A.- UNIPV)

Published in: Front. Artif. Intell., 24 May 2019 | <https://doi.org/10.3389/frai.2019.00003>

Financial intermediation has changed extensively over the course of the last two decades. One of the most significant change has been the emergence of FinTech. In the context of credit services, fintech peer to peer lenders have introduced many opportunities, among which improved speed, better customer experience and reduced costs. However, peer-to-peer lending platforms lead to higher risks, among which higher credit risk: not owned by the lenders, and systemic risks: due to the high interconnectedness among borrowers generated by the platform. This calls for new and more accurate credit risk models to protect consumers and preserve financial stability. In this paper we propose to enhance credit risk accuracy of peer-to-peer platforms by leveraging topological information embedded into similarity networks, derived from borrowers' financial information. Topological coefficients describing borrowers' importance and community structures are employed as additional explanatory variables, leading to an improved predictive performance of credit scoring models.

Keywords: FinTech, Peer-to-Peer Lending, Credit Scoring Models

USE CASE 2: FACTORIAL NETWORK MODELS TO IMPROVE P2P CREDIT RISK MANAGEMENT (AHELEGBEY D.F. - UNIPV, GIUDICI P.-UNIPV, HADJI-MISHEVA B.-ZHAW)

Published in: Front. Artif. Intell., 04 June 2019 | <https://doi.org/10.3389/frai.2019.00008>

This paper investigates how to improve statistical-based credit scoring of SMEs involved in P2P lending. The methodology discussed in the paper is a factor network-based segmentation for credit score modeling. The approach first constructs a network of SMEs where links emerge from comovement of latent factors, which allows us to segment the heterogeneous population into clusters. We then build a credit score model for each cluster via lasso logistic regression. We compare our approach with the conventional logistic model by analyzing the credit score of over 15000 SMEs engaged in P2P lending services across Europe. The result reveals that credit risk modeling using our network-based segmentation achieves higher predictive performance than the conventional model.

Keywords: Credit Risk, Factor models, Fintech, Peer-to-Peer lending, Credit Scoring, Lasso, Segmentation

USE CASE 3: SPATIAL REGRESSION MODELS TO IMPROVE P2P CREDIT RISK MANAGEMENT (AGOSTO A.-UNIPV, GIUDICI P.-UNIPV, LEACH T. -UNIPV)

Published in: Front. Artif. Intell., 16 May 2019 | <https://doi.org/10.3389/frai.2019.00006>

Calabrese et al. (2017) have shown how binary spatial regression models can be exploited to measure contagion effects in credit risk arising from bank failures. To illustrate their methodology, the authors have employed the Bank for International Settlements' data on flows between country banking systems. Here we apply a binary spatial regression model to measure contagion effects arising from corporate failures. To derive interconnectedness measures, we use the World Input-Output Trade (WIOT) statistics between economic sectors. Our application is based on a sample of 1,185 Italian companies. We provide evidence of high levels of contagion risk, which increases the individual credit risk of each company.

Keywords: credit risk, systemic risk, contagion, spatial autoregressive models, binary data

USE CASE 4: LOAN SCREENING AND DEFAULT PREDICTION WITH MACHINE LEARNING AND DEEP NEURAL NETWORKS

(TURIEL J.- UCL, ASTE T.-UCL)

Work in progress

Logistic Regression and Support Vector Machine algorithms, together with Linear and Deep Neural Networks, are applied to lending data. A two layer model is formed, where the first layer predicts loan rejection, while the second one further screens the loans for default risk. Logistic Regression was found to be the best performer for the first layer, with test set recall macro score of 77.4%. Deep Neural Networks, applied to the second layer alone, were the best performer, with validation set recall score of 72%, for defaults. The models were also tested on the subcategory of the dataset comprising loans taken for small businesses. Benefits of training on the whole dataset to predict the specific category were tested. The first layer of the model was found to benefit strongly from the larger training dataset, while the second layer was found to perform significantly better when trained on small business data only. This suggests a potential discrepancy between how these loans are screened and how they should be analysed in terms of default prediction.

Attached documents

The material concerning the repository in Big Data Analytics is attached as follows:

1. Slides used during the Suptech workshop
2. The three open access papers chosen as use cases
3. Screenshots of the R codes related to the chosen use cases

Please note that – given the deliverable format constraints - full replication codes and the datasets are attached in .zip folders.

5.2 D5.2 - Repository of use cases and slides (AI)

The following section contains a summary of the repository of use cases and slides used in the AI workstream. Contents starts on next page.



Deliverable information

WP NO.	WP5
DEL. REL. NO.	D5.2
DEL. NO.	D14
TITLE	Repository of use cases and slides in artificial intelligence
DESCRIPTION	Repository of use cases and slides (including paper, data and code) in artificial intelligence shared during the SupTech and RegTech workshops
NATURE	Website
EST. DEL. DATE	31 May 2020

Document information

DATE	06 July 2020
WRITTEN BY	Paolo Pagnottoni
APPROVED BY	Paolo Giudici

Actions and achieved results

The University of Pavia, with the support of all the project partners, has developed the repository of use cases and slides for the Artificial Intelligence part. The repository includes research and teaching material, in the form of use cases, regarding AI, Robo Advice and Market Risk. The material has been developed first gathering contributions from the consortium and, then, improving them according to the received feedbacks from all project's participants: partners, regulators, supervisors, banks, fintechs and international advisors.

The material has been prepared, shared and disseminated during:

1. The Regtech sessions (one in Winthertur and one in Vienna) in which FinTech companies and banks had the chance to replicate the use cases, with the provided software code;
2. The Suptech sessions, in which each partner discussed the developed use cases with their national Supervisors;

The material was firstly prepared by the consortium partners under the form of proposal. Secondly, the proposal has been then evaluated by the WP 3 leader, together with the Project Coordinator. Thirdly, consortium partners submitted their feedbacks on the material which has been consequently updated. Fourthly partners from the consortium have collected feedbacks from their national Supervisors during the Suptech sessions organised in all European Union countries, and material has been updated. Fifthly, we have gathered feedbacks from participants during the Regtech sessions, which comprised mostly IT developers and risk management experts from FinTechs and banks, and updated the material. Finally, the material has been finalized taking into account all feedbacks. All intermediate outputs and the final one (attached to this report) have been made available to all the stakeholders on the project web platform.

Specifically, the final repository contains:

1. Final open source papers regarding each use case
2. Final codes related to each use case
3. Final data required for the empirical application of each use case
4. Final set of slides, gathering all use cases into one comprehensive training session.

From a technical viewpoint, the use cases selected are three. A summary description of each of them is reported below.

USE CASE 1: NETWORK MODELS TO ENHANCE AUTOMATED CRYPTOCURRENCY PORTFOLIO MANAGEMENT

(GIUDICI P.- UNIPV, PAGNOTTONI P.- UNIPV, POLINESI G.- UNIVERSITA' POLITECNICA DELLE MARCHE)

Published in: Front. Artif. Intell., 24 April 2020 | <https://doi.org/10.3389/frai.2020.00022>

The usage of cryptocurrencies, together with that of financial automated consultancy, is widely spreading in the last few years. However, automated consultancy services are not yet exploiting the potentiality of this nascent market, which represents a class of innovative financial products that can be proposed by robo-advisors. For this reason, we propose a novel approach to build efficient portfolio allocation strategies involving volatile financial instruments such as cryptocurrencies. In other words, we develop an extension

of the traditional Markowitz model which combines Random Matrix Theory and network measures, in order to achieve portfolio weights enhancing portfolios' risk-return profiles. The results show that overall our model overperforms several competing alternatives, maintaining a relatively low level of risk.

Keywords: cryptocurrencies, correlation networks, network centrality, portfolio optimization, random matrix theory, minimal spanning tree

USE CASE 2: SENTIMENT ANALYSIS OF EUROPEAN BONDS 2016–2018

(SCHWENDNER P.- ZHAW, SCHÜLE M.- ZHAW AND HILLEBRAND M.- ESM LUXEMBOURG)

Published in: Front. Artif. Intell., 15 October 2019 | <https://doi.org/10.3389/frai.2019.00020>

We revisit the discussion of market sentiment in European sovereign bonds using a correlation analysis toolkit based on influence networks and hierarchical clustering. We focus on three case studies of political interest. In the case of the 2016 Brexit referendum, the market showed negative correlations between core and periphery only in the week before the referendum. Before the French presidential elections in 2017, the French bond spread widened together with the estimated Le Pen election probability, but the position of French bonds in the correlation blocks did not weaken. In summer 2018, during the budget negotiations within the new Italian coalition, the Italian bonds reacted very sensitively to changing political messages but did not show contagion risk to Spain or Portugal for several months. The situation changed during the week from October 22 to 26, as a spillover pattern of negative sentiment also to the other peripheral countries emerged.

Keywords: sovereign bonds, contagion, sentiment, European sovereign bond crisis, correlation, correlation influence, networks

USE CASE 3: EXPLAINABLE AI IN FINTECH RISK MANAGEMENT

(BUSSMANN N.- FIRAMIS and UNIPV, GIUDICI P.- UNIPV, MARINELLI D. - FIRAMIS, PAPENBROCK J.- FIRAMIS)

Published in: Front. Artif. Intell., 24 April 2020 | <https://doi.org/10.3389/frai.2020.00026>

The paper proposes an explainable AI model that can be used in fintech risk management and, in particular, in measuring the risks that arise when credit is borrowed employing peer to peer lending platforms. The model employs Shapley values, so that AI predictions are interpreted according to the underlying explanatory variables. The empirical analysis of 15,000 small and medium companies asking for peer to peer lending credit reveals that both risky and not risky borrowers can be grouped according to a set of similar financial characteristics, which can be employed to explain and understand their credit score and, therefore, to predict their future behavior.

Keywords: credit risk management, explainable AI, financial technologies, peer to peer lending, logistic regression, predictive models

Attached documents

The material concerning the repository in Artificial Intelligence is attached as follows:

1. Slides used during the Suptech workshop
2. The three open access papers chosen as use cases
3. Screenshots of the R codes related to the chosen use cases

Please note that – given the deliverable format constraints - full replication codes and the datasets are attached in .zip folders.

5.3 D5.3 - Repository of use cases and slides (BC)

The following section contains a summary of the repository of use cases and slides used in the BC workstream. Contents starts on next page.



Deliverable information

WP NO.	WP5
DEL.	D5.3
DEL. NO.	D15
TITLE	Repository of use cases and slides in blockchain
DESCRIPTION	Repository of use cases and slides (including paper, data and code) in blockchain shared during the Suptech and RegTech workshops
NATURE	Website (Github)
EST. DEL. DATE	31 March 2021

Document information

DATE	23 March 2021
WRITTEN BY	Thomas Leach
APPROVED BY	Paolo Giudici

Actions and achieved results

The University of Pavia, with the support of all the project partners, has developed the repository of use cases and slides for the Blockchain part. The repository includes research and teaching material, in the form of use cases, regarding Blockchain, payments and cyber risk. The material has been developed first gathering contributions from the consortium and, subsequently improving them based on feedback received from the project's participants: partners, regulators, supervisors, banks, fintechs and international advisors.

The material has been prepared, shared and disseminated during:

1. The Regtech sessions (virtual sessions organised by partners in Madrid and in Paris) in which FinTech companies and banks had the chance to replicate the use cases, with the provided software code;
2. The Suptech sessions, in which each partner discussed the developed use cases with their national Supervisors;

The material was firstly prepared by the consortium partners under the form of proposal. Secondly, the proposal has been then evaluated by the WP3 leader, together with the Project Coordinator. The consortium partners then submitted feedback on the material which was then updated. Partners from the consortium also collect feedback from their national Supervisors during the Suptech sessions organised in all European Union countries, and update the material based on the feedback. We also gather feedback from participants during the Regtech sessions, which comprised of mostly IT developers and risk management experts from FinTechs and banks, again updating the slides. All intermediate outputs and the final one (attached to this report) have been made available to all the stakeholders on the project web platform.

Specifically, the final repository contains:

1. Final open source papers regarding each use case
2. Final codes related to each use case
3. Final data required for the empirical application of each use case
4. Final set of slides, gathering all use cases into one comprehensive training session.

There are six use cases. A summary description of each of them is reported below.

USE CASE 1: INITIAL COIN OFFERINGS: RISK OR OPPORTUNITY? (TOMA A.- UNIPV, CERCHIELLO P.- UNIPV)

Published in: Front. Artif. Intell., 16 April 2020 | <https://doi.org/10.3389/frai.2020.00018>

Initial coin offerings (ICOs) are one of the several by-products in the world of the cryptocurrencies. Start-ups and existing businesses are turning to alternative sources of capital as opposed to classical channels like banks or venture capitalists. They can offer the inner value of their business by selling “tokens,” i.e., units of the chosen cryptocurrency, like a regular firm would do by means of an IPO. The investors, of course, hope for an increase in the value of the token in the short term, provided a solid and valid business idea typically described by the ICO issuers in a white paper. However, fraudulent activities perpetrated by unscrupulous actors are frequent and it would be crucial to highlight in advance clear signs of illegal money raising. In this paper, we employ statistical approaches to detect what characteristics of ICOs are significantly related to fraudulent behavior. We leverage a number of different variables like: entrepreneurial skills, Telegram chats, and relative sentiment for each ICO, type of business, issuing country, team characteristics. Through logistic regression, multinomial logistic regression, and text analysis, we are able to shed light on the riskiest ICOs.

USE CASE 2: A STATISTICAL CLASSIFICATION OF CRYPTOCURRENCIES
(PELE DT.- BUCHAREST UNIVERSITY OF ECONOMIC STUDIES, HÄRDLE WK.- HUMBOLDT
UNIVERSITÄT ZU BERLIN, WESSELHÖFFT N - HUMBOLDT UNIVERSITÄT ZU BERLIN,
KOLOSSIATIS M.- UNIVERSITY OF CYPRUS, YATRACOS Y.- TSINGHUA UNIVERSITY)

Available at SSRN: <https://ssrn.com/abstract=3548462> or <http://dx.doi.org/10.2139/ssrn.3548462>

In review at European Journal of Finance

The aim of this paper is to derive the main factors that separate cryptocurrencies from the classical assets, by using various classification techniques applied to the daily time series of log-returns. In this sense, a daily time series of asset returns (either cryptocurrencies or classical assets) can be characterized by a multidimensional vector with statistical components like variance, skewness, kurtosis, tail probability, quantiles, conditional tail expectation or GARCH parameters. By using dimension reduction techniques (Factor Analysis) and classification models (Binary Logistic Regression, Discriminant Analysis, Support Vector Machines, K-means clustering, Variance Components Split methods) for a representative sample of cryptocurrencies, stocks, exchange rates and commodities, we are able to classify cryptocurrencies as a new asset class with unique features in the tails of the log-returns distribution. The main result of our paper is the complete separation of the cryptocurrencies from the other type of assets, by using the Maximum Variance Components Split method. In addition, we observe a synchronicity in the evolution of the cryptocurrencies, compared to the classical assets, mainly due to the tails behaviour of the log-return distribution.

USE CASE 3: LIBRA OR LIBRAE? BASKET BASED STABLECOINS TO MITIGATE FOREIGN EXCHANGE VOLATILITY SPILLOVERS
(LEACH T.- UNIPV, GIUDICI P. - UNIPV, PAGNOTTONI P. - UNIPV)

Available at SSRN: <https://ssrn.com/abstract=3546779> or <http://dx.doi.org/10.2139/ssrn.3546779>

In review at Financial Research Letters

The paper aims to assess, from an empirical viewpoint, the advantages of a stablecoin whose value is derived from a basket of underlying currencies, against a stablecoin which is pegged to the value of one major currency, such as the dollar. To this aim, we first find the optimal weights of the currencies that can comprise our basket. We then employ volatility spillover decomposition methods to understand which foreign currency mostly drives the others. We then look at how the stability of either stablecoin is affected by currency shocks, by means of VAR models and impulse response functions. Our empirical findings show that our basket based stablecoin is less volatile than all single currencies. This results is fundamental for policy making, and especially for emerging markets with a high level of remittances: a librae (basket based stable coin) can preserve their value during turbulent times better than a libra (single currency based stable coin).

CHAPTER 6

WP6 - RegTech Workshops

6.1 D6.1 Research and Development Environment

Deliverable information

WP NO.	WP 6
DEL.	D6.1
DEL. NO.	D16
TITLE	Research and development environment
DESCRIPTION	The creation of a coding technical infrastructure that is scalable and extendable in a modular approach. The basis for the infrastructure will be open-source projects like R which gives access to developed machine learning projects like Tensorflow, PyTorch, MXNet and H2O. These research and development environments will be made available in a dedicated cloud server environment to manage the code, scripts, GUIs, models, users' access rights, software interaction and workflows.
NATURE	Websites, patents filling, etc.
EST. DEL. DATE	31 Mar 2019

Document information

DATE	28/03/2019
WRITTEN BY	Firamis GmbH
APPROVED BY	Arianna Agosto

Actions and achieved results

We have developed and built up a coding technical infrastructure that serves as the central platform for all coding related content of the FIN-TECH project. All project-participants, meaning consortium-partners as well as regulators and fintechs, are able to download or upload content (depending on their access rights). The platform is solely based on open-source software modules and is designed in a modular approach. Therefore the platform can be modified or expanded during the project life-time and afterwards, depending on the feedback and the future needs of the users.

The platform is designed in line with the EU General Data Protection Regulation (GDPR), as it can only be accessed by registered users. After the first registration personal data is processed.

The login-button on the project-website <https://www.fintech-ho2020.eu> serves as the entrance gate to the platform. All staff of the consortium-partners who are supposed to publish relevant content for the FIN-TECH project need access to the platform. The staff of regulators and fintechs who take part in suptech or regtech workshops, have access to the platform but not to a separate file management tool that is reserved to partners only. This is where the platform contents are prepared collaboratively by the partners before made available for the regulators and fintechs.

In order to register for a suptech or regtech workshop, a user has to reveal name, email address, affiliation, department, position and role in special forms that were designed for the project. This data is saved in an excel-list on the project-server at BadenIT GmbH. It is extended by user passwords that were generated with a password generator. There is also a script that runs automatically every minute in order to collect all data from all running forms and aggregates them on an overview list.

Using a self-written script, the relevant data is imported to LDAP, an application protocol for accessing and maintaining distributed directory information services over an Internet Protocol network. This program is necessary for allowing the sharing of the project-content with regard to different access rights of the users (only the staff of the consortium-partners has the right to upload content in the file management tool, whereas the staff of regulators and fintechs is only allowed to download/read content on the platform).

As the final step we have developed a fully automated process in order to send the relevant email address and the corresponding passwords (necessary for registering to the platform) to the single user. We use the open source based email-program Thunderbird for this step. The automatically generated (and personalized) email contains all information the user has to receive with regard to Art. 13 GDPR.

Detailed platform description:

The underlying technology of the platform is based on the open-source R packages “shiny” and the open-source IDE “Rstudio” that can be run in a browser. The main purpose of the platform is to provide and run code and to show corresponding papers, markdowns and other formats for users or for executing regtech and suptech workshops.

The following screenshot shows the first window that opens up after the login to the platform:

```

# Clean the environment
graphics.off()
rm(list=ls(all = TRUE))

# set working directory to Folder "Material"
setwd(paste0(getwd(),"/Material"))

# Pre-load the packages and model_perf function
libraries <- c("readr", "tibble", "Hmisc", "stargazer", "dplyr", "purrr", "xtable", "base", "gridExtra", "DescTools", "style", "igraph", "MASS", "ROCR", "rpart", "e1071", "SOMtools", "caret", "Metrics", "lattice", "cluster", "randomForest", "Hmisc", "networkD3", "mnormtest")
lapply(libraries, library, quietly = TRUE, character.only = TRUE)
source("model_perf.R")

#####
##### ===== GENERATE THE DATASETS =====
#####

# Import the dataset "final_dataset_meps.csv"
dataset = read.csv("final_dataset_meps.csv")
dataset = dataset[,c(1:22)] # keep financial ratios plus the response variable "status" which takes value 0 if the company has not defaulted and 1 if it has.
dataset = dataset[complete.cases(dataset),]

# we define a metricMatrix that provides the relative distance between
# companies by applying the standardized euclidean distance between each pair (x1,x2)
# of institutions feature vectors
dist = as.metricMatrix(as.dist(dist[,-c(1,2)]))
g = graph_from_adjacency_matrix(dist, mode = "undirected", weighted = TRUE) # we define the graph

# we find the MST representation of the graph g
g_mst = mst(g)

# Plot the g_mst
V(g_mst)$status == 1)color = "#firebrick" # color defaulted companies red
V(g_mst)$status == 0)color = "#lightgreen" # color active companies green
plot(g_mst, graph = "edges",
      vertex.labelNA,
      vertex.size = 3,
      main = "MST representation of the borrowing companies networks")

# Generate the dataset with network and community information
dataset$netDegree = igraph::degree(g_mst) # degree centrality
dataset$netStrength = igraph::strength(g_mst) # strength centrality
dataset$netCloseness = igraph::closeness(g_mst) # closeness centrality

```

In the area “Material for Sessions” the platform user can select between different (session) materials that were published by consortium partners for their suptech or regtech workshop. This tree like structure is the same as the one in the file management where the partners work on this structure collectively. New versions of the file structure from that file management tool can be pushed to the platform where they are then available to the users.

The user has the possibility to display the content of the single files in the right area of the window or to download the file/material on his computer. If the material contains R or Rmd code, this code can also be shown in an Rstudio IDE dashboard (see next screenshot).

The following graphic is a screenshot of the R-Studio dashboard that is used during the first regtech workshop in Milan on March 2019, 29th:

```

## Load the required libraries
library(tidyverse)
library(DescTools)
library(Metrics)
library(caret)
library(Hmisc)
library(gridExtra)
library(style)
library(lattice)
library(cluster)
library(randomForest)
library(Hmisc)
library(networkD3)
library(mnormtest)

## Read the dataset
dataset = read.csv("final_dataset_meps.csv")
dataset = dataset[,c(1:22)] # keep financial ratios plus the response variable "status" which takes value 0 if the company has not defaulted and 1 if it has.
dataset = dataset[complete.cases(dataset),]

## we define a metricMatrix that provides the relative distance between
## companies by applying the standardized euclidean distance between each pair (x1,x2)
## of institutions feature vectors
dist = as.metricMatrix(as.dist(dist[,-c(1,2)]))
g = graph_from_adjacency_matrix(dist, mode = "undirected", weighted = TRUE) # we define the graph

## we find the MST representation of the graph g
g_mst = mst(g)

## Plot the g_mst
V(g_mst)$status == 1)color = "#firebrick" # color defaulted companies red
V(g_mst)$status == 0)color = "#lightgreen" # color active companies green
plot(g_mst, graph = "edges",
      vertex.labelNA,
      vertex.size = 3,
      main = "MST representation of the borrowing companies networks")

## Generate the dataset with network and community information
dataset$netDegree = igraph::degree(g_mst) # degree centrality
dataset$netStrength = igraph::strength(g_mst) # strength centrality
dataset$netCloseness = igraph::closeness(g_mst) # closeness centrality

```

In the top left area the relevant R-code is shown as a script:

The R code is compiled and can be run:

- on the whole (by selecting all the script)
- line by line (by selecting only the line or by placing the cursor in the correspondent line of the script)
- as a given part of the code inside a line (by selecting such part of the code).

The result of running the code is shown either in the R console (bottom left area) or in the graphical output window (bottom right area). If the code includes the creation of any object, it is listed in the R working environment window (top right area).

The R console (bottom left area) has the same functionalities as the R-Gui (graphical user interface). It has only one editing line and the results of the calculation are displayed in the same window. The error messages and other information related with the script running process are also shown in the R console. The R console is very useful for testing code before implementing it into the script.

The R environment window (top right area) shows all the objects that were created in R and that are active to be used. It provides a quick overview of not only the number and name of the objects in the working environment, but also about the information stored and the type of the object.

In the graphical output (bottom right area) the graphs are represented as default. The figures can also be represented in external devices by request. In this window the help about the core functions or the implemented in each library is displayed.

It is also possible to integrate web-links to code git repositories as a file with extension “.link” in the file structure. When clicked on those files in the tree structure the user gets a Rstudio browser tab with the linked git project opened and ready to be executed.

The required R libraries for the standardized code examples available in the file tree structure are prepared in a customized installer script before they are made available to the platform application. In this way, users need only a few clicks to have the code ready to be launched in a live coding or self-learning session.

The modular approach we chose for developing and building up the platform allows us to further modify or expand the platform during the project duration. The open-source and user community of our two main software building blocks (Rshiny and Rstudio) is already very large but still growing. This helps us to permanently improve and expand the project platform and the tools for dissemination and for support of the coding session.

Besides the event registration forms we have a number of evaluation forms for supervisors, regulators, fintechs and other evaluators of the syllabus, content and code material of the project.

Here are some potential next steps for implementation. The modular structure of the platform is helpful as most of the suggested tools should be able to be connected and combined with the platform

1. We are considering to use the R package reticulate which is able to run Python code besides the R code in Rstudio. If we are able to deploy customized R/Python-environments we could be able to also run Python codes in the same environments and even run mixed code examples with R and Python involved.
2. We could set up a community or communication tool like slack also for the non-partners. There are open-source packages that can be installed on the BadenIT server where the platform already runs. These can be connected to the same authentication (LDPA) that is already set-up for the platform.
3. For building the paper repositories we consider to use an R-package like “bibliometrix” as a tool for browsing and analyzing corresponding scientific paper collections which are collected and maintained by the work package leaders and the other partners.
4. Complex data and algorithmic visualization. The built-in access to javascript in Rshiny allows to get exposure to web-visualization technologies that can be connected to the R models and kernels by interactive dashboards. This supports advanced data analytics, teaching and dissemination of the project activities.

CHAPTER 7

WP7 - Dissemination

7.1 D7.1 - Establishment of network

Deliverable information

WP NO.	WP7
DEL. REL. NO.	D7.1
DEL. NO.	D20
TITLE	Establishment of website and social media channels
DESCRIPTION	Establishment of website and social media channels
NATURE	Website
EST. DEL. DATE	31 January 2019

Document information

DATE	28 January 2019
WRITTEN BY	Firamis GmbH
APPROVED BY	Paolo Giudici

Actions and achieved results

The website (<https://www.fintech-ho2020.eu>) and the social media activities of the FIN-TECH project shall mainly inform external visitors about the project. The website furthermore serves as the starting point for accessing the project-platform.

Website and social media activities aim at promoting and raising awareness on the project approach and of its impact for the FinTech industry. Especially the website shall provide information and access to project results: accessible by all stakeholders and by the general public.

The underlying technology of the website is based on the programming-language R. We created the website by using a combination of the tool RMarkdown and the website generator Hugo. We have chosen a design called Universal and changed it into our specific website-design.

We created our own Logo via the online tool ‘LogoMakr’. This Logo is also used in the social media channels.

At the top of the project website we created several links to our social media channels via social icons. There are two social icons for LinkedIn where visitors of our website are able to visit the LinkedIn-account of our project as well as a group, which they can participate to stay informed about our activities. Our social media channels are:

LinkedIn: <https://www.linkedin.com/company/fintech-ho2020-eu/>
 LinkedIn: <https://www.linkedin.com/groups/8734998/>
 Facebook: <https://m.facebook.com/groups/540482969435657?tsid=0.3893573805737165&source=result>
 Twitter: https://twitter.com/fintech_ho2020

The menu bar furthermore contains an icon, which visitors of our website can use to write us an e-mail.

Besides other tabs the menu bar also contains a login tab. This login constitutes the connection of the project-website with the project-platform. All external and internal users of the project-platform will use this login in order to access the platform.

Below the menu bar we implemented a carousel, which informs visitors about our three main topics:

- What we do?

- How we do it?
- How we improve it?

This carousel constantly rotates between these three topics.

In the second part of our website (the part below the carousel) it is firstly explained, who contributes to the FIN-TECH project:

- Fintechs and fintech hubs, who have detailed understanding of business models based on financial technologies;
- Regulators and supervisors, who have detailed understanding of the regulations and risks that concern financial technologies;
- Universities and research centres, which have detailed understanding of the risk management models that can be applied to financial technologies.

The following part of the project website contains the presentation of the project executive board. Every box presents one member of the executive board and includes a link to the corresponding website. The management board consists of:

University of Pavia
University College London
Pantheon-Sorbonne University
Firamis GmbH
B Hive
Humboldt University of Berlin

Afterwards we included a Youtube-link to a video informing about Fintech solutions that make use of artificial intelligence, big data analytics and blockchain technologies.

The last part of our website is a blog, which we use to inform about our latest activities and publications. One can find our blog also via using the button 'News' which is on top of the website.

At the bottom of the website one can find a contact-form where the European coordinator Prof. Paolo Giudici can be contacted. One can find our contact-file also via using the button 'Contact' which is on top of the website.

At the bottom of the website we further refer to the received Grant of the EC, to the terms of use, and our data policy.

Attached documents



D20_Attachment.pdf

Links

<https://www.fintech-ho2020.eu>

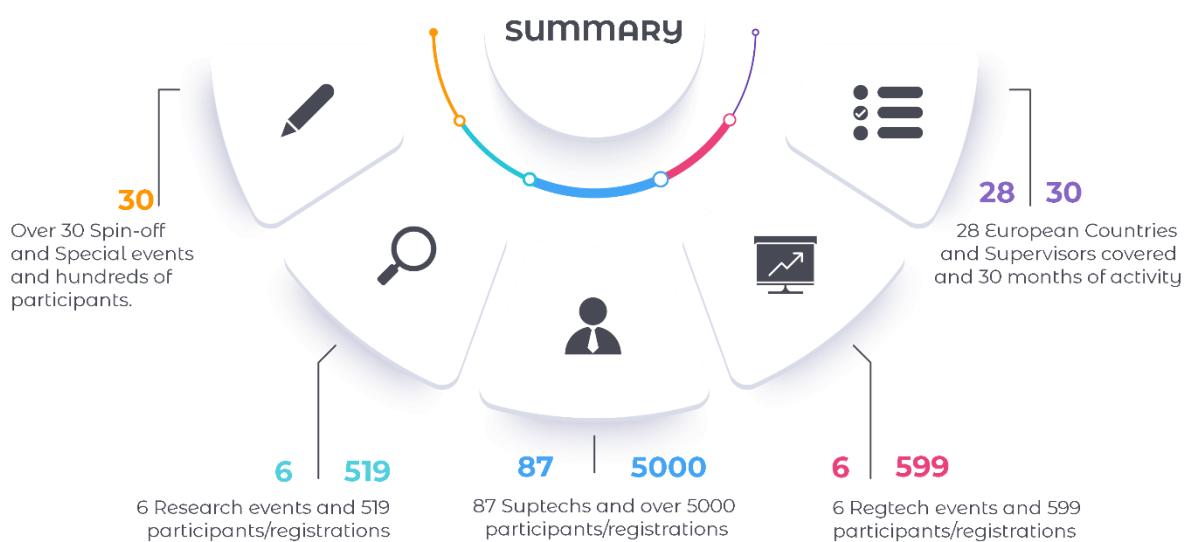
7.2 D7.2 - Event participation repository

Deliverable information

WP NO.	WP 7
DEL.	D7.2
DEL. NO.	D21
TITLE	Event participation repository
DESCRIPTION	In this task the work package leader (Firamis M1-M15, ASE Bucuresti M16-end of the project) will promote and monitor the participation of all project participants to conference, workshops and professional events, on the project topics, and the related publications in international scientific journals. Specifically, Firamis is responsible for collecting and sharing updates on participations to conferences and research papers by the project network participants.
NATURE	Websites, patents filling, etc.
EST. DEL. DATE	30 June 2021

Document information

DATE	28/06/2021
WRITTEN BY	Bucharest University of Economic Studies
APPROVED BY	Anca Mirela TOMA



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LinkedIn account (metrics) / Over 325 Posts / Over 1160 Followers / Over 100K Impressions

Twitter account (metrics) / Over 313 Posts / Over 260 Followers / Over 112K Reactions

Podcasts (metrics) / 14 Podcasts / Over 940 Views / Over 11394 Impressions on LinkedIn

Bringing all stakeholders together: regulators, supervisors, business and academia in over 100 events

The deliverable D7.2 presents the participation to the activities of the Horizon 2020 Fintech Project over its 30 months. The deliverable presents different statistics in order to capture the magnitude of the project.

The report is organised around the main type of activities/events organised in the project:

- 1. Research events**
- 2. Regtech events**
- 3. Supitech events**
- 4. Spin-off events**
- 5. Other type of activities and events held by partners**
- 6. Social media and online activity**

A. Type of events organised by the Consortium

A.1. Research events

The Fintech Horizon2020 Project included over its 30 months 6 Research events organised by the partners, as described below. Among the main objectives of the events were: monitoring the activity of the project, opening the activity of the project to international stakeholders and providing a discussion platform for the latest research and training activity conducted by the project partners.

 University of Pavia	 ZHAW Zurich university for applied science	 The Bucharest University of Economic Studies
FINTECH Horizon 2020 Kick-off PAVIA 01.02.2019	Research Event Big Data Analytics WINTHERTUR 03.09.2019 <small>*UBER co-organizer</small>	Research Event Mild-Term Workshop BUCHAREST 13.11.2019

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 University College London	 ZHAW Zurich university for applied science	 Humboldt University of Berlin
Research Event Artificial Intelligence LONDON 19.05.2020	Research Event Blockchain WINTERTHUR 25.03.2021	FINTECH Horizon 2020 Closing Event BERLIN 18.06.2021

A.2. Regtech events

The Fintech Horizon2020 Project included over its 30 months 6 Regtech events organised by the partners, as described below. The main objective of the events was to present the technical part of the use cases to all interested parties, including: Consortium partners, national and international supervisors, international regulators, and practitioners. The events were focused mainly on the R code and on the datasets used by the use cases.

 modefinance	 Firamis GmbH	 ZHAW Zurich university for applied science
RegTech MILANO 29.03.2019 Big Data Analytics	RegTech FRANKFURT 28.06.2019 Big Data Analytics	RegTech WINTERTHUR 04.09.2019 Artificial Intelligence

 <small>WIRTSCHAFTS UNIVERSITÄT WIEN VIENNA UNIVERSITY OF ECONOMICS AND BUSINESS</small> WU Vienna University of Economics and Business	 UNIVERSIDAD COMPLUTENSE MADRID	 Pantheon-Sorbonne University
RegTech VIENNA 26.02.2020 Artificial Intelligence	RegTech MADRID 23.10.2020 Blockchain	RegTech PARIS 24.03-01.04.2021 Blockchain

A.3. Suptech Workshops and Spin-off events

The Fintech Horizon2020 Project included over its 30 months 87 Suptech (Belgium and Luxembourg have a special situation) events organised by the partners, at national level, as described below. Each partner was responsible of organising a national level Big Data Analytics Suptech, an Artificial Intelligence Suptech and a Blockchain Suptech. The main objective of the events was to present the use cases developed under the three main pillars to the national supervisors and to obtain their feedback. Another important objective was to help creating a common understanding of the presented concepts at the level of all EU (plus Switzerland) national level supervisors. The events also tried, where possible to bring together several supervisors with the practitioners representing Fintechs, Banks, Insurance companies and other interested stakeholders.



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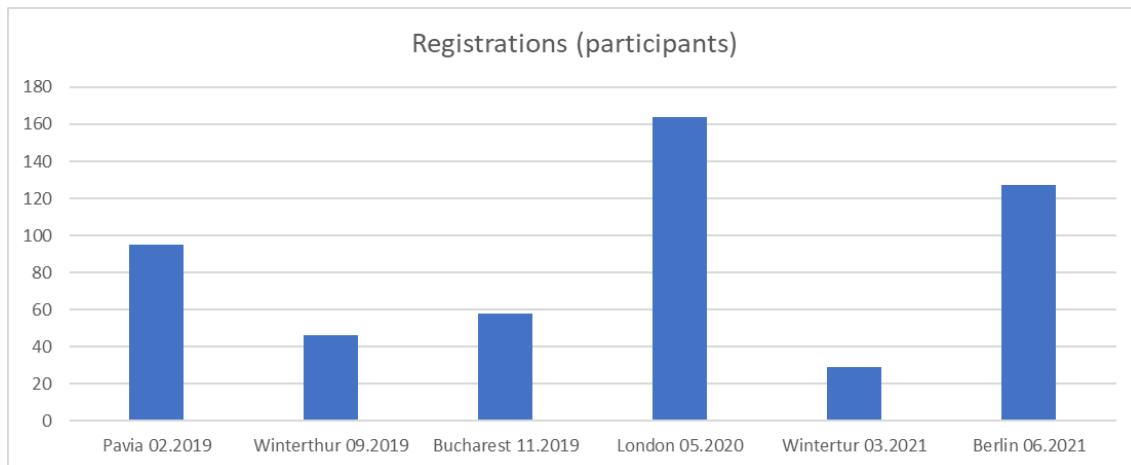
			G			
						
ROMANIA	SLOVAKIA	SLOVENIA	SPAIN	SWEDEN	SWITZERLAND	UNITED KINGDOM

B. Participants

B.1. Overview of the project

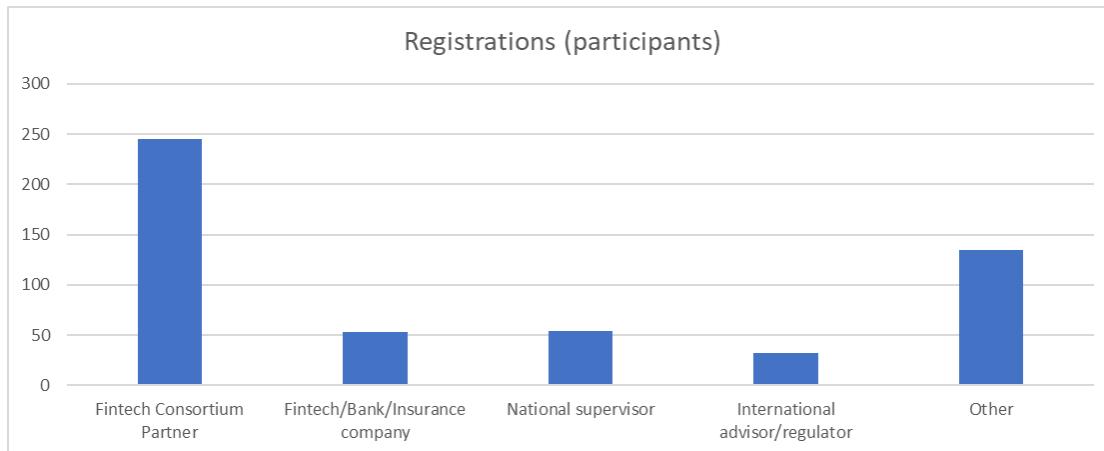
<i>Over 87 Suptech events and 5000 registrations (participants)</i>	<i>6 Research events and 519 registrations (participants)</i>	<i>6 Regtech events and 599 registrations (participants)</i>
<i>Over 11 Spin-off events and over 20 other special events</i>	<i>Over 13 podcasts and 940 views</i>	<i>Over 325 LinkedIn posts and 1160 followers</i>

B.2. Research events registrations (participants)

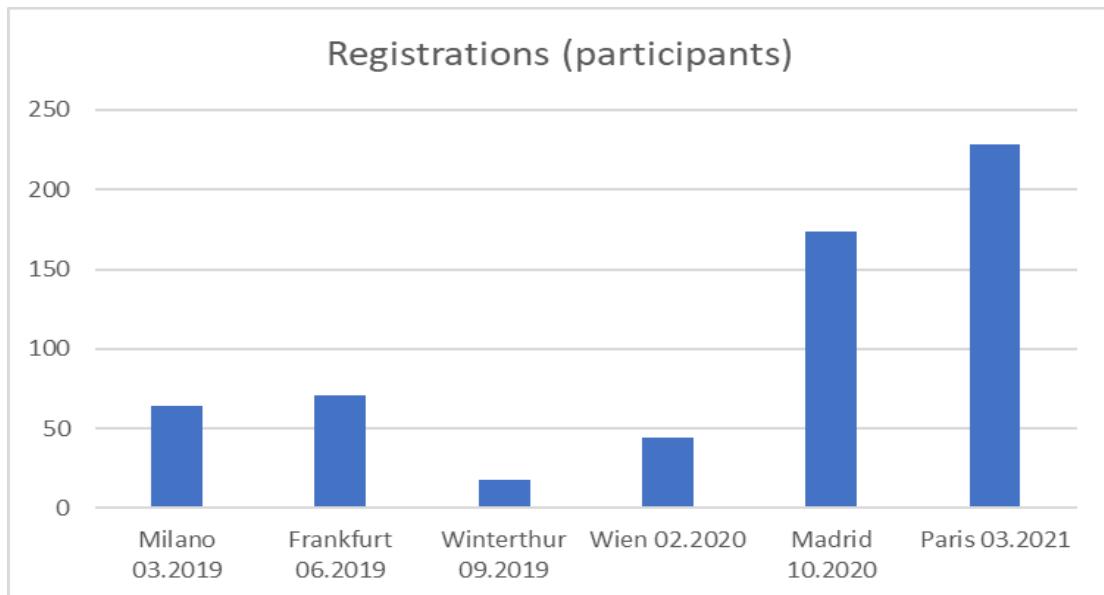


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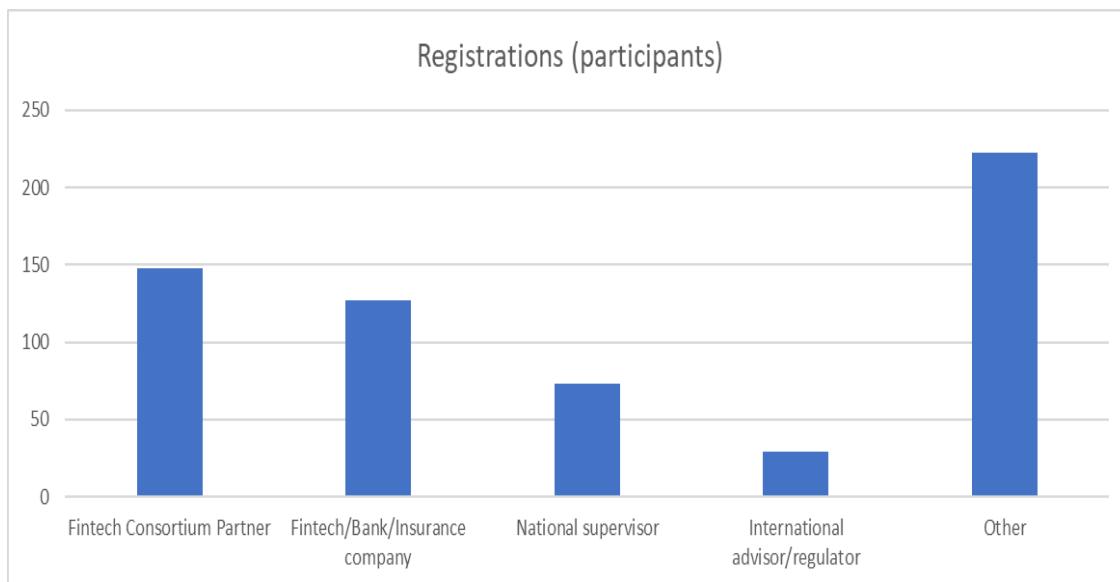


B.3. Regtech events registrations (participants)

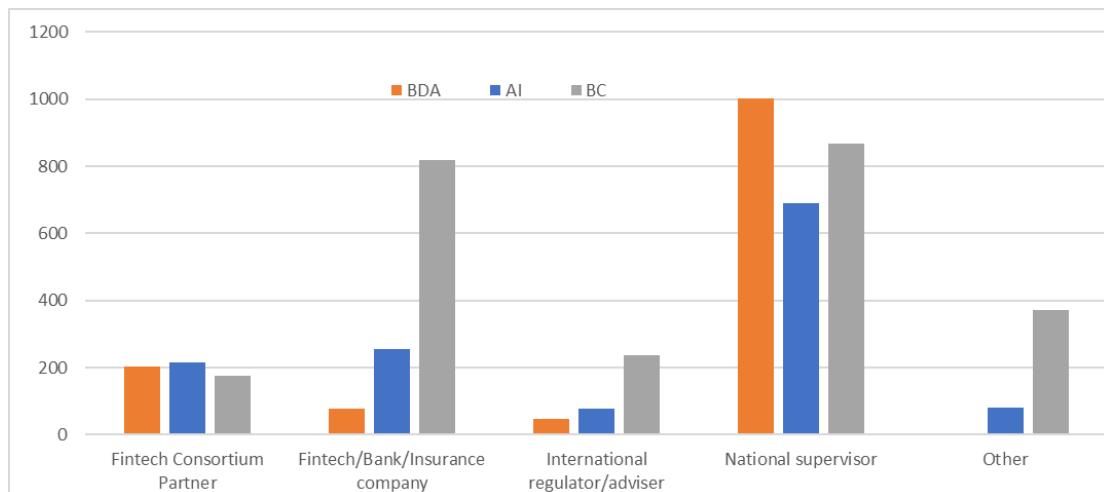


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B.4. Suptech events registrations (participants)



B.5. Participation to Research workshops - distribution

	Registrations (participants)	Fintech Consortium Partner	Fintech/Bank/Insurance company	National supervisor	International advisor/regulator	Other
Pavia 02.2019	95	35	14	4	10	32
Winterthur 09.2019	46	43	1	0	2	0
Bucharest 11.2019	58	31	2	13	2	10

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London 05.2020	164	86	27	17	7	27
Winterthur 03.2021	29	19	0	0	4	6
Berlin 06.2021	127	31	9	20	7	60
Total	519	245	53	54	32	135

B.6. Participation to RegTech workshops-distribution

	Registrations (participants)	Fintech Consortiu m Partner	Fintech/Bank/Insurance company	National supervisor	International advisor/regulator	Other
Milano 03.2019	64	24	19	0	4	17
Frankfurt 06.2019	71	31	31	4	5	0
Winterthur 09.2019	18	17	0	1	0	0
Wien 02.2020	44	17	12	3	1	11
Madrid 10.2020	174	31	22	22	10	89
Paris 03.2021	228	28	43	43	9	105
Total	599	148	127	73	29	222

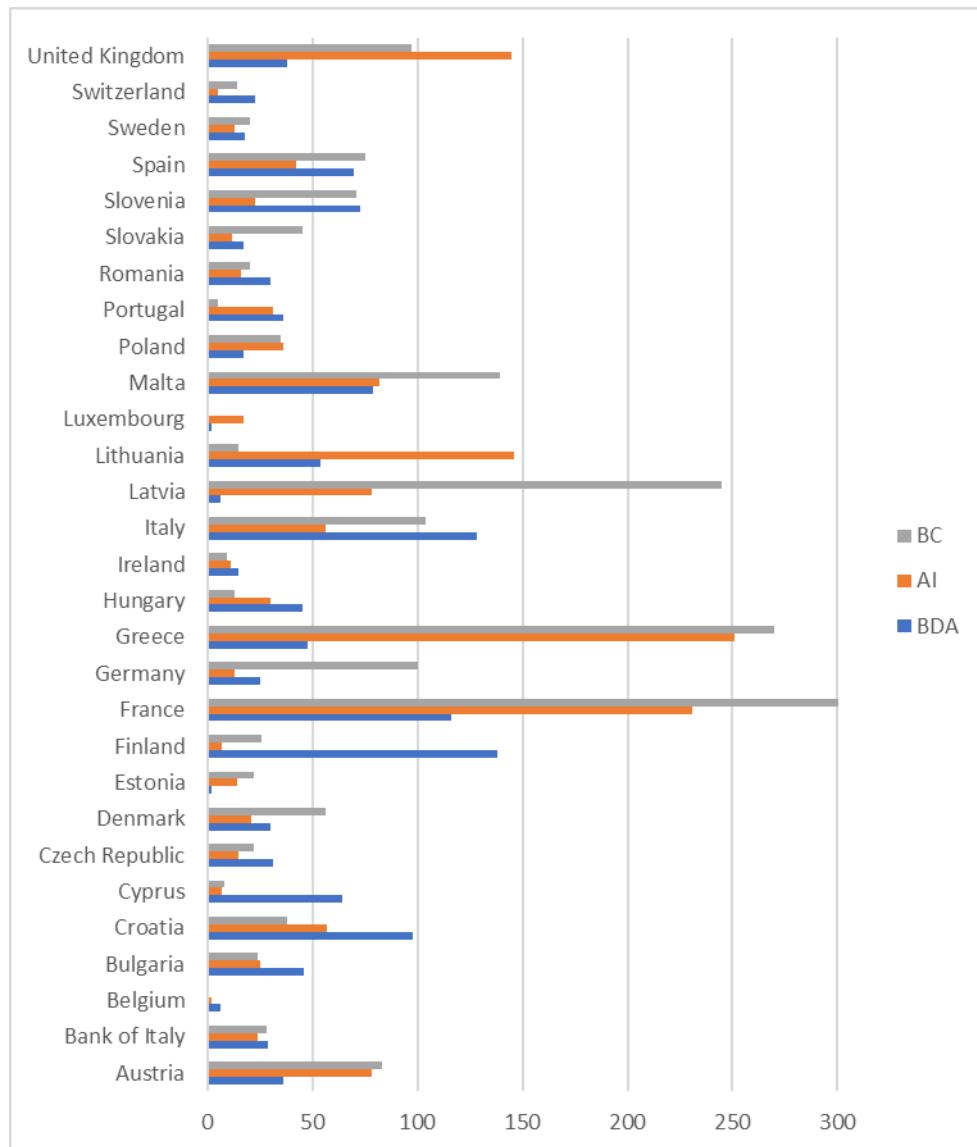
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B.7. Participation (registrations) to Suptech events - individual events

All participants (registrations) to Suptech events - individual events

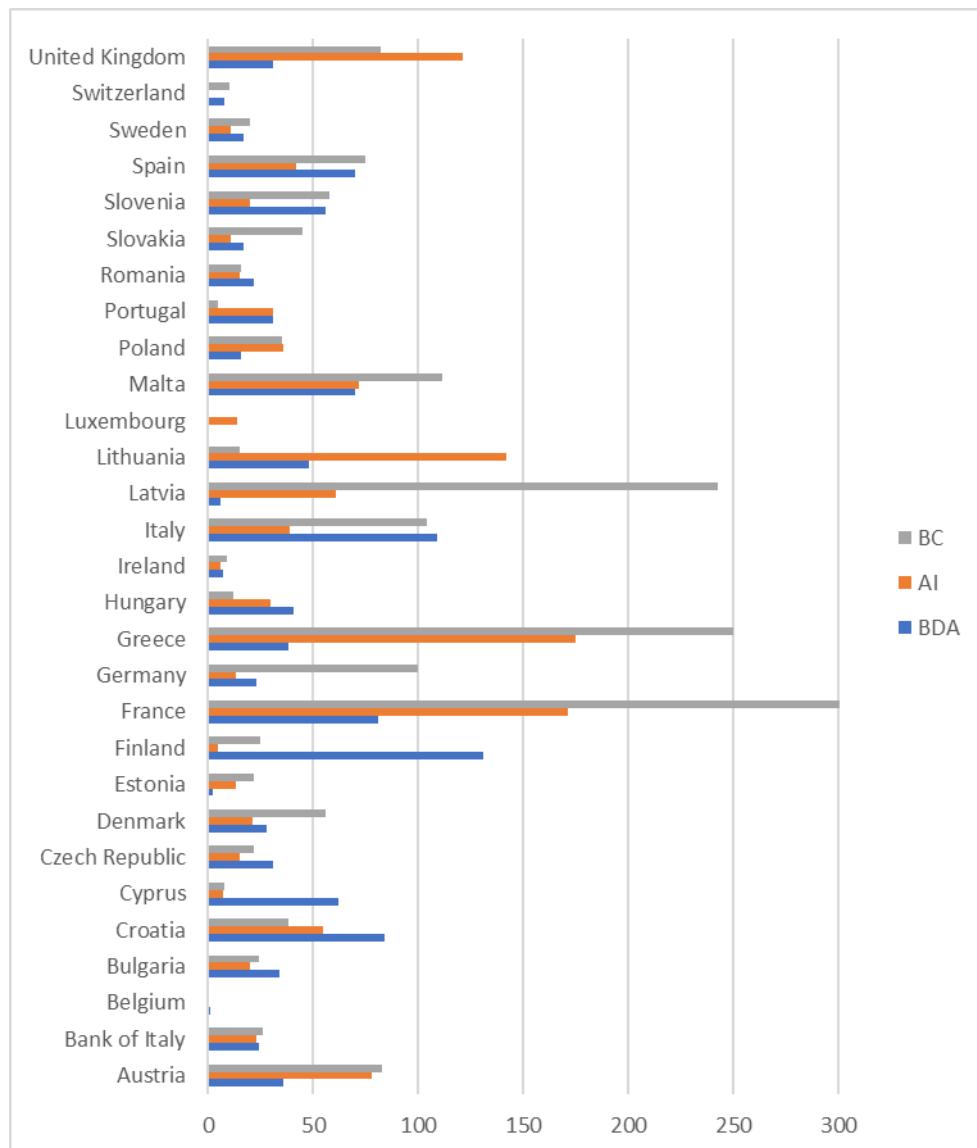


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All participants (registrations) to SupTech events (without Consortium Partners) - individual events



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B.8. Participation to Spin-off events:

SPECIAL WORKSHOP FOR BANKERS & INSURERS BDA AND AI	Event organized on the 29.11.2019 attended by representatives of EBA, ECB, EBF, KBC, Intesa San Paolo and DZ Bank.
Suptech ECB Frankfurt	30.01.2020 - Presentation of two use cases of the project. Use case I: network-based credit scoring models and Use case II: explainable AI in credit risk management. Attended by ECB representatives.
Suptech ESMA Paris	03.02.2020 - Presentation of two use cases of the project. Use case I: network-based credit scoring models and Use case II: explainable AI in credit risk management. Attended by ESMA representatives.
Suptech EBA Paris	03.02.2020 - Presentation of two use cases of the project. Use case I: network-based credit scoring models and Use case II: explainable AI in credit risk management. Attended by EBA representatives.
Roundtables_BC_Paris	The coordinator of the project, Professor Paolo Giudici attended 7 events, presenting the perspective of the project on AI and BC topics. Attended by several stakeholders. The Coordinator of the project was part of the roundtable
Workshop_ECB	21.11.2020 - Presentation of two use cases of the project. Use case I: network-based credit scoring models and Use case II: explainable AI in credit risk management. Attended by ECB representatives
Policy Workshop EBA	13.11.2020 - Libra or Librae? Basked Based Stable coins to Mitigate Foreign Exchange Volatility Spillovers use case was presented. Attended by interested stakeholders.
Risk and Opportunity of Central Bank Digital Currencies	04.05.2021 - Event organized by Zhaw with open enrollment on topics related to Digital Currencies.

B.9. Other type of activities and events held by partners

1. Virtual Events organised by Zhaw:

- ✓ 19th June 2020 11.00 – 12.00 Momentum and contrarian effects on the cryptocurrency market - an interactive shiny application | Prof. Pawel Sakowski, University of Warsaw
- ✓ 1st July 2020 10.00 – 11.00 Explainability of a Machine Learning Granting Scoring Model in Peer-to-Peer Lending | Prof. Javier Arroyo, UCM
- ✓ 30th September 2020 10.00 – 11.00 Blockchain for finance: Bond issuance and asset trading | Dr. Veni Arakelian, Senior Manager Piraeus Bank

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- ✓ 29th October 2020 11.00 – 12.00 Investing with Cryptocurrencies - On the Informative Effects of Experts Sentiment | Dr. Simon Trimborn, City University of Hong Kong
- ✓ 11th November 2020 10.00 – 11.00 Central Bank Digital Currencies | Henry Holden, Advisor – Bank for International Settlements - Innovation HUB
- ✓ 3rd December 2020 11.00 – 12.00 Portfolio Compression in Financial Networks: Incentives and Systemic Risk | Dr. Steffen Schuldenzucker, Goethe University Frankfurt
- ✓ 08 January 2021- 10.00 – 11.00 Blockchain Technology and Financial Regulation: A Risk-Based Approach to the Regulation of Initial Coin Offerings (ICOs) | Alexis Collomb & Primavera de Filippi, CNAM
- ✓ 12 March 2021 - 13.00 – 14.00 Blockchain Technology as a Regulatory Technology: From Code is Law to Law is Code | Samer Hassan, Universidad Complutense de Madrid
- ✓ 9 April 2021 - 09.00 – 10.00 FinTech, RegTech, and the Reconceptualization of Financial Regulation | Douglas W. Arner and Ross P. Buckley, University of Hong Kong and University of New South Wales
- ✓ 17 May 2021 - 11.00 – 12.00 Machine Learning Inference | Andreas Joseph, Bank of England

*all events had open participation

2. Events organised by Polimi

- ✓ November 9th, 2020 – 17.30 (CET) E. Barucci (Politecnico di Milano), A machine learning algorithm for stock picking built on information based outliers
- ✓ December 9th, 2020 - 17.30 (CET) J. D. Turiel (UCL-ICL, Barclays Investment Bank), Deep learning modelling of the limit order book
- ✓ January 18th, 2021 - 17.30 (CET) M. Azzone (Politecnico di Milano), A Machine Learning Model for Lapse Prediction in Life Insurance Contracts
- ✓ February 22nd, 2021 - 17.30 (CET) Charalampos Stasinakis (University of Glasgow) Big Data, Artificial Intelligence and Machine Learning: A Transformative Symbiosis in Favor of Financial Technology
- ✓ March 22nd, 2021 - 17.30 (CET) Valerio Potì (University College Dublin), COVID Narrative Risk: A Computational Linguistic Approach to the Econometric Identification of Narrative Risk During the COVID-19 Pandemic
- ✓ Big Data and Machine Learning in Finance Conference, June 10-11, 2021
- ✓ From Networks to Neural Networks in Finance - Lake Como School of Advanced Studies, 14-18 June 2021

*all events had open participation

3. Events organised by Warsaw

- ✓ 2021-02-22 Sakowski Paweł, Turovtseva Anna, "Verification of investment opportunities on the cryptocurrency market within Markowitz framework".
- ✓ 2021-03-22 Osowska Ewelina, Wójcik Piotr, "The impact of the content of Federal Open Market Committee post-meeting statements on financial markets – text mining approach".
- ✓ 2021-04-19 Chlebus Marcin, "XAI tools as a part of the best practices in model selection for business decision modelling. Example of marketing campaign success forecasting".
- ✓ 2021-05-17 Karimov Bedil, Wójcik Piotr, "Identification of scams in Initial Coin Offerings with machine learning".

*all events had open participation

4. Events organised by UBER

- ✓ September 23, 2020, 1030 - 1200 CET, The Webinar at ECB "FRM - Financial Risk meter", Wolfgang K. Härdle (HU Berlin) and Jochen Papenbrock (Firamis)
- ✓ December 10, 2020 1000-1300 CET, The 2nd Yushan Conference "FinTech & RegTech: Fundamentals Techs Apps",
- ✓ December 11, 2020 0600-0920 CET, The 2nd Yushan Conference "FinTech & RegTech: Fundamentals Techs Apps"
- ✓ May 17, 2021 1700-1800 CET, Manuela Veloso (JP Morgan AI Research and Carnegie Mellon University), "AI in Finance: Scope and Examples"
- ✓ Series of monthly research seminars "Transparency in Fintech"
 - 25.11.2020 1300-1400 CET, 1. Professor Dr. Stefan Lessmann (HU Berlin), "Fighting the Sampling Bias: A Framework for Training and Evaluating Scoring Models"; 2. Jovanka Lili Matic (HU Berlin& Deutsche Bank), "Valuation and risk management of cryptocurrency options"
 - 14.01.2021, 1400-1500 CET, Valerio Poti (UCD), "Application of methods from computational linguistics to gauge the effect of narrative about covid-19 on markets"
 - 11.02.2021, 1400-1500 CET, 1 Marianna Russo and Florentina Paraschiv (NTNU), A multifactor random field model for the term structure of interest rates 2 Wei Li and Denis Becker NTNU, Day-ahead electricity prices prediction applying hybrid models of LSTM-based deep learning methods and feature selection algorithms under consideration of market coupling
 - 11.03.2021, 1400-1500 CET, Xi Chen (University of Bath), Unrepresentative prior issue and Bayesian nested sampling
 - 08.04.2021, 1400-1500 CET, Anna Shchekina (HU Berlin), "FRM for Cryptos"

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- 13.05.2021, 1400-1500 CET, Wei Li (NTNU), Florentina Paraschiv (NTNU) and Georgios Sermpinis (UoG), "CBR for FRD"
- 10.06.2021, 1400-1500 CET, 1 Endre Jo Reite and Florentina Paraschiv NTNU Harvesting from customer loyalty in mortgage lending 2 Rui Ren (HU Berlin) "FRM Based on Expectiles".

*all events had open participation

5. Events organised/co-organized or attended by ASE (BUES)

- ✓ Fintech Workshop – ICESS 2020 – attended by the representatives of the National Bank of Romania, by the representatives of the Financial Supervision Authority from Romania and by the representatives of the Romanian Fintech Association – cooperation opportunities based on the activities and results of the Fintech Horizon 2020 Project.
- ✓ New Tech in the Financial Markets - Round Table – ICESS 2021 – 10th of June 2021, Table moderated by Vasile Alecsandru Strat.
- ✓ ASF Insurtech Meeting – Bucharest 24th of June 2021 – Presentation of the main outcomes of the Fintech Horizon 2020 Project to the Financial Environment in Romania (Fintechs, Insurance companies, associations of profile)..

* all events had open registration

6. Events where FIRAMIS (Dr. Jochen Papenbrock) was engaged and where the project and use cases were promoted and discussed

- ✓ 2019-12-06, "XAI-presentation at EIOPA Insurtech task force in Frankfurt"
- ✓ 2019-12-11, "representing fin-tech and XAI project at EU fintech lab in Brussels (most other fintech start-ups had XAI on the agenda as well)"
- ✓ 2019-11-20, "Euro Finance Week"
- ✓ 2020-02-05, Presentation and moderation of session "Session 3 - Data, Machine Learning & Artificial Intelligence"
- ✓ 2020-08-20, "AI Round Table", Frankfurt Institute of Risk Management
- ✓ 2020-09-03, "5th Conference on AI in Finance and Industry organized by the School of Management and Law of the Zurich University of Applied Sciences (ZHAW) with presentation about XAI"
- ✓ 2020-09-17, Webinar "AI in the Financial Industry - The better normal?", Frankfurt Digital Finance
- ✓ 2020-10-22, "AI Round Table", Frankfurt Institute of Risk Management

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- ✓ 2020-11-27, "[Bundesbank Innovation Challenge](#)",
- ✓ 2020-12-04 , "[AI Round Table](#)", Frankfurt Institute of Risk Management
- ✓ 2021-05-25, "Global Webinar Series on Artificial Intelligence, Explainability, and Trustworthiness in Financial Services presented jointly with World Economic Forum (WEF), World Alliance of International Financial Centers (WAIFC) and NVIDIA " – [NALA edition](#)
- ✓ 2021-06-22, "Global Webinar Series on Artificial Intelligence, Explainability, and Trustworthiness in Financial Services presented jointly with World Economic Forum (WEF), World Alliance of International Financial Centers (WAIFC) and NVIDIA " – [Europe edition](#)
- ✓ 2021-01-13, "[Explainable, accelerated machine intelligence in finance and insurance](#)", Thalesians London, [2nd promotion link](#)
- ✓ [Promotion of Global Webinar Series and GARP presentation](#)
- ✓ [Promotion of use case presentation at GTC](#) – one of the largest global AI conferences
- ✓ Another [Promotion of use case presentation at GTC](#) – one of the largest global AI conferences
- ✓ [2nd GAIA-X FAIC meeting, presentation of XAI use case extension](#)
- ✓ [Presentation at CFA Society New York](#)
- ✓ [Presentation at GARP](#)
- ✓ [GAIA-X panel to represent FAIC and FIN-TECH](#)

7. Joint events with other Horizon 2020 projects:

- ✓ Cybersecurity in Finance 30 October 2020: Fintech has been joined by several other H2020 projects tackling cybersecurity, including SOTER, CRITICAL-CHAINS, FINSEC, CyberSec4Europe, CONCORDIA and SPARTA (CAPE Programme), to exchange knowledge, lessons learned and best practices on cybersecurity with a focus on the financial sector. The joint virtual event was attended by 80 participants.
- ✓ Recent Security Advances in the Finance Sector 4 January 2021. The event has been an online training workshop on finance with the aim of understanding better the main security challenges faced nowadays by financial organizations and the newest solutions available to tackle them. The workshop stimulated a discussion about novel approaches in risk assessment and mitigation and help understand the role of leading technologies like Artificial Intelligence and Machine Learning in the resilience of financial institutions. During the workshop, H2020 projects SOTER, FIN-SEC and FIN-TECH presented their research on cybersecurity in the finance sector. The joint virtual event was attended by 50 participants.

C. Social – Media and Podcasts

C.1. LinkedIn account (metrics)

<i>Over 325 Posts</i>
<i>Over 1160 Followers</i>
<i>Over 100K Impressions</i>

C.2. Twitter account (metrics)

<i>Over 313 Posts</i>
<i>Over 260 Followers</i>
<i>Over 112K Reactions</i>

C.3. Podcasts (metrics)

<i>14 Podcasts</i>
<i>Over 940 Views</i>
<i>Over 11394 Impressions on LinkedIn</i>

Annex 1
Total number of BDA and AI and BC participants (registrations)

Country	AI	BDA	BC	Grand Total
Austria	78	36	83 (*AU)	197
Bank of Italy	24	29	28	81
Belgium	2	6	(*BE)	8
Bulgaria	25	46	24	95
Croatia	57	98	38	193
Cyprus	7	64	8 (*CY)	79
Czech Republic	15	31	22	68
Denmark	21	30	56	107
Estonia	14	2	22	38
Finland	7	138	26	171
France	231	116	1155 (*F)	1502
Germany	13	25	100 (*G)	138
Greece	251	48	270 (*GR)	569
Hungary	30	45	13	88
Ireland	11	15	9	35
Italy	56	128	104	288
Latvia	78	6	245	329
Lithuania	146	54	15	215
Luxembourg	17	2	(*LX)	19
Malta	82	79	139(*M)	300
Poland	36	17	35	88
Portugal	31	36	5	72
Romania	16	30	20	66
Slovakia	12	17	45	74
Slovenia	23(*SL)	73(*SL)	71(*SL)	167
Spain	42	70	75	187
Sweden	13	18	20	51
Switzerland	5	23	14	42
United Kingdom	145(*UK)	38(*UK)	97 (*UK)	280
Grand Total	1488	1320	2739	5547

1. Some registrations for Estonia, Latvia and Lithuania have attended an event which was a mix between BDA and AI.
2. * Participation to the Greece/Cyprus BC Suptech on the 12.02.2021 were divided 3% Cyprus and 97% Greece (similar distribution as for SupTech AI).
3. (*BE) and (*LX) - The BC Suptechs for Luxembourg and Belgium were not completed.
4. *G – the participants to the event were registered with BuBa system and only aggregate details are available.
5. *AU, *F – registered with own systems with few details.
6. *SL - participants were not registered with the structured forms.
7. *UK – participants were not registered (tailored events) with the structured forms.

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8. *M – recordings done with the supervisor’s internal system and we hypothesize that 80% of the attendees were not Fintech Consortium Partners

Total number of BDA and AI and BC participants (registrations)

Country	AI	BDA	BC	Total
Austria	78	36	83	197
Bank of Italy	23	24	26	73
Belgium	-	1	-	1
Bulgaria	20	34	24	78
Croatia	55	84	38	177
Cyprus	7	62	8	209
Czech Republic	15	31	22	68
Denmark	21	28	56	105
Estonia	13	2	22	37
Finland	5	131	25	161
France	171	81	1041	1293
Germany	13	23	100	136
Greece	175	38	250	331
Hungary	30	41	12	83
Ireland	6	7	9	22
Italy	39	109	104	252
Latvia	61	6	243	310
Lithuania	142	48	15	205
Luxembourg	14	-	-	14
Malta	72	70	111	253
Poland	36	16	35	87
Portugal	31	31	5	67
Romania	15	22	16	53
Slovakia	11	17	45	73
Slovenia	20	56	58	134
Spain	42	70	75	187
Sweden	11	17	20	48
Switzerland	-	8	10	18
United Kingdom	121	31	82	234
Grand Total	1247	1124	2535	4906

. Hypothesis 1 to 8 were also considered for the construction of this table

7.3 D7.5 - Event feedback repository

Deliverable information

WP NO.	WP 7
DEL.	D7.5
DEL. NO.	D27
TITLE	Event feedback repository
DESCRIPTION	Firamis (M1-M15) and ASE Bucuresti (M16-end of the project) is responsible for collecting and sharing feedbacks from the participants to SupTech and RegTech workshops.
NATURE	Websites, patents filling, etc.
EST. DEL. DATE	30 June 2021

Document information

DATE	28/06/2021
WRITTEN BY	Bucharest University of Economic Studies
APPROVED BY	Anca Mirela TOMA

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LinkedIn account (metrics) / Over 325 Posts / Over 1160 Followers / Over 100K Impressions

Twitter account (metrics) / Over 313 Posts / Over 260 Followers / Over 112K Reactions

Podcasts (metrics) / 14 Podcasts / Over 940 Views / Over 11394 Impressions on LinkedIn

Network models are of significant interest

Explainable Artificial Intelligence is essential

ICOs, stable-coins are useful and more on cybersecurity is needed

Introductory standardized material for each topic is highly appreciated

More practical use cases would be a plus in the future and less technical presentations

Bringing all stakeholders together: regulators, supervisors, business and academia in over 100 events

The deliverable D7.5 presents the evaluation of the contents presented during the events held into the Horizon 2020 Fintech Project over its 30 months. The deliverable presents different statistics in order to capture the magnitude of the project.

The report is organised around the main type of activities/events organised in the project:

- 1. Research events**
- 2. Regtech events**
- 3. Suptech events**
- 4. Spin-off events**
- 5. Social media and online activity**
- 6. Other type of activities and events held by partners**

During the Suptech activities, the Regtech activities the participants were kindly requested to rate the presented use cases based on the following characteristics:

- Explainability (min. 1 – max. 5)
- Predictive Accuracy (min. 1 – max. 5)
- Utility (min. 1 – max. 5)

The participants were also kindly invited to assess the overall quality of the event. rating (min. 1 – max. 5). For the research events since the flexibility of the structure was very high and the events were organized around: discussion panels, round tables, key note talks, etc, the participants were kindly invited to evaluate the quality of each item using the same scale, 1 to 5.

A. Type of events organised by the Consortium

A.1. Research events

The Fintech Horizon2020 Project included over its 30 months 6 Research events organised by the partners, as described below. Among the main objectives of the events were: monitoring the activity of the project, opening the activity of the project to international stakeholders and providing a discussion platform for the latest research and training activity conducted by the project partners.

 University of Pavia	 ZHAW Zurich university for applied science	 The Bucharest University of Economic Studies
FINTECH Horizon 2020 Kick-off PAVIA 01.02.2019	Research Event Big Data Analytics WINTHERTUR 03.09.2019	Research Event Mild-Term Workshop BUCHAREST 13.11.2019

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	*UBER co-organizer	
 University College London	 ZHAW Zurich university for applied science	 Humboldt University of Berlin
Research Event Artificial Intelligence LONDON 19.05.2020	Research Event Blockchain WINTHERTUR 25.03.2021	FINTECH Horizon 2020 Closing Event BERLIN June 2021

A.2. Regtech events

The Fintech Horizon2020 Project included over its 30 months 6 Regtech events organised by the partners, as described below. The main objective of the events was to present the technical part of the use cases to all interested parties, including: Consortium partners, national and international supervisors, international regulators, and practitioners. The events were focused mainly on the R code and on the datasets used by the use cases.

 modefinance	 Firamis GmbH	 ZHAW Zurich university for applied science
RegTech MILANO 29.03.2019 Big Data Analytics	RegTech FRANKFURT 28.06.2019 Big Data Analytics	RegTech WINTERTHUR 04.09.2019 Arficial Intelligence

 <p>WU WIRTSCHAFTS UNIVERSITÄT WIEN VIENNA UNIVERSITY OF ECONOMICS AND BUSINESS</p> <p>WU Vienna University of Economics and Business</p>	 <p>UNIVERSIDAD COMPLUTENSE MADRID</p> <p>Universidad Complutense de Madrid</p>	 <p>UNIVERSITÉ PARIS I PANTHÉON SORBONNE</p> <p>Pantheon-Sorbonne University</p>
<p>RegTech WIEN 26.02.2020 Artificial Intelligence</p>	<p>RegTech MADRID 23.10.2020 Blockchain</p>	<p>RegTech PARIS 24.03-01.04.2021 Blockchain</p>

A.3. Suptech Workshops and Spin-off events

The Fintech Horizon2020 Project included over its 30 months 87 Suptech events (Belgium and Luxembourg have a special situation) organised by the partners, at national level, as described below. Each partner was responsible of organising a national level Big Data Analytics Suptech, an Artificial Intelligence Suptech and a Blockchain Suptech. The main objective of the events was to present the use cases developed under the three main pillars to the national supervisors and to obtain their feedback. Another important objective was to help creating a common understanding of the presented concepts at the level of all EU (plus Switzerland) national level supervisors. The events also tried, where possible to bring together several supervisors with the practitioners representing Fintechs, Banks, Insurance companies and other interested stakeholders.



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ROMANIA	SLOVAKIA	SLOVENIA	SPAIN	SWEDEN	SWITZERLAND	UNITED KINGDOM

B. Evaluations

B.1. The overview of the project

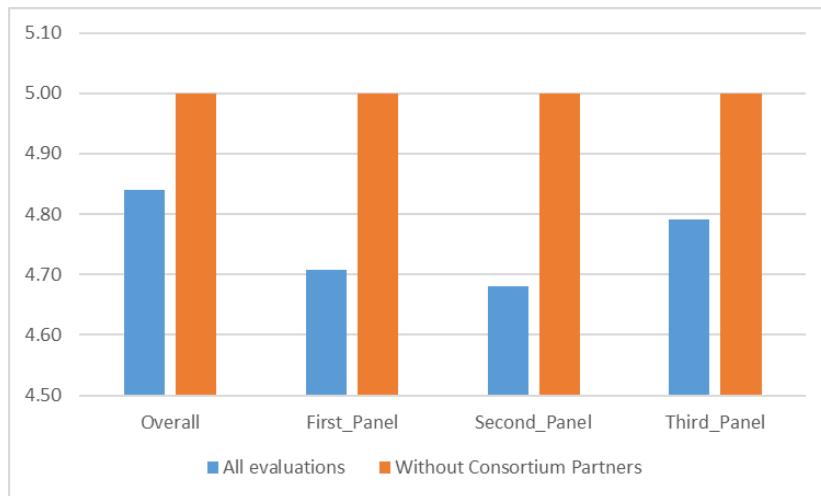
<i>Over 87 Suptech events and over 1030 Evaluations + qualitative feedback</i>	<i>6 Research events and almost 120 evaluations</i>	<i>6 Regtech events and almost 115 evaluations</i>
<i>Over 11 Spin-off events and qualitative feedback received</i>	<i>Over 14 podcasts and 940 views</i>	<i>Over 325 LinkedIn posts and 1160 followers</i>

B.2. Research events evaluation – overview

B.2.1. Kick-off Meeting Pavia

All evaluations	Without Consortium Partners (CP)
20 evaluations	1 evaluations
Overall evaluation 4.4	Overall evaluation 5

B.2.2. Research Winterthur



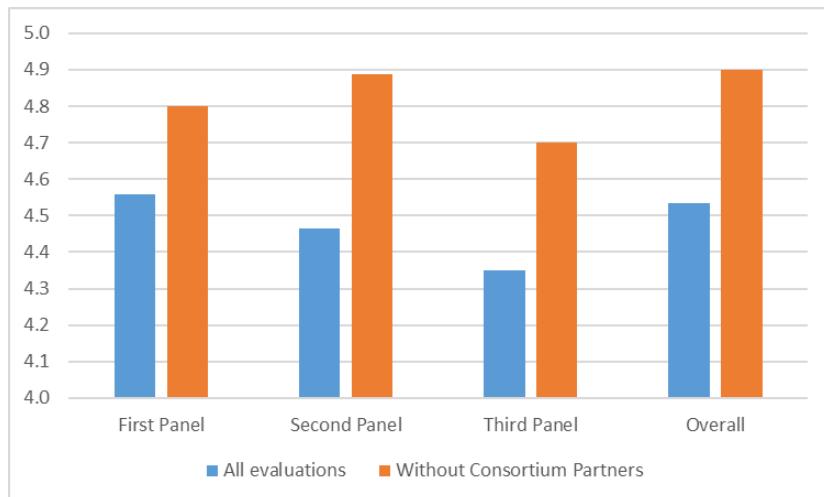
All evaluations	Without Consortium Partners (CP)
25 evaluations	3 evaluations
Overall evaluation – not requested	Overall evaluation – not requested

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B.2.3. Mid-term Bucharest

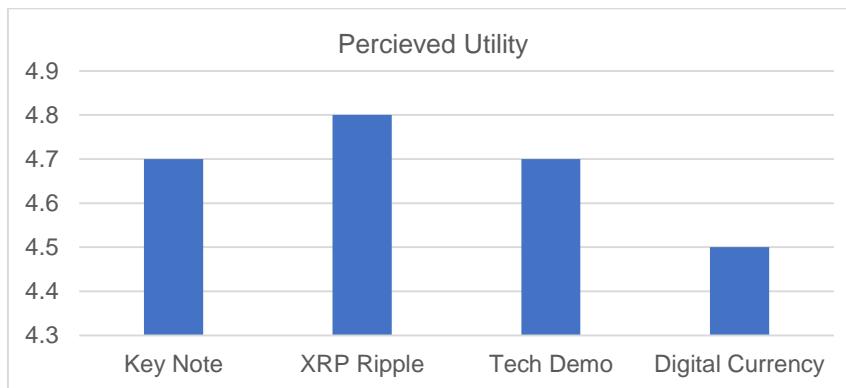


All evaluations	Without Consortium Partners (CP)
43 evaluations	10 evaluations
Overall evaluation – not requested	Overall evaluation – not requested

B.2.4. Research London

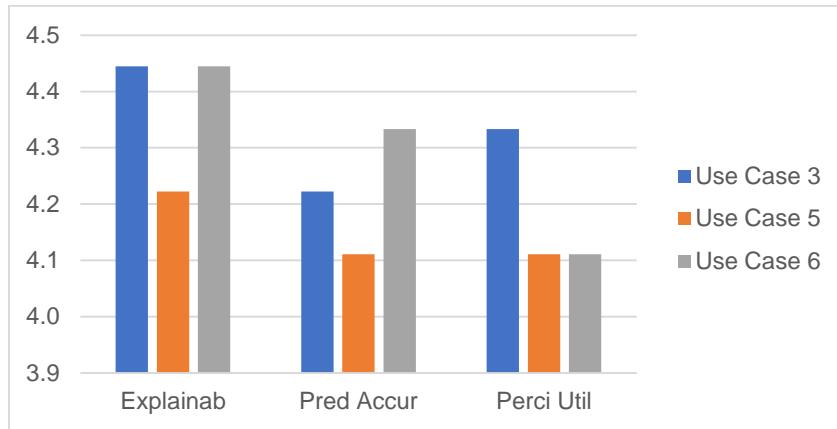
The feedback for the AI meeting in London on May 2020 was collected by direct enquiring the participants both form the regulator side and the industry part. The feedback is somehow continuing; indeed, this EU project facilitated the formation of a permanent group of interest on the topic of FINTECH, AI and Blockchain that is now meeting regularly. The May event in London was judged extremely useful interesting by the participants. Despite being online, it was still at the beginning of the COVID online shift and therefore it kept some momentum and excitement. We had the usual presentations in format of panels from project participants that were all well received, but we also had all our international advisors that gave an invited talk projecting the topics onto a global scale. The audience was well mixed between practitioners, academics and regulators with several being actually the same person. Indeed, London is a very dynamic town where jobs rarely last over two years and people move between these compartments in a fluid fashion. Together with the panel and invited talks we had sections of ‘junior’ presenters that brought novelty and enthusiasm into the arena. We had a 9h long uninterrupted activity, all recorded for anyone’s curiosity and for reference.

B.2.5. Research Winterthur



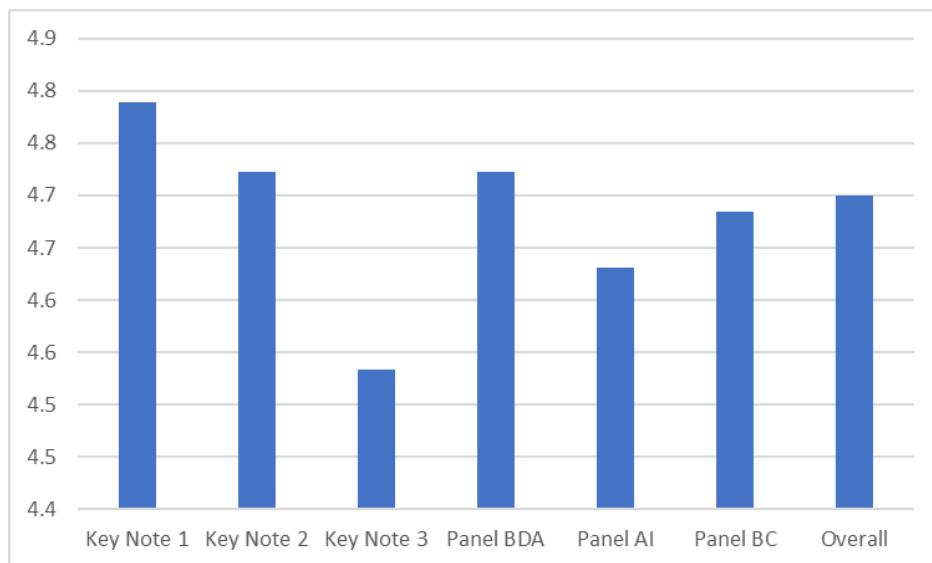
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All evaluations	Without Consortium Partners (CP)
10 evaluations	3 evaluations
Overall evaluation – 4.7	Overall evaluation – 4.0
Use Case 3 and Use Case 5 considered best use cases	

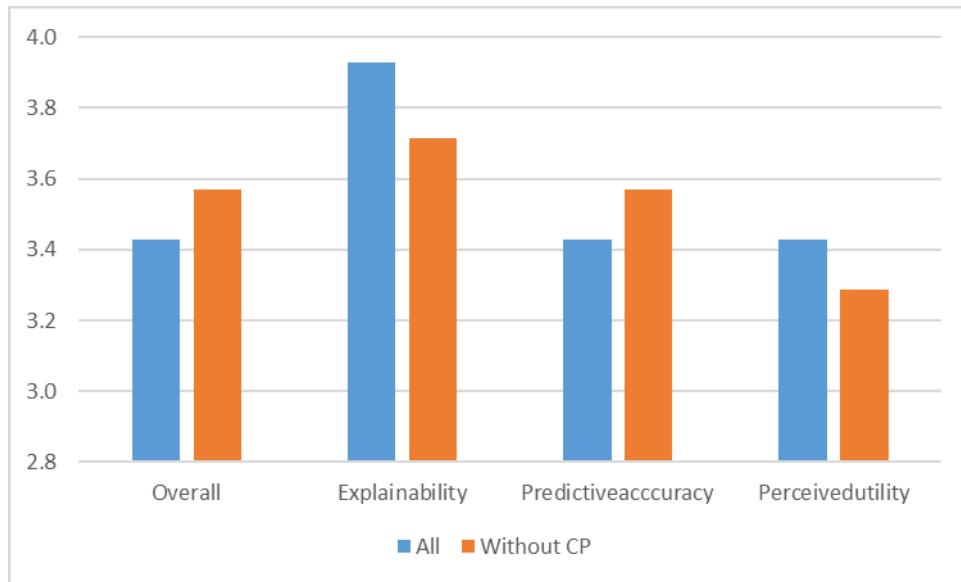
B.2.6. Closing Event Berlin



All evaluations	Without Consortium Partners (CP)
20 evaluations	3 evaluations
Overall evaluation – 4.7	Overall evaluation – 5.0
Key Note Talk 1 and the Panel about BDA were graded with the highest average	

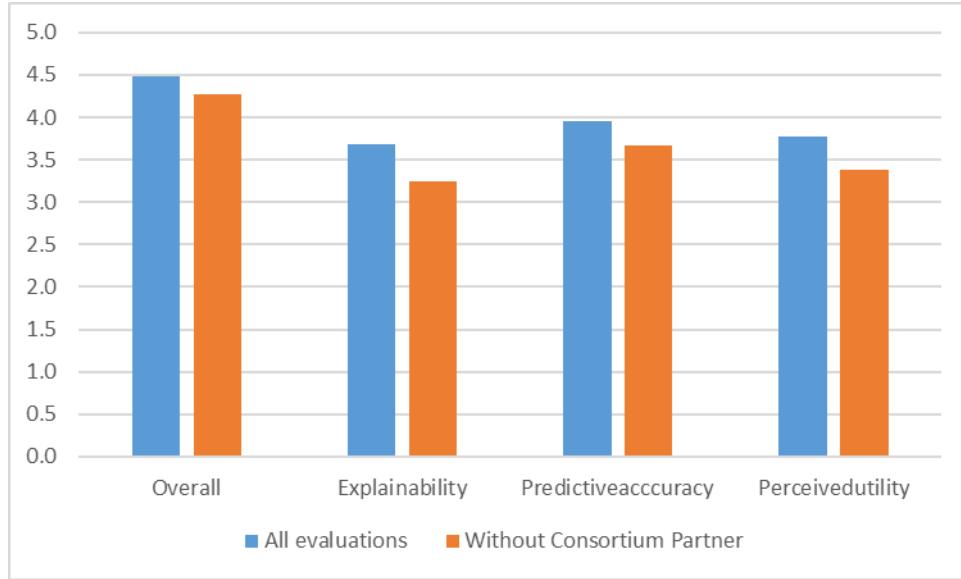
B.3. Regtech events evaluation – overview

B.3.1. Regtech Milano



All evaluations	Without Consortium Partners (CP)
14 evaluations	7 evaluations
Best Use Case - Use Case 1	Best Use Case - Use Case 1

B.3.2. Regtech Frankfurt

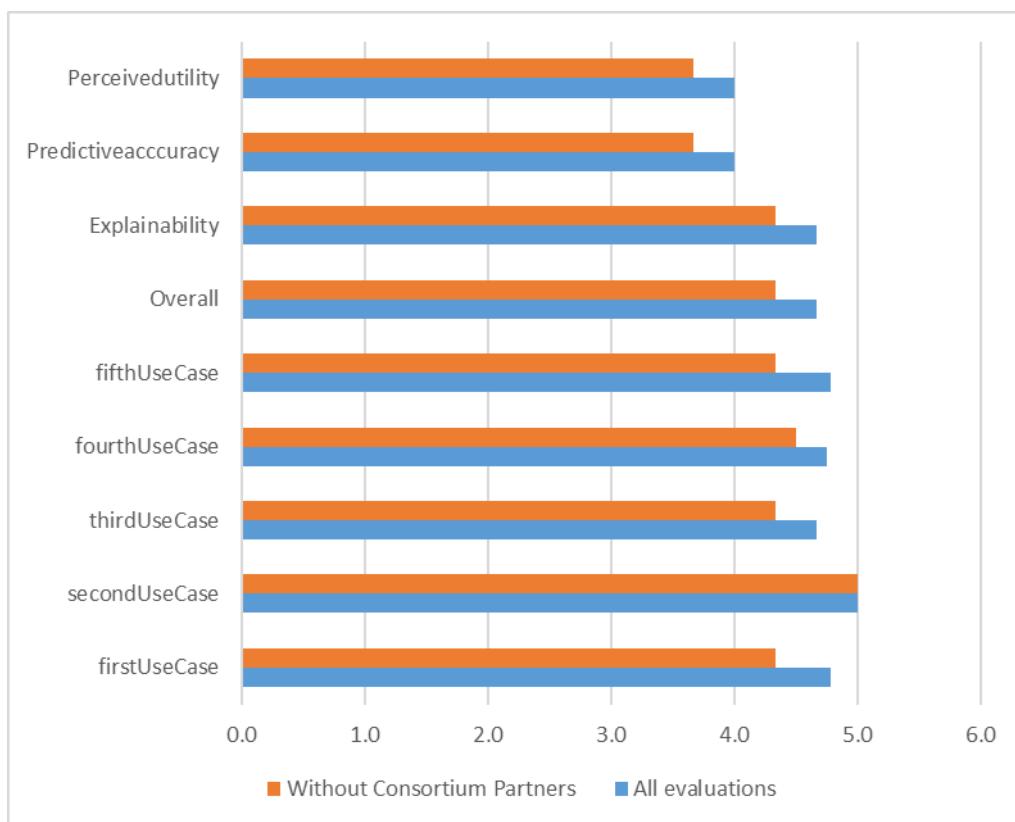


All evaluations	Without Consortium Partners (CP)
25 evaluations	12 evaluations
Best Use Case - Use Case 1	Best Use Case - Use Case 1

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B.3.3. Regtech Witerthur

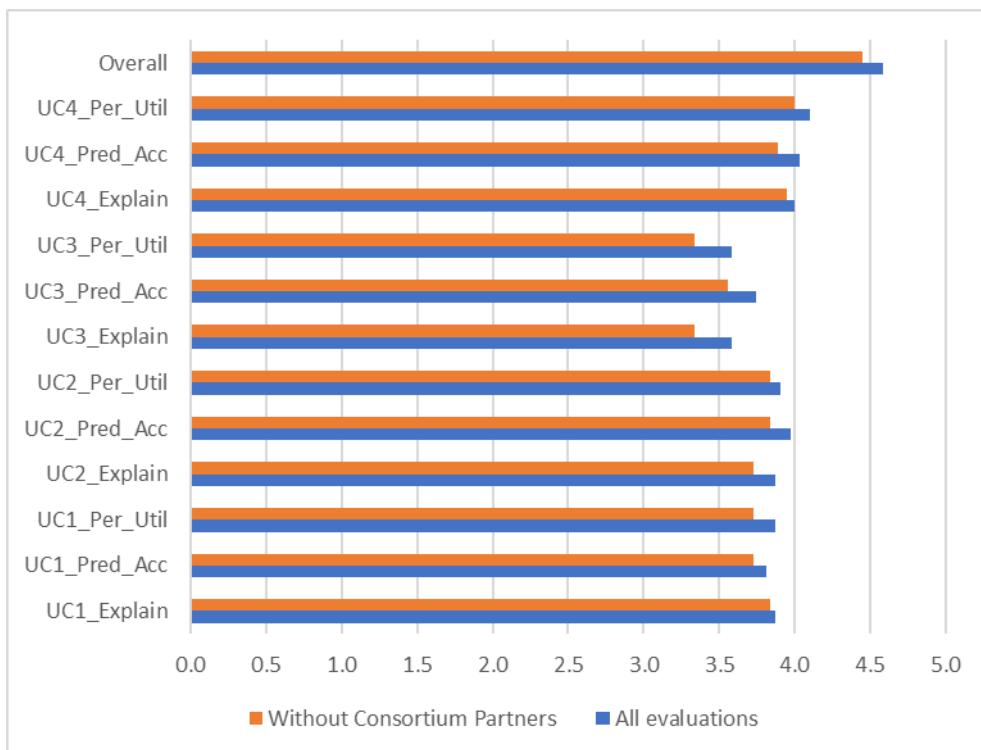


All evaluations	Without Consortium Partners (CP)
9 evaluations	3 evaluations
Best Use Case - Use Case 3	3, 4 and 5 – each one vote

B.3.4. Regtech Wien

For Regtech Wien the feedback was not collected in a structured manner using forms and a more qualitative approach was preferred. The connection between the WU and the national Supervisor FMA is continuous and FMA has appointed a special person as liaison between the academic team of the project and the supervisor. The contacts are conducted on a monthly basis, for updates and exchange of ideas. FMA considers the AI use cases a very useful application of AI in the realm of FinTech, RegTech and SupTech, and would appreciate to have more use cases presented (3 might not be enough for covering the field sufficiently). The use cases presented were considered very interesting and a clear focus and interest was raised by the Explainable AI case.

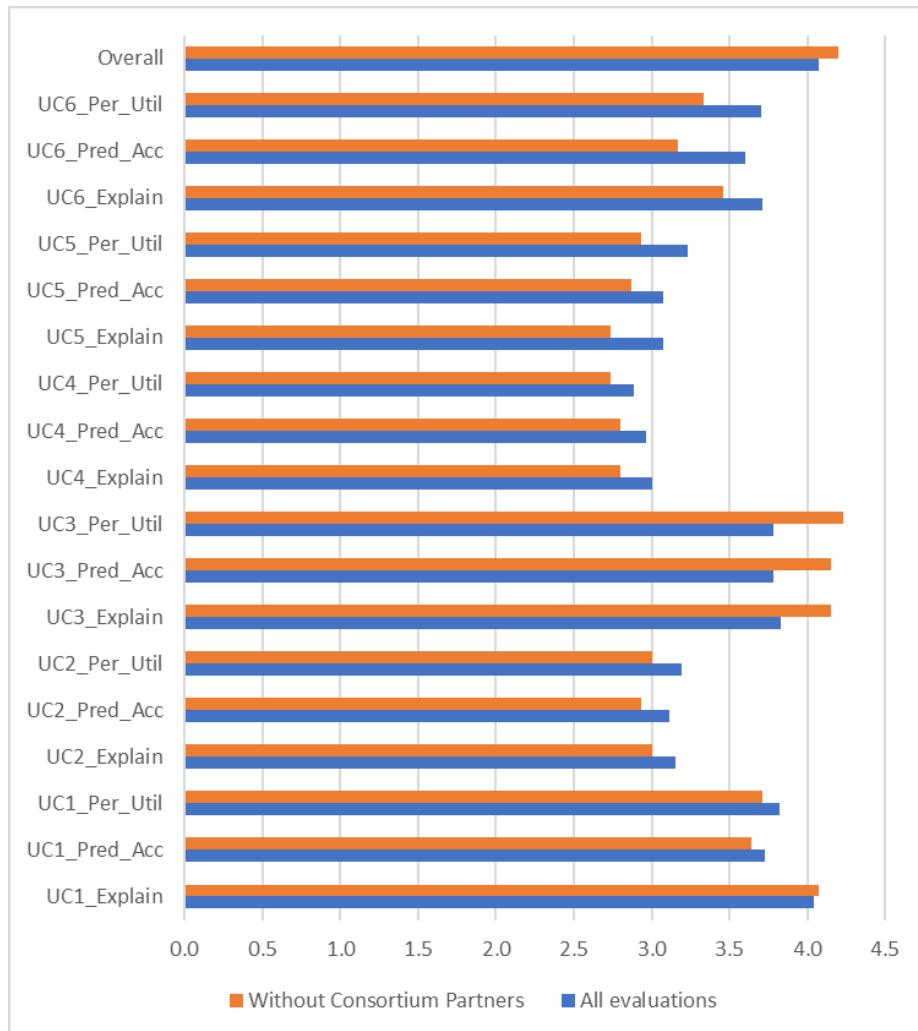
B.3.5. Regtech Madrid



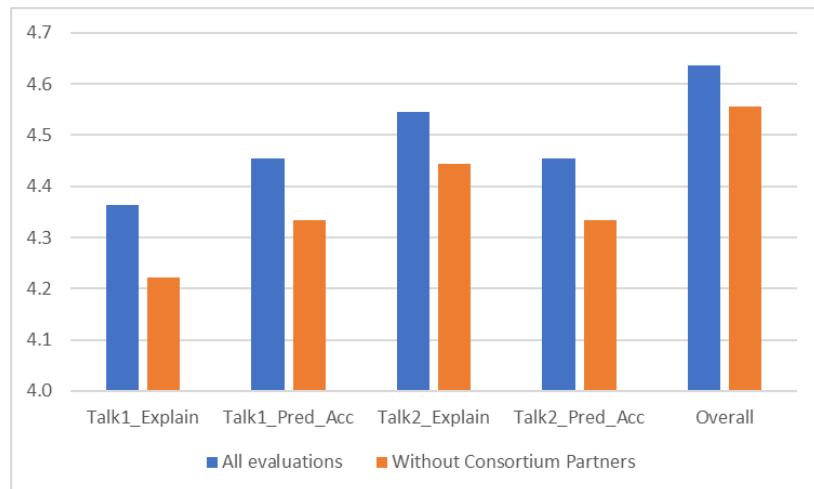
All evaluations	Without Consortium Partners (CP)
31 evaluations	18 evaluations
Best Use Case - Use Case 4	Best Use Case - 2 and 4, each five votes



B.3.6. Regtech Paris



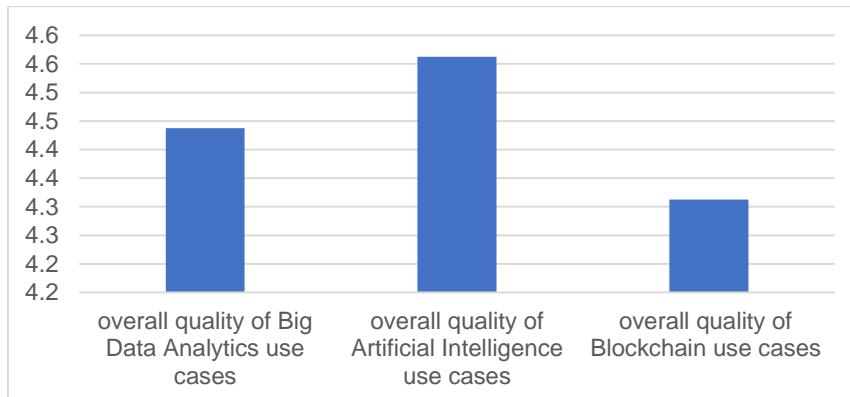
All evaluations	Without Consortium Partners (CP)
25 evaluations	15 evaluations
Best Use Case - Use Case 2	Best Use Case - 2 and 5, each four votes



All evaluations	Without Consortium Partners (CP)
11 evaluations	9 evaluations
Best Talk – Talk 1	Best Talk – Talk 1

B.4. Suptech events evaluation – overview

Overall evaluations (June 2021) of the Suptechs from the Supervisors

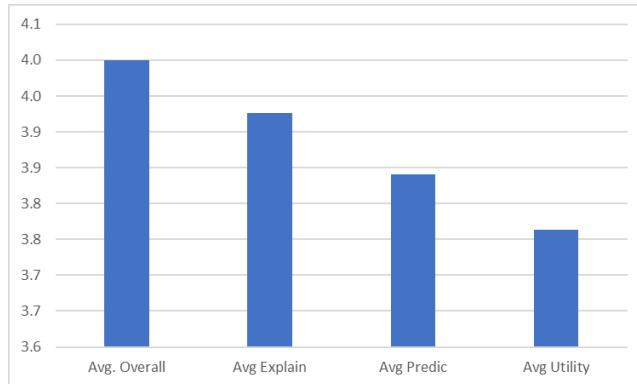


17 supervisors have answered the survey

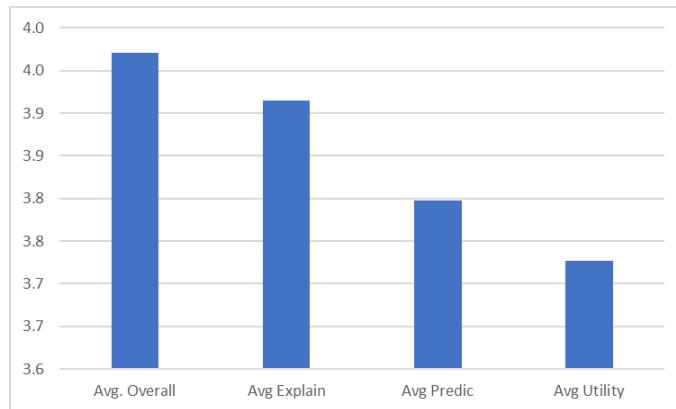
Main pluses
+ Getting together academia, public and private institutions throughout Europe and sharing diverse perspectives.
+ Knowledgeable instructors.
+ Artificial Intelligence use cases.
For the future
x Further potential topics: CyberRisk and Cloud (Risks & Developments)
x supervisors will be in great demand for training covering both topics generated by MiCA and DORA
x More in-depth and hands-on use cases



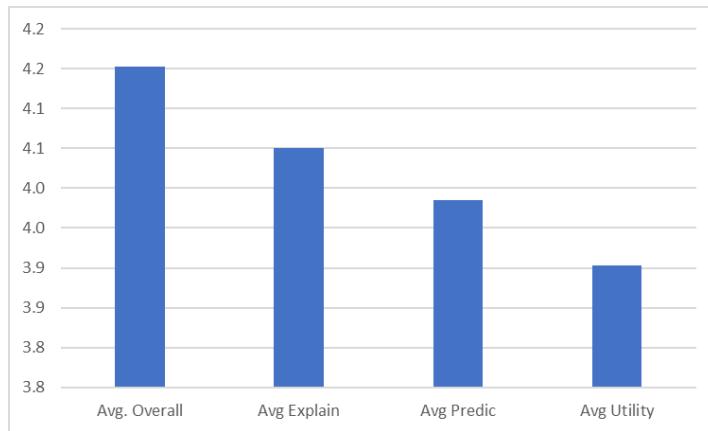
Average evaluations for BDA Suptechs – all evaluations



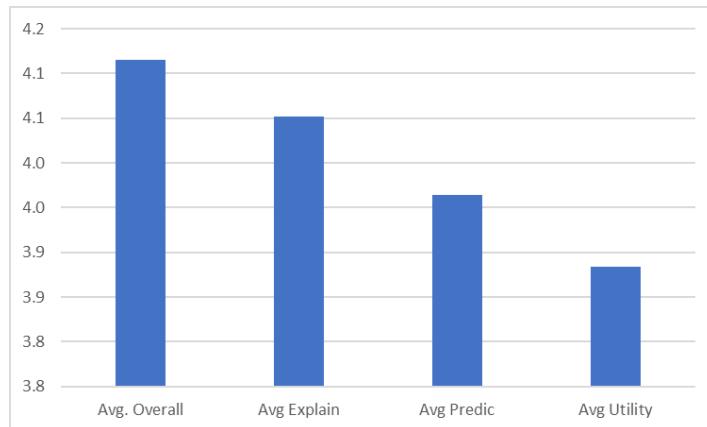
Average evaluations for BDA Suptechs – all evaluations without Consortium Partners



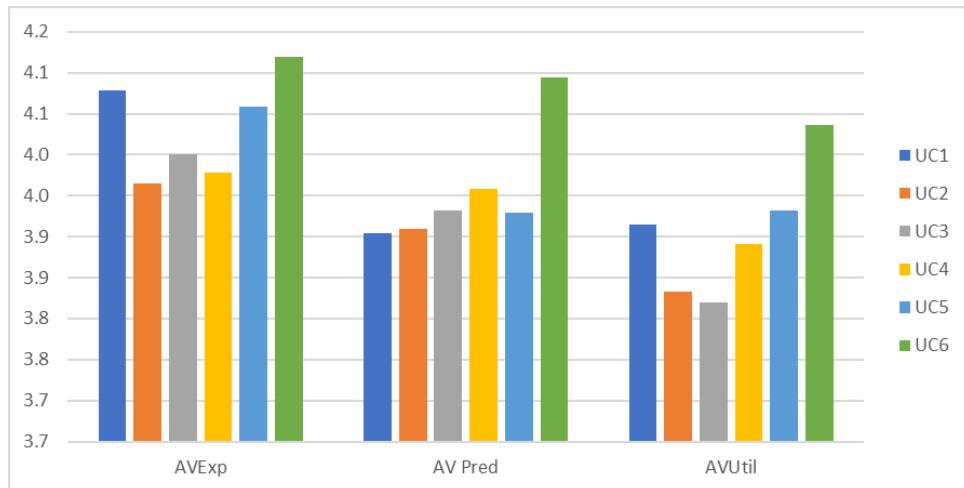
Average evaluations for AI Suptechs – all evaluations



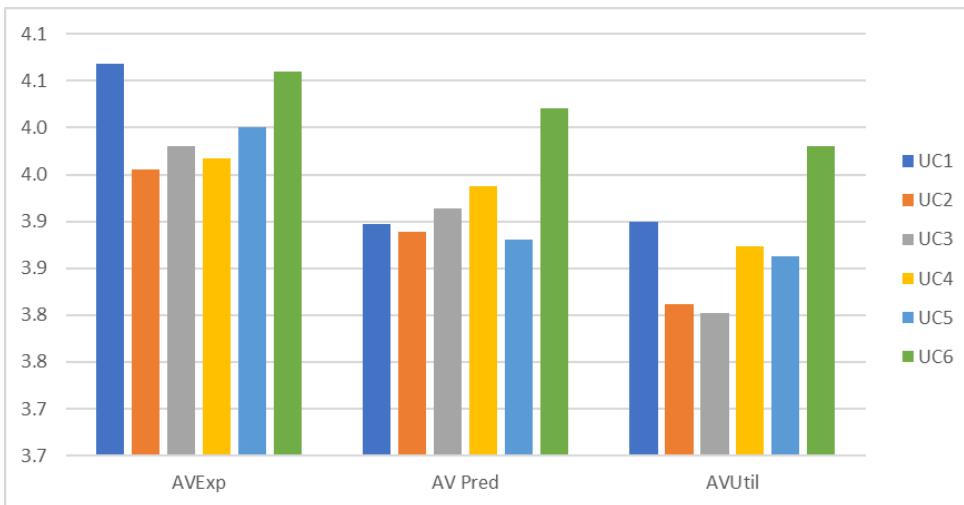
Average evaluations for AI Suptechs – all evaluations without Consortium Partners



Average evaluations for BC Suptechs – all evaluations



Average evaluations for BC Suptechs – all evaluations without Consortium Partners



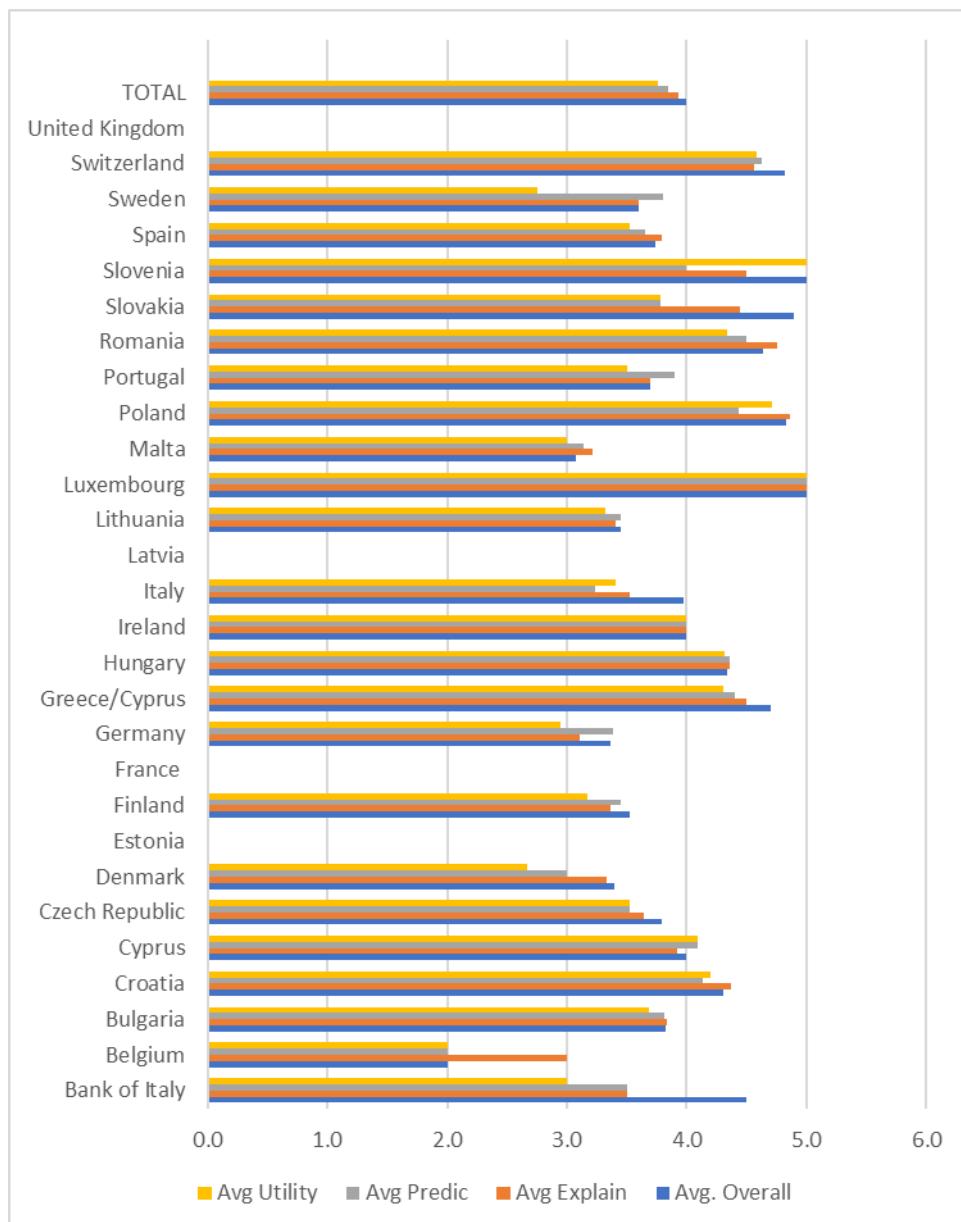
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B.5. Evaluation from Suptech events - individual events

Average evaluations for each BDA Suptechs – all evaluations

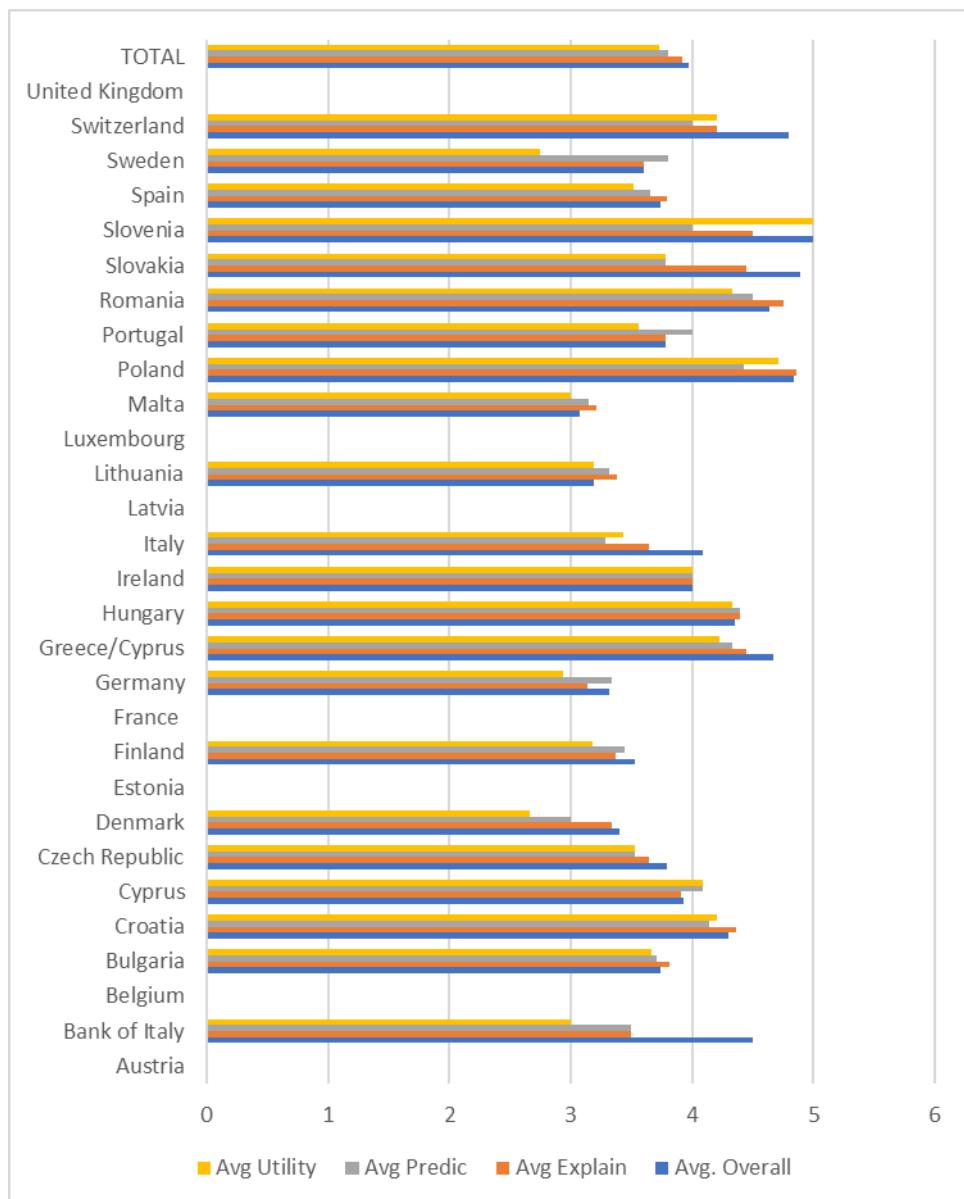


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Average evaluations for each BDA Suptechs – all evaluations without Consortium members

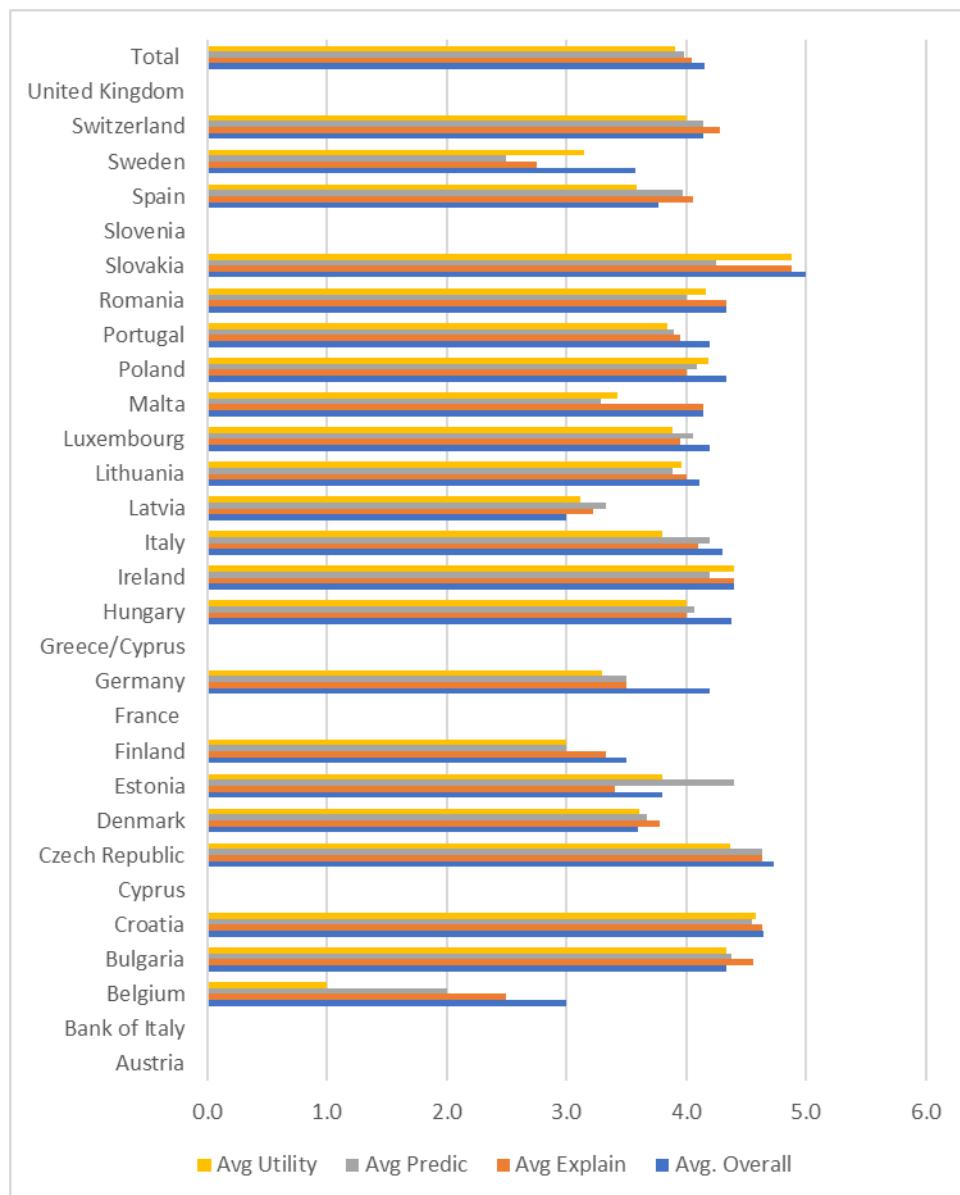


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Average evaluations for each AI Suptechs – all evaluations

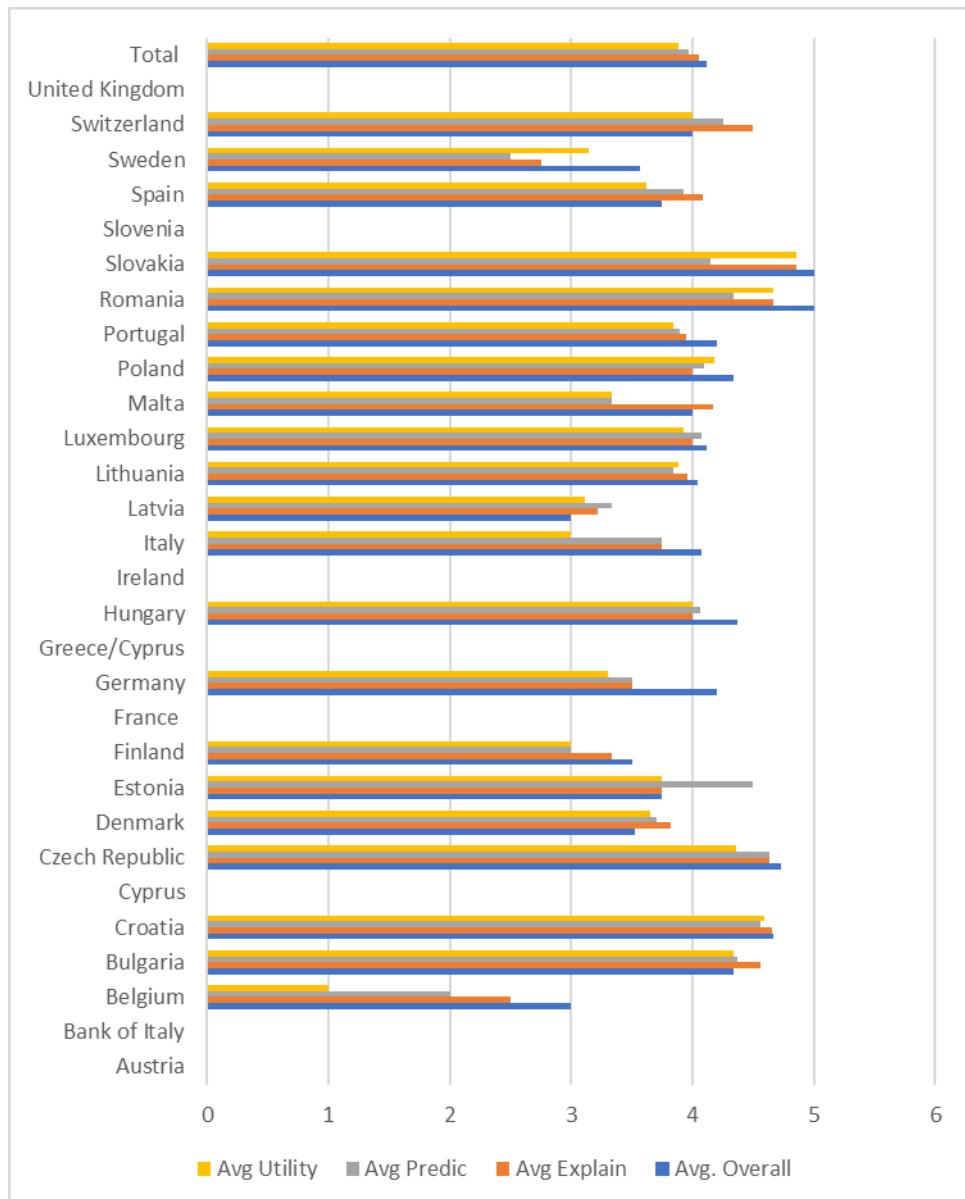


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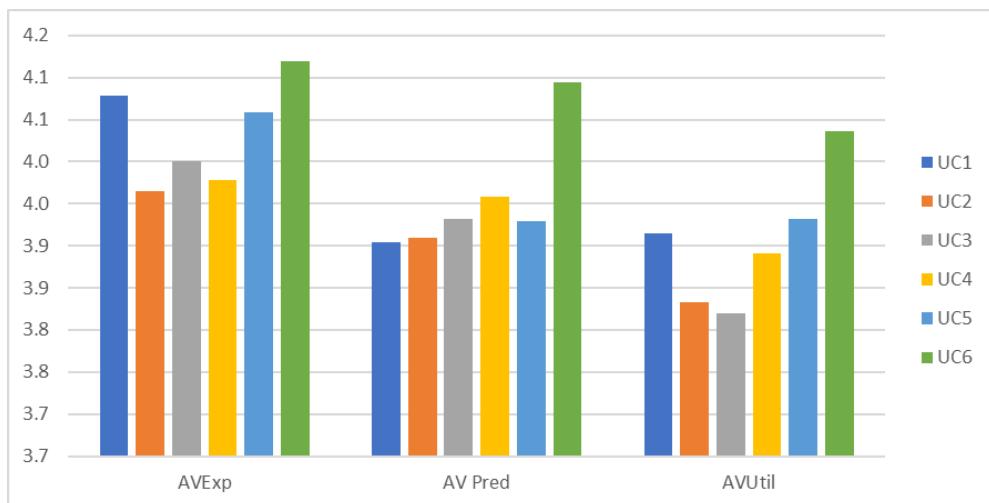
Average evaluations for each AI Suptechs – all evaluations without Consortium members



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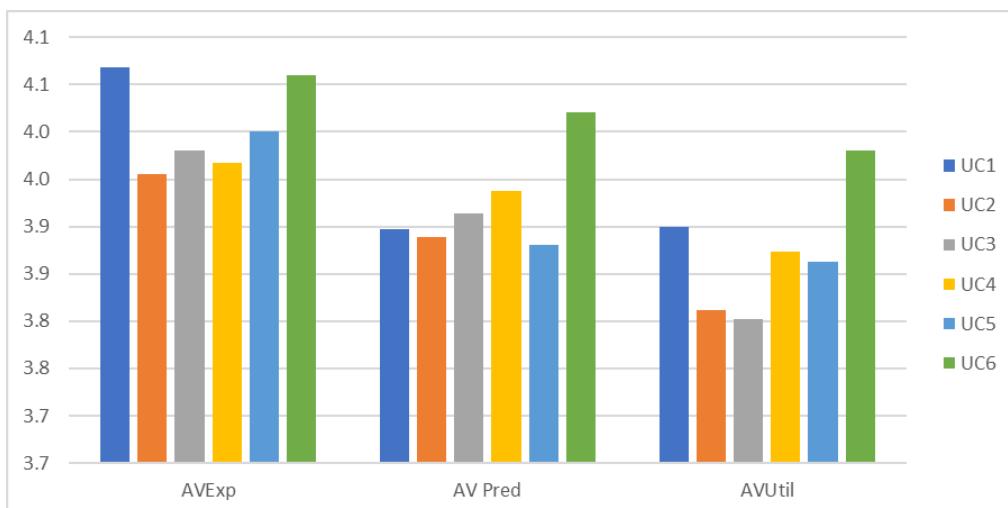
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Average evaluations for BC Suptechs – all evaluations



** evaluations for individual Suptechs are presented in the following tables (in chart form they are difficult to follow)

Average evaluations for BC Suptechs – all evaluations without Consortium members



** evaluations for individual Suptechs are presented in the following tables (in chart form they are difficult to follow)

B.6. Main take-aways and feedback from Spin-off events:

The spinoff events were jointly organized with other stakeholders or were designed to cater to some specific needs. The events were not evaluated in the structured manner since they were not focusing *This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 825215 (Topic: ICT-35-2018 Type of action: CSA)*

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only on the use cases but have been platforms were discussions among researchers and practitioners were facilitated. The models and use cases presented were of interest but they can be further improved both in terms of modeling and data used. New and significantly larger data base would be of real use. Some of the most pertinent comments made are:

- For P2P lending models the default concept needs to be clarified and more data (longer time series) would be useful. Inclusion of behavioral information could help the models and since behavior is important constant re-estimation is needed. (Creval 26.11.2019)
- AI and explainability is essential since 5% of the investment budget of the entity is invested in AI. Security and data privacy were other aspects of interest. The fairness of the AI algorithms is another important topic (DZ Bank 12.12.2019).
- It is not clear if the proposed use cases and methods actually bring an improvement. However, network models are new information. The proposed algorithms and methods (such as - Shapley values for explainability) should be further explained and more details are needed for assessing their practical implications (Intesa Sanpaolo Bank).
- The use of machine learning in models in assessing risks in P2P lending environments is considered useful. However, the presented model shows substantial invariance and it is not clear what and how it brings improvements. However, the research can be further extended and useful results might be reached (Illimity).
- Practical usability for the classical bank sector would need to be clarified. Several limitations like outlier removal should be overcome and other data cleansing steps are necessary. More details on the used data is needed and larger samples are important. The hypothesis of the methodology should be further verified. More investigation is needed before assessing the validity. However, the idea is very promising (NORD L/B).
- The project, by opening a constructive and cross-country dialogue, allowed for a practical and theoretical conversation on how not only to preserve but improve the risk management in innovative credit scoring models. (Marta Ghiglioni, former General Manager @ ItaliaFintech).
- Credit scores represent just one of the many models, governed by AI and data science, crucial for the entire finance and economics world -no more seen as a competitor but a partner from the traditional finance and banks- allowing a rapid and more democratic access to advanced tech solutions, to SMEs and professionals worldwide (Antonio La Mura, former Business Development Director @ Fintech District).
- The application of AI and advance analytics techniques makes steps forward with event like this, where interesting use cases are presented and well explained. With these opportunities it is possible to understand how to create real value starting from data (Nicholas Parini, former Head of Data @ Moneymour -acquired by Klarna).

B.7. Other type of activities and events held by partners

1. Events organised by Zhaw:

- ✓ 19th June 2020 11.00 – 12.00 Momentum and contrarian effects on the cryptocurrency market - an interactive shiny application | Prof. Paweł Sakowski, University of Warsaw
- ✓ 1st July 2020 10.00 – 11.00 Explainability of a Machine Learning Granting Scoring Model in Peer-to-Peer Lending | Prof. Javier Arroyo, UCM
- ✓ 30th September 2020 10.00 – 11.00 Blockchain for finance: Bond issuance and asset trading | Dr. Veni Arakelian, Senior Manager Piraeus Bank

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- ✓ 29th October 2020 11.00 – 12.00 Investing with Cryptocurrencies - On the Informative Effects of Experts Sentiment | Dr. Simon Trimborn, City University of Hong Kong
- ✓ 11th November 2020 10.00 – 11.00 Central Bank Digital Currencies | Henry Holden, Advisor – Bank for International Settlements - Innovation HUB
- ✓ 3rd December 2020 11.00 – 12.00 Portfolio Compression in Financial Networks: Incentives and Systemic Risk | Dr. Steffen Schuldenzucker, Goethe University Frankfurt
- ✓ 08 January 2021- 10.00 – 11.00 Blockchain Technology and Financial Regulation: A Risk-Based Approach to the Regulation of Initial Coin Offerings (ICOs) | Alexis Collomb & Primavera de Filippi, CNAM
- ✓ 12 March 2021 - 13.00 – 14.00 Blockchain Technology as a Regulatory Technology: From Code is Law to Law is Code | Samer Hassan, Universidad Complutense de Madrid
- ✓ 9 April 2021 - 09.00 – 10.00 FinTech, RegTech, and the Reconceptualization of Financial Regulation | Douglas W. Arner and Ross P. Buckley, University of Hong Kong and University of New South Wales
- ✓ 17 May 2021 - 11.00 – 12.00 Machine Learning Inference | Andreas Joseph, Bank of England

* evaluation was not required

2. Events organised by Polimi: Polimi Fintech Seminars, a series of online talks on different fintech topics.

- ✓ November 9th, 2020 – 17.30 (CET) E. Barucci (Politecnico di Milano), A machine learning algorithm for stock picking built on information based outliers
- ✓ December 9th, 2020 - 17.30 (CET) J. D. Turiel (UCL-ICL, Barclays Investment Bank), Deep learning modelling of the limit order book
- ✓ January 18th, 2021 - 17.30 (CET) M. Azzone (Politecnico di Milano), A Machine Learning Model for Lapse Prediction in Life Insurance Contracts
- ✓ February 22nd, 2021 - 17.30 (CET) Charalampos Stasinakis (University of Glasgow) Big Data, Artificial Intelligence and Machine Learning: A Transformative Symbiosis in Favor of Financial Technology
- ✓ March 22nd, 2021 - 17.30 (CET) Valerio Potì (University College Dublin), COVID Narrative Risk: A Computational Linguistic Approach to the Econometric Identification of Narrative Risk During the COVID-19 Pandemic
- ✓ Big Data and Machine Learning in Finance Conference, June 10-11, 2021
- ✓ From Networks to Neural Networks in Finance - Lake Como School of Advanced Studies, 14-18 June 2021

* evaluation was not required

3. Events organised by Warsaw: monthly seminars of Quantitative Finance Research Group and Data Science Lab WNE UW

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- ✓ 2021-02-22 Sakowski Paweł, Turovtseva Anna, "Verification of investment opportunities on the cryptocurrency market within Markowitz framework".
- ✓ 2021-03-22 Osowska Ewelina, Wójcik Piotr, "The impact of the content of Federal Open Market Committee post-meeting statements on financial markets – text mining approach".
- ✓ 2021-04-19 Chlebus Marcin, "XAI tools as a part of the best practices in model selection for business decision modelling. Example of marketing campaign success forecasting".
- ✓ 2021-05-17 Karimov Bedil, Wójcik Piotr, "Identification of scams in Initial Coin Offerings with machine learning".

* evaluation was not required

4. Events organised by UBER

- ✓ September 23, 2020, 1030 - 1200 CET, The Webinar at ECB "FRM - Financial Risk meter", Wolfgang K. Härdle (HU Berlin) and Jochen Papenbrock (Firamis)
- ✓ December 10, 2020 1000-1300 CET, The 2nd Yushan Conference "FinTech & RegTech: Fundamentals Techs Apps",
- ✓ December 11, 2020 0600-0920 CET, The 2nd Yushan Conference "FinTech & RegTech: Fundamentals Techs Apps"
- ✓ May 17, 2021 1700-1800 CET, Manuela Veloso (JP Morgan AI Research and Carnegie Mellon University), "AI in Finance: Scope and Examples"
- ✓ Series of monthly research seminars "Transparency in Fintech"
 - 25.11.2020 1300-1400 CET, 1. Professor Dr. Stefan Lessmann (HU Berlin), "Fighting the Sampling Bias: A Framework for Training and Evaluating Scoring Models"; 2. Jovanka Lili Matic (HU Berlin& Deutsche Bank), "Valuation and risk management of cryptocurrency options"
 - 14.01.2021, 1400-1500 CET, Valerio Poti (UCD), "Application of methods from computational linguistics to gauge the effect of narrative about covid-19 on markets"
 - 11.02.2021, 1400-1500 CET, 1 Marianna Russo and Florentina Paraschiv (NTNU), A multifactor random field model for the term structure of interest rates 2 Wei Li and Denis Becker NTNU, Day-ahead electricity prices prediction applying hybrid models of LSTM-based deep learning methods and feature selection algorithms under consideration of market coupling
 - 11.03.2021, 1400-1500 CET, Xi Chen (University of Bath), Unrepresentative prior issue and Bayesian nested sampling
 - 08.04.2021, 1400-1500 CET, Anna Shchekina (HU Berlin), "FRM for Cryptos"
 - 13.05.2021, 1400-1500 CET, Wei Li (NTNU), Florentina Paraschiv (NTNU) and Georgios Sermpinis (UoG), "CBR for FRD"

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- 10.06.2021, 1400-1500 CET, 1 Endre Jo Reite and Florentina Paraschiv NTNU
Harvesting from customer loyalty in mortgage lending 2 Rui Ren (HU Berlin)
"FRM Based on Expectiles".

* evaluation was not required

5. Events organised/co-organized or attended by ASE (BUES)

- ✓ Fintech Workshop – ICESS 2020 – attended by the representatives of the National Bank of Romania, by the representatives of the Financial Supervision Authority from Romania and by the representatives of the Romanian Fintech Association – cooperation opportunities based on the activities and results of the Fintech Horizon 2020 Project.
- ✓ New Tech in the Financial Markets - Round Table – ICESS 2021 – 10th of June 2021, Table moderated by Vasile Alecsandru Strat.
- ✓ ASF Insurtech Meeting – Bucharest 24th of June 2021 – Presentation of the main outcomes of the Fintech Horizon 2020 Project to the Financial Environment in Romania (Fintechs, Insurance companies, associations of profile).

* evaluation was not required

6. Events where FIRAMIS (Dr. Jochen Papenbrock) was engaged and where the project and use cases were promoted and discussed

- ✓ 2019-12-06, "XAI-presentation at EIOPA Insurtech task force in Frankfurt"
- ✓ 2019-12-11, "representing fin-tech and XAI project at EU fintech lab in Brussels (most other fintech start-ups had XAI on the agenda as well)"
- ✓ 2019-11-20, "Euro Finance Week"
- ✓ 2020-02-05, Presentation and moderation of session "Session 3 - Data, Machine Learning & Artificial Intelligence"
- ✓ 2020-08-20, "AI Round Table", Frankfurt Institute of Risk Management
- ✓ 2020-09-03, "5th Conference on AI in Finance and Industry organized by the School of Management and Law of the Zurich University of Applied Sciences (ZHAW) with presentation about XAI"
- ✓ 2020-09-17, Webinar "AI in the Financial Industry - The better normal?", Frankfurt Digital Finance
- ✓ 2020-10-22, "AI Round Table", Frankfurt Institute of Risk Management
- ✓ 2020-11-27, "Bundesbank Innovation Challenge",
- ✓ 2020-12-04 , "AI Round Table", Frankfurt Institute of Risk Management

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- ✓ 2021-05-25, "Global Webinar Series on Artificial Intelligence, Explainability, and Trustworthiness in Financial Services presented jointly with World Economic Forum (WEF), World Alliance of International Financial Centers (WAIFC) and NVIDIA " – NALA edition
- ✓ 2021-06-22, "Global Webinar Series on Artificial Intelligence, Explainability, and Trustworthiness in Financial Services presented jointly with World Economic Forum (WEF), World Alliance of International Financial Centers (WAIFC) and NVIDIA " – Europe edition
- ✓ 2021-01-13, "Explainable, accelerated machine intelligence in finance and insurance", Thalesians London, 2nd promotion link
- ✓ Promotion of Global Webinar Series and GARP presentation
- ✓ Promotion of use case presentation at GTC – one of the largest global AI conferences
- ✓ Another Promotion of use case presentation at GTC – one of the largest global AI conferences
- ✓ 2nd GAIA-X FAIC meeting, presentation of XAI use case extension
- ✓ Presentation at CFA Society New York
- ✓ Presentation at GARP
- ✓ GAIA-X panel to represent FAIC and FIN-TECH

7. Joint events with other Horizon 2020 projects:

These events were not evaluated in a structured manner since they were not focused on the use cases produced by the Fintech Horizon 2020 project but have allowed for dissemination of the main results or activities of the involved projects and have also allowed for identifying synergies between activities.

C. Social – Media and Podcasts

C.1. LinkedIn account (metrics)

- | |
|---|
| <ul style="list-style-type: none"> • <i>Over 325 Posts</i> |
| <ul style="list-style-type: none"> • <i>Over 1160 Followers</i> |
| <ul style="list-style-type: none"> • <i>Over 100K Impressions</i> |

C.2. Twitter account (metrics)

- | |
|---|
| <ul style="list-style-type: none"> • <i>Over 313 Posts</i> |
| <ul style="list-style-type: none"> • <i>Over 260 Followers</i> |
| <ul style="list-style-type: none"> • <i>Over 112K Reactions</i> |

C.3. Podcasts (metrics)

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- ***14 Podcasts***
- ***Over 940 Views***
- ***Over 11394 Impressions on LinkedIn***

All BDA, AI and BC – Evaluations (number of evaluations per Suptech)

	# of Eval. BDA	# of Eval. AI	# of Eval. BC
Austria	a - qualitative	a – qualitative	a - different format/qual.
Bank of Italy	c - qualitative	c - qualitative	2
Belgium	1	2	#NE
Bulgaria	30	9	17
Croatia	66	47	23
Cyprus	20	h - qualitative	together with Greece
Czech Republic	35	11	10
Denmark	7	21	28
Estonia	* together Lithuania	5	16
Finland	18	b + qualitative	11
France	g - qualitative	43 used for brief qual.	g – diff. format used for qual.
Germany	20	10	e- qualitative
Greece/Cyprus	10	h - qualitative	8
Hungary	24	17	10
Ireland	4	5	5
Italy	41	27	40
Latvia	* together Lithuania	9	66
Lithuania	22	30	8
Luxembourg	2	20	#NE
Malta	14	7	13
Poland	7	13	i - qualitative
Portugal	10	20	6
Romania	14	6	11
Slovakia	5	8	18
Slovenia	4 – f qualitative	4 – f qualitative	5 – f qualitative
Spain	24	40	13
Sweden	5	9	10
Switzerland	17	8	4
United Kingdom	d - qualitative	d - qualitative	d - qualitative

Legend:

#Overall – number of evaluations for the item Overall rating
Explain – number of evaluations for the item Explainability
#Predic – number of evaluations for the item Predictive Accuracy
#Utility - number of evaluations for the item Utility

Avg Overall – average grade for the item Overall rating (min. 1 – max. 5)
Avg Explain - average grade for the item Explainability (min. 1 – max. 5)
Avg Predic - average grade for the item Predictive Accuracy (min. 1 – max. 5)
Avg Utility - average grade for the item Utility (min. 1 – max. 5)

All BDA Evaluations	# Overall	# Explain	# Predic	# Utility
Austria				
Bank of Italy	2	2	2	2
Belgium	1	1	1	1
Bulgaria	30	30	30	30
Croatia	66	65	65	65
Cyprus	20	20	20	20
Czech Republic	35	35	35	35
Denmark	7	7	7	7
Estonia				
Finland	18	19	19	18
France				
Germany	20	20	20	20
Greece/Cyprus	10	10	10	10
Hungary	24	24	24	24
Ireland	4	4	4	4
Italy	41	23	23	23
Latvia				
Lithuania	22	22	22	22
Luxembourg	2	2	2	2
Malta	14	14	14	14
Poland	7	7	7	7
Portugal	10	10	10	10
Romania	14	14	14	14
Slovakia	9	9	9	9
Slovenia	2	2	2	2
Spain	24	24	24	24
Sweden	5	5	5	4
Switzerland	17	17	17	17
United Kingdom				
Total	404	386	386	384

All BDA evaluations	Avg. Overall	Avg Explain	Avg Predic	Avg Utility
Austria				
Bank of Italy	4.5	3.5	3.5	3.0
Belgium	2.0	3.0	2.0	2.0
Bulgaria	3.8	3.8	3.8	3.7
Croatia	4.3	4.4	4.1	4.2
Cyprus	4.0	3.9	4.1	4.1
Czech Republic	3.8	3.6	3.5	3.5
Denmark	3.4	3.3	3.0	2.7
Estonia				

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Finland	3.5	3.4	3.4	3.2
France				
Germany	3.4	3.1	3.4	2.9
Greece/Cyprus	4.7	4.5	4.4	4.3
Hungary	4.3	4.4	4.4	4.3
Ireland	4.0	4.0	4.0	4.0
Italy	4.0	3.5	3.2	3.4
Latvia				
Lithuania	3.5	3.4	3.5	3.3
Luxembourg	5.0	5.0	5.0	5.0
Malta	3.1	3.2	3.1	3.0
Poland	4.8	4.9	4.4	4.7
Portugal	3.7	3.7	3.9	3.5
Romania	4.6	4.8	4.5	4.3
Slovakia	4.9	4.4	3.8	3.8
Slovenia	5.0	4.5	4.0	5.0
Spain	3.7	3.8	3.7	3.5
Sweden	3.6	3.6	3.8	2.8
Switzerland	4.8	4.6	4.6	4.6
United Kingdom				
TOTAL	4.0	3.9	3.8	3.8

BDA evaluations without CP	# Overall	# Explain	# Predic	# Utility
Austria				
Bank of Italy	2	2	2	2
Belgium				
Bulgaria	27	27	27	27
Croatia	66	65	65	65
Cyprus	18	18	18	18
Czech Republic	35	35	35	35
Denmark	7	7	7	7
Estonia				
Finland	18	19	19	18
France				
Germany	17	17	17	17
Greece/Cyprus	9	9	9	9
Hungary	20	20	20	20
Ireland	4	4	4	4
Italy	36	20	20	20
Latvia				
Lithuania	16	16	16	16
Luxembourg				
Malta	14	14	14	14

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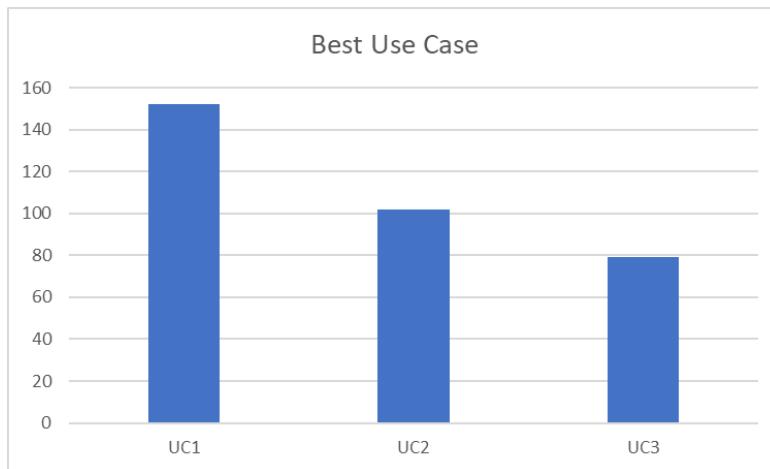
Poland	7	7	7	7
Portugal	9	9	9	9
Romania	12	12	12	12
Slovakia	9	9	9	9
Slovenia	2	2	2	2
Spain	24	24	24	24
Sweden	5	5	5	4
Switzerland	5	5	5	5
United Kingdom				
TOTAL	362	346	346	344

BDA evaluations without CP	Avg. Overall	Avg Explain	Avg Predic	Avg Utility
Austria				
Bank of Italy	4.5	3.5	3.5	3.0
Belgium				
Bulgaria	3.7	3.8	3.7	3.7
Croatia	4.3	4.4	4.1	4.2
Cyprus	3.9	3.9	4.1	4.1
Czech Republic	3.8	3.6	3.5	3.5
Denmark	3.4	3.3	3.0	2.7
Estonia				
Finland	3.5	3.4	3.4	3.2
France				
Germany	3.3	3.1	3.3	2.9
Greece/Cyprus	4.7	4.4	4.3	4.2
Hungary	4.4	4.4	4.4	4.3
Ireland	4.0	4.0	4.0	4.0
Italy	4.1	3.6	3.3	3.4
Latvia				
Lithuania	3.2	3.4	3.3	3.2
Luxembourg				
Malta	3.1	3.2	3.1	3.0
Poland	4.8	4.9	4.4	4.7
Portugal	3.8	3.8	4.0	3.6
Romania	4.6	4.8	4.5	4.3
Slovakia	4.9	4.4	3.8	3.8
Slovenia	5.0	4.5	4.0	5.0
Spain	3.7	3.8	3.7	3.5
Sweden	3.6	3.6	3.8	2.8
Switzerland	4.8	4.2	4.0	4.2
United Kingdom				
TOTAL	4.0	3.9	3.8	3.7

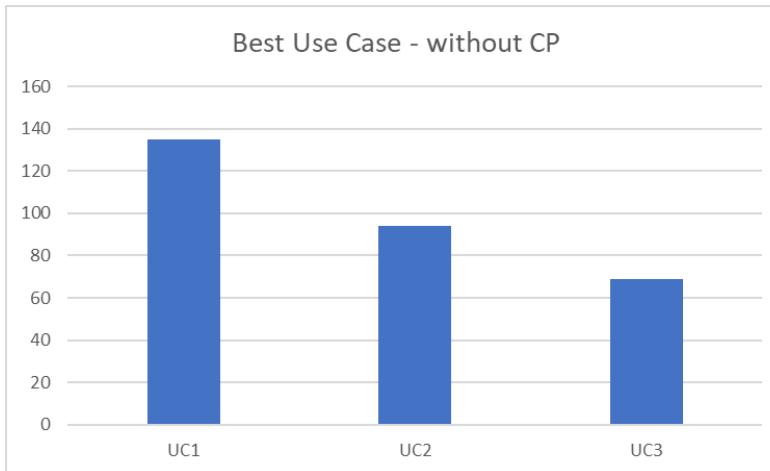
Best Use Case BDA

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Best Use Case BDA without Consortium Partners



All AI evaluations	# Overall	# Explain	# Predic	# Utility
Austria				
Bank of Italy				
Belgium	2	2	2	2
Bulgaria	9	9	9	9
Croatia	37	33	33	33
Cyprus				
Czech Republic	11	11	11	11
Denmark	20	18	18	18
Estonia	5	5	5	5
Finland	2	3	2	2
France	10	10	10	10
Germany				
Greece/Cyprus				
Hungary	17	17	17	17
Ireland	5	5	5	5
Italy	23	10	10	10
Latvia	9	9	9	9
Lithuania	30	30	30	30
Luxembourg	20	18	17	17
Malta	7	7	7	7
Poland	13	13	13	13
Portugal	20	20	20	20
Romania	6	6	6	6
Slovakia	8	8	8	8
Slovenia				
Spain	38	40	40	40
Sweden	7	8	6	7
Switzerland	8	8	8	8
United Kingdom				
Total	307	290	286	287

All AI Evaluations	Avg. Overall	Avg Explain	Avg Predic	Avg Utility
Austria				
Bank of Italy				
Belgium	3.0	2.5	2.0	1.0
Bulgaria	4.3	4.6	4.4	4.3
Croatia	4.6	4.6	4.5	4.6
Cyprus				
Czech Republic	4.7	4.6	4.6	4.4
Denmark	3.6	3.8	3.7	3.6
Estonia	3.8	3.4	4.4	3.8

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Finland	3.5	3.3	3.0	3.0
France				
Germany	4.2	3.5	3.5	3.3
Greece/Cyprus				
Hungary	4.4	4.0	4.1	4.0
Ireland	4.4	4.4	4.2	4.4
Italy	4.3	4.1	4.2	3.8
Latvia	3.0	3.2	3.3	3.1
Lithuania	4.1	4.0	3.9	4.0
Luxembourg	4.2	3.9	4.1	3.9
Malta	4.1	4.1	3.3	3.4
Poland	4.3	4.0	4.1	4.2
Portugal	4.2	3.9	3.9	3.8
Romania	4.3	4.3	4.0	4.2
Slovakia	5.0	4.9	4.3	4.9
Slovenia				
Spain	3.8	4.1	4.0	3.6
Sweden	3.6	2.8	2.5	3.1
Switzerland	4.1	4.3	4.1	4.0
United Kingdom				
Total	4.2	4.1	4.0	3.9

AI evaluations without CP	# Overall	# Explain	# Predic	# Utility
Austria				
Bank of Italy				
Belgium	2	2	2	2
Bulgaria	9	9	9	9
Croatia	36	32	32	32
Cyprus				
Czech Republic	11	11	11	11
Denmark	19	17	17	17
Estonia	4	4	4	4
Finland	2	3	2	2
France				
Germany	10	10	10	10
Greece/Cyprus				
Hungary	17	17	17	17
Ireland				
Italy	13	4	4	4
Latvia	9	9	9	9
Lithuania	28	28	28	28
Luxembourg	17	15	14	14
Malta	6	6	6	6

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Poland	13	13	13	13
Portugal	20	20	20	20
Romania	3	3	3	3
Slovakia	7	7	7	7
Slovenia				
Spain	36	38	38	38
Sweden	7	8	6	7
Switzerland	5	5	5	5
United Kingdom				
Total	274	261	257	258

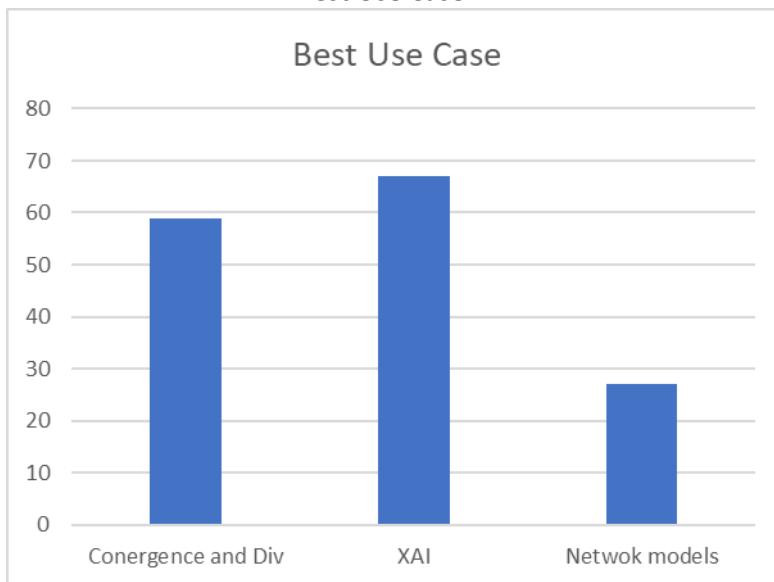
AI evaluations without CP	Avg. Overall	Avg Explain	Avg Predic	Avg Utility
Austria				
Bank of Italy				
Belgium	3.0	2.5	2.0	1.0
Bulgaria	4.3	4.6	4.4	4.3
Croatia	4.7	4.7	4.6	4.6
Cyprus				
Czech Republic	4.7	4.6	4.6	4.4
Denmark	3.5	3.8	3.7	3.6
Estonia	3.8	3.8	4.5	3.8
Finland	3.5	3.3	3.0	3.0
France				
Germany	4.2	3.5	3.5	3.3
Greece/Cyprus				
Hungary	4.4	4.0	4.1	4.0
Ireland				
Italy	4.1	3.8	3.8	3.0
Latvia	3.0	3.2	3.3	3.1
Lithuania	4.0	4.0	3.8	3.9
Luxembourg	4.1	4.0	4.1	3.9
Malta	4.0	4.2	3.3	3.3
Poland	4.3	4.0	4.1	4.2
Portugal	4.2	3.9	3.9	3.8
Romania	5.0	4.7	4.3	4.7
Slovakia	5.0	4.9	4.1	4.9
Slovenia				
Spain	3.8	4.1	3.9	3.6
Sweden	3.6	2.8	2.5	3.1
Switzerland	4.0	4.5	4.3	4.0
United Kingdom				
Total	4.1	4.1	4.0	3.9

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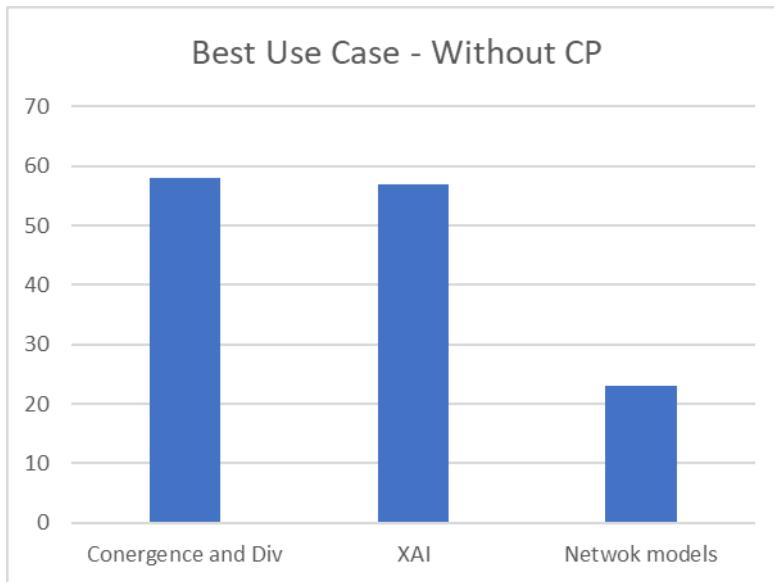
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Best Use Case AI



Best Use Case AI without Consortium Partners



BC all evaluations		UC1	UC1	UC1	UC2	UC2	UC2
	# Overall	#Exp	# Pred	#Util	#Exp	# Pred	#Util
Austria							
Bank of Italy	2	1	1	1	1	1	1
Belgium							
Bulgaria	17	17	17	17	17	17	17
Croatia	23	22	22	22	17	17	17
Cyprus							
Czech Republic	10	8	8	8	8	8	8

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Denmark	28	3	2	3	3	2	3
Estonia	16	16	16	16	16	16	16
Finland	11	10	9	10	9	7	9
France							
Germany							
Greece/Cyprus	8	3	3	3	3	3	3
Hungary	10	8	8	8	10	10	9
Ireland	5						
Italy	40	38	38	38	38	38	38
Latvia	66	62	61	62	60	60	60
Lithuania	8	7	7	7	7	7	7
Luxembourg							
Malta	13	13	12	13	12	13	13
Poland							
Portugal	6	6	6	6	6	6	6
Romania	11	4	4	4	11	11	11
Slovakia	18	18	17	18	18	17	18
Slovenia							
Spain	13	11	11	11	13	13	13
Sweden	10	7	5	7	6	4	6
Switzerland	3	3	3	3	3	3	3
United Kingdom							
Total	317	257	250	257	258	253	258

BC all evaluations	UC3	UC3	UC3	UC4	UC4	UC4
	#Exp	# Pred	#Util	#Exp	# Pred	#Util
Austria						
Bank of Italy	2	2	2	1	1	1
Belgium						
Bulgaria	17	17	17	17	17	17
Croatia	20	20	20	18	18	18
Cyprus						
Czech Republic	8	7	7	7	6	6
Denmark	5	3	5	4	3	3
Estonia	16	16	16	14	14	14
Finland	9	8	9	8	7	8
France						
Germany						
Greece/Cyprus	4	4	4	6	6	6
Hungary	2	2	2	2	1	1
Ireland						
Italy	37	37	37	27	26	27
Latvia	62	62	62	52	52	52
Lithuania	7	7	7	3	3	3

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Luxembourg						
Malta	13	13	13	12	12	12
Poland						
Portugal	6	6	6	6	6	6
Romania	10	10	10	10	10	10
Slovakia	18	18	18	17	17	17
Slovenia						
Spain	12	12	12	13	13	13
Sweden	6	5	6	3	3	4
Switzerland	3	3	3	3	3	3
United Kingdom						
	257	252	256	223	218	221

BC all evaluations	UC5	UC5	UC5	UC6	UC6	UC6
	#Exp	# Pred	#Util	#Exp	# Pred	#Util
Austria						
Bank of Italy	2	2	2	2	2	2
Belgium						
Bulgaria	17	17	17	17	17	17
Croatia						
Cyprus						
Czech Republic	6	6	6	8	8	8
Denmark	3	2	3	4	2	4
Estonia						
Finland	8	7	8	8	7	8
France						
Germany						
Greece/Cyprus	3	3	3	6	6	6
Hungary	3	3	3	2	2	2
Ireland	4	4	4	4	4	4
Italy						
Latvia						
Lithuania						
Luxembourg						
Malta	13	13	13	12	12	12
Poland						
Portugal	6	6	6	6	6	6
Romania	5	5	5	10	10	10
Slovakia	16	16	16	16	16	16
Slovenia						
Spain	9	9	9	9	9	9
Sweden	4	3	4	2	2	3
Switzerland	3	3	3	3	3	3

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United Kingdom						
	102	99	102	109	106	110

BC all evaluations		UC1	UC1	UC1	UC2	UC2	UC2
	AV Overall	AVExp	AV Pred	AVUtil	AVExp	AV Pred	AVUtil
Austria							
Bank of Italy	4.5	5.0	4.0	4.0	5.0	4.0	5.0
Belgium							
Bulgaria	4.8	4.8	4.5	4.6	4.5	4.6	4.6
Croatia	4.2	4.1	4.0	4.0	4.2	4.1	4.0
Cyprus							
Czech Republic	4.6	4.6	4.1	4.1	4.5	4.4	4.5
Denmark	3.8	3.0	2.5	2.7	3.0	2.5	2.7
Estonia	4.3	4.3	4.3	4.3	4.3	4.3	4.3
Finland	3.5	3.4	2.8	2.9	3.3	3.1	2.9
France							
Germany							
Greece/Cyprus	4.7	4.0	4.0	4.0	4.0	3.3	3.7
Hungary	4.2	3.5	3.3	3.1	3.4	3.6	3.4
Ireland	4.8						
Italy	4.4	4.3	4.1	4.2	4.0	3.8	3.8
Latvia	4.1	3.8	3.7	3.7	3.7	3.6	3.5
Lithuania	4.5	4.3	4.4	4.3	4.7	4.4	4.4
Luxembourg							
Malta	4.0	3.7	3.5	3.7	3.8	3.5	3.3
Poland							
Portugal	4.3	4.3	4.3	4.2	4.2	4.0	4.3
Romania	4.9	5.0	5.0	5.0	5.0	4.9	5.0
Slovakia	4.7	4.6	4.3	4.3	4.4	4.3	4.1
Slovenia							
Spain	3.4	3.6	3.3	3.5	3.5	3.5	3.3
Sweden	2.4	3.0	2.8	2.6	2.3	2.3	2.3
Switzerland	5.0	5.0	4.7	5.0	4.3	4.7	4.7
United Kingdom							
Total	4.2	4.1	3.9	3.9	4.0	3.9	3.8

BC all evaluations	UC3	UC3	UC3	UC4	UC4	UC4
	AVExp	AV Pred	AVUtil	AVExp	AV Pred	AVUtil
Austria						
Bank of Italy	5.0	4.5	5.0	4.0	3.0	5.0

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Belgium						
Bulgaria	4.7	4.8	4.8	4.4	4.4	4.4
Croatia	4.2	4.0	4.1	4.1	4.1	4.1
Cyprus						
Czech Republic	4.8	4.7	4.6	4.7	4.5	4.5
Denmark	3.4	2.3	2.6	2.5	2.3	2.0
Estonia	4.1	4.1	4.1	5.0	5.0	5.0
Finland	3.2	3.5	3.3	2.9	3.0	3.0
France						
Germany						
Greece/Cyprus	4.3	4.3	4.0	4.8	4.7	4.7
Hungary	4.0	3.5	3.5	4.0	4.0	4.0
Ireland						
Italy	3.7	3.7	3.3	3.7	3.7	3.6
Latvia	3.7	3.7	3.5	3.8	3.8	3.7
Lithuania	4.6	4.3	4.6	4.7	4.7	4.3
Luxembourg						
Malta	3.9	3.7	3.7	3.6	3.4	3.4
Poland						
Portugal	4.3	4.2	4.2	4.2	3.8	4.2
Romania	5.0	5.0	5.0	5.0	5.0	5.0
Slovakia	4.6	4.4	4.4	4.2	4.2	4.1
Slovenia						
Spain	3.3	3.3	3.4	3.3	3.4	3.2
Sweden	2.7	2.8	2.0	2.3	1.7	1.5
Switzerland	5.0	4.7	4.3	4.3	4.7	4.7
United Kingdom						
	4.0	3.9	3.8	4.0	4.0	3.9

BC all evaluations	UC5	UC5	UC5	UC6	UC6	UC6
	AVExp	AV Pred	AVUtil	AVExp	AV Pred	AVUtil
Austria						
Bank of Italy	4.5	4.0	3.5	3.5	5.0	4.0
Belgium						
Bulgaria	4.6	4.6	4.7	4.2	4.4	4.5
Croatia						
Cyprus						
Czech Republic	4.5	4.2	4.2	4.6	4.6	4.5
Denmark	2.7	2.5	2.7	3.3	3.0	2.8
Estonia						
Finland	3.0	2.9	2.9	3.1	2.9	3.0
France						

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Germany						
Greece/Cyprus	4.3	3.7	3.3	4.2	4.0	4.2
Hungary	3.7	4.0	3.7	4.0	3.5	4.0
Ireland	5.0	5.0	4.8	5.0	5.0	4.8
Italy						
Latvia						
Lithuania						
Luxembourg						
Malta	3.6	3.3	3.1	4.0	3.8	4.0
Poland						
Portugal	4.7	4.7	4.8	4.5	4.5	4.5
Romania	4.8	4.8	4.8	5.0	5.0	5.0
Slovakia	4.6	4.2	4.5	4.3	4.1	4.1
Slovenia						
Spain	3.3	3.4	3.3	3.3	3.2	3.2
Sweden	1.5	1.3	2.0	2.0	2.0	1.3
Switzerland	5.0	4.3	5.0	5.0	5.0	4.3
United Kingdom						
	4.1	3.9	3.9	4.1	4.1	4.0

Eval. BC without CP		UC1	UC1	UC1	UC2	UC2	UC2
	# Overall	#Exp	# Pred	#Util	#Exp	# Pred	#Util
Austria							
Bank of Italy	1	1	1	1	1	1	1
Belgium							
Bulgaria	16	16	16	16	16	16	16
Croatia	23	22	22	22	17	17	17
Cyprus							
Czech Republic	10	8	8	8	8	8	8
Denmark	27	3	2	3	3	2	3
Estonia	16	16	16	16	16	16	16
Finland	11	10	9	10	9	7	9
France							
Germany							
Greece/Cyprus	6	2	2	2	2	2	2
Hungary	9	7	7	7	9	9	8
Ireland	3						
Italy	38	37	37	37	37	37	37
Latvia	66	62	61	62	60	60	60
Lithuania	8	7	7	7	7	7	7
Luxembourg							
Malta	13	13	12	13	12	13	13
Poland							
Portugal	6	6	6	6	6	6	6
Romania	9	4	4	4	9	9	9

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Slovakia	18	18	17	18	18	17	18
Slovenia							
Spain	13	11	11	11	13	13	13
Sweden	10	7	5	7	6	4	6
Switzerland							
United Kingdom							
Total	303	250	243	250	249	244	249

Evaluations BC without CP	UC3	UC3	UC3	UC4	UC4	UC4
	#Exp	# Pred	#Util	#Exp	# Pred	#Util
Austria						
Bank of Italy	1	1	1	1	1	1
Belgium						
Bulgaria	16	16	16	16	16	16
Croatia	20	20	20	18	18	18
Cyprus						
Czech Republic	8	7	7	7	6	6
Denmark	5	3	5	4	3	3
Estonia	16	16	16	14	14	14
Finland	9	8	9	8	7	8
France						
Germany						
Greece/Cyprus	3	3	3	5	5	5
Hungary	2	2	2	2	1	1
Ireland						
Italy	36	36	36	26	25	26
Latvia	62	62	62	52	52	52
Lithuania	7	7	7	3	3	3
Luxembourg						
Malta	13	13	13	12	12	12
Poland						
Portugal	6	6	6	6	6	6
Romania	8	8	8	8	8	8
Slovakia	18	18	18	17	17	17
Slovenia						
Spain	12	12	12	13	13	13
Sweden	6	5	6	3	3	4
Switzerland						
United Kingdom						
Total	248	243	247	215	210	213

Eval. BC without CP	UC5	UC5	UC5	UC6	UC6	UC6
	#Exp	# Pred	#Util	#Exp	# Pred	#Util
Austria						
Bank of Italy	1	1	1	1	1	1

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Belgium						
Bulgaria	16	16	16	16	16	16
Croatia						
Cyprus						
Czech Republic	6	6	6	8	8	8
Denmark	3	2	3	4	2	4
Estonia						
Finland	8	7	8	8	7	8
France						
Germany						
Greece/Cyprus	2	2	2	5	5	5
Hungary	3	3	3	2	2	2
Ireland	3	3	3	3	3	3
Italy						
Latvia						
Lithuania						
Luxembourg						
Malta	13	13	13	12	12	12
Poland						
Portugal	6	6	6	6	6	6
Romania	5	5	5	8	8	8
Slovakia	16	16	16	16	16	16
Slovenia						
Spain	9	9	9	9	9	9
Sweden	4	3	4	2	2	3
Switzerland						
United Kingdom						
Total	95	92	95	100	97	101

Eval. BC without CP		UC1	UC1	UC1	UC2	UC2	UC2
	AV Overall	AVExp	AV Pred	AVUtil	AVExp	AV Pred	AVUtil
Austria							
Bank of Italy	4.0	5.0	4.0	4.0	5.0	4.0	5.0
Belgium							
Bulgaria	4.8	4.8	4.6	4.6	4.6	4.6	4.6
Croatia	4.2	4.1	4.0	4.0	4.2	4.1	4.0
Cyprus							
Czech Republic	4.6	4.6	4.1	4.1	4.5	4.4	4.5
Denmark	3.7	3.0	2.5	2.7	3.0	2.5	2.7
Estonia	4.3	4.3	4.3	4.3	4.3	4.3	4.3
Finland	3.5	3.4	2.8	2.9	3.3	3.1	2.9
France							
Germany							
Greece/Cyprus	4.7	4.0	4.0	4.0	4.0	3.0	3.5

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Hungary	4.1	3.3	3.0	2.9	3.2	3.4	3.3
Ireland	4.7						
Italy	4.4	4.3	4.2	4.2	4.1	3.9	3.8
Latvia	4.1	3.8	3.7	3.7	3.7	3.6	3.5
Lithuania	4.5	4.3	4.4	4.3	4.7	4.4	4.4
Luxembourg							
Malta	4.0	3.7	3.5	3.7	3.8	3.5	3.3
Poland							
Portugal	4.3	4.3	4.3	4.2	4.2	4.0	4.3
Romania	4.9	5.0	5.0	5.0	5.0	4.9	5.0
Slovakia	4.7	4.6	4.3	4.3	4.4	4.3	4.1
Slovenia							
Spain	3.4	3.6	3.3	3.5	3.5	3.5	3.3
Sweden	2.4	3.0	2.8	2.6	2.3	2.3	2.3
Switzerland							
United Kingdom							
Total	4.1	4.1	3.9	3.9	4.0	3.9	3.8

Evaluations BC without CP	UC3	UC3	UC3	UC4	UC4	UC4
	AVExp	AV Pred	AVUtil	AVExp	AV Pred	AVUtil
Austria						
Bank of Italy	5.0	4.0	5.0	4.0	3.0	5.0
Belgium						
Bulgaria	4.7	4.8	4.8	4.4	4.4	4.4
Croatia	4.2	4.0	4.1	4.1	4.1	4.1
Cyprus						
Czech Republic	4.8	4.7	4.6	4.7	4.5	4.5
Denmark	3.4	2.3	2.6	2.5	2.3	2.0
Estonia	4.1	4.1	4.1	5.0	5.0	5.0
Finland	3.2	3.5	3.3	2.9	3.0	3.0
France						
Germany						
Greece/Cyprus	4.3	4.3	4.0	4.8	4.6	4.6
Hungary	4.0	3.5	3.5	4.0	4.0	4.0
Ireland						
Italy	3.8	3.7	3.4	3.8	3.8	3.6
Latvia	3.7	3.7	3.5	3.8	3.8	3.7
Lithuania	4.6	4.3	4.6	4.7	4.7	4.3
Luxembourg						
Malta	3.9	3.7	3.7	3.6	3.4	3.4
Poland						
Portugal	4.3	4.2	4.2	4.2	3.8	4.2
Romania	5.0	5.0	5.0	5.0	5.0	5.0
Slovakia	4.6	4.4	4.4	4.2	4.2	4.1
Slovenia						

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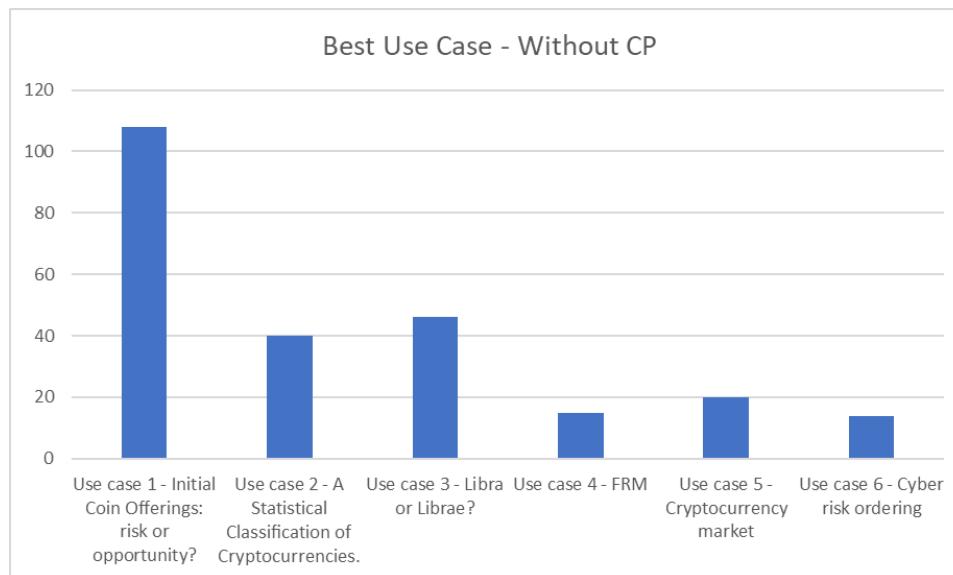
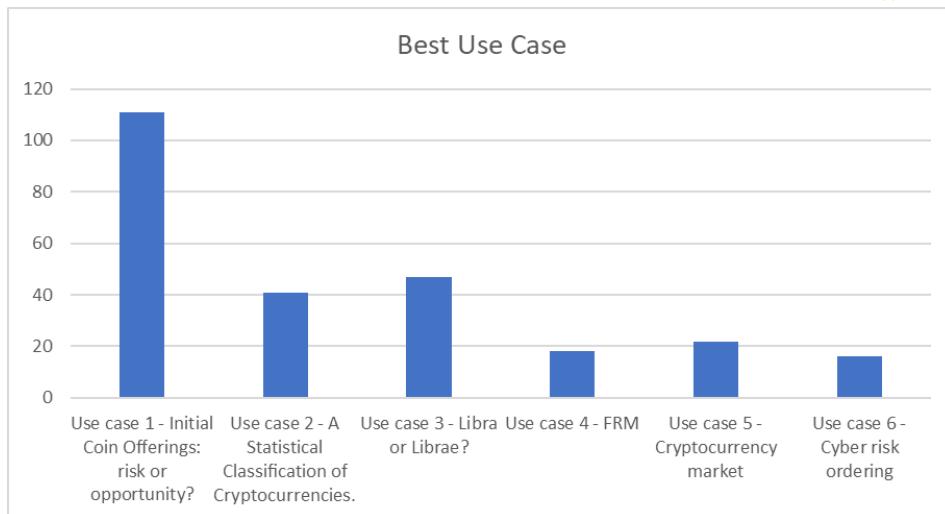


Spain	3.3	3.3	3.4	3.3	3.4	3.2
Sweden	2.7	2.8	2.0	2.3	1.7	1.5
Switzerland						
United Kingdom						
Total	4.0	3.9	3.8	4.0	3.9	3.9

Evaluations BC without CP	UC5	UC5	UC5	UC6	UC6	UC6
	AVExp	AV Pred	AVUtil	AVExp	AV Pred	AVUtil
Austria						
Bank of Italy	4.0	3.0	2.0	2.0	5.0	3.0
Belgium						
Bulgaria	4.6	4.6	4.7	4.3	4.3	4.4
Croatia						
Cyprus						
Czech Republic	4.5	4.2	4.2	4.6	4.6	4.5
Denmark	2.7	2.5	2.7	3.3	3.0	2.8
Estonia						
Finland	3.0	2.9	2.9	3.1	2.9	3.0
France						
Germany						
Greece/Cyprus	4.5	3.5	3.0	4.2	4.0	4.2
Hungary	3.7	4.0	3.7	4.0	3.5	4.0
Ireland	5.0	5.0	4.7	5.0	5.0	4.7
Italy						
Latvia						
Lithuania						
Luxembourg						
Malta	3.6	3.3	3.1	4.0	3.8	4.0
Poland						
Portugal	4.7	4.7	4.8	4.5	4.5	4.5
Romania	4.8	4.8	4.8	5.0	5.0	5.0
Slovakia	4.6	4.2	4.5	4.3	4.1	4.1
Slovenia						
Spain	3.3	3.4	3.3	3.3	3.2	3.2
Sweden	1.5	1.3	2.0	2.0	2.0	1.3
Switzerland						
United Kingdom						
Total	4.0	3.9	3.9	4.1	4.0	4.0

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Annex:

a - Austria

Qualitative feedback BDA – Austria

The FMA highly appreciates the application of Big Data Analytics to problems in the realm of FinTech, RegTech and SupTech. They are interested in more cases. They could easily connect to the content. However, three to four cases are not enough - they'd love to have an overview over a larger set of cases, especially as the cases were almost all centered around P2P lending, which is interesting but a restricted topic. They were basically pretty interested in the general topic of the first three use cases (P2P lending) and highly enjoyed the overview of Machine Learning and Deep Learning methods in the fourth use case.

Qualitative feedback AI – Austria

The FMA highly appreciates the application of Artificial Intelligence to problems in the realm of FinTech, RegTech and SupTech. They are interested in more cases. They could easily connect to the content. However, three to four cases are not enough - they'd love to have an overview over a larger set of cases. Very interested in Explainability.

Different format BC – Austria

The FMA representatives appreciate the organization of the events. They consider that less theoretical aspects could be presented. The presentations on BC and the entire technology and its application are of high interest and in the future they would appreciate details about smart contracts and legal implications of BC.

b - Finland

Qualitative feedback AI – Finland

Thorough understanding of modeling process is needed in managing the model risk related to nontraditional (AI or data driven) fintech models. Since the artificial intelligence affects insurance and financial sector in really many ways – speed and video recognition and statistical modelling will be (or are already) used. Ethical and legal aspects must be considered in early stage when introducing a new AI process and these would be of interest for supervisors. Two main directions are of interest: 1) AI technologies and 2) graphical illustrations of dependences between different processes powered by technology.

c – Bank of Italy BDA and AI Bank of Italy

BDA: During the SupTech event in Rome on June 12th 2019, the project use cases I and III were presented and discussed with Bank of Italy's representatives and researchers. The main comments collected from the audience concern the interpretation of the "networks" on which the methodological approach of both papers relies on and on the data used:

- Centrality measures (Use case I) based on balance sheet similarity are shown to improve the prediction of companies' probability of default. Though, the authors, when presenting their results, should better clarify whether a higher centrality of the companies leads to an increased default risk

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and whether this could potentially change based on the different industries to which companies belong.

- Is the financial interpretation of the network based on commercial flows (Use case III) different from that of the network based on balance sheet similarity (Use case I)?
- In Use case III, commercial relationships between companies are proxied using country and sector-level data collected from the WIOT database. Could model accuracy be improved by using alternative data sources?
- How can the methodology proposed in Use case III be applied by a fintech or a commercial bank using internal data?

AI: During the AI SupTech event with Bank of Italy in November, the project use cases I and III were presented and discussed with Bank of Italy's representatives and researchers.

The main suggestions are:

- To try to investigate performances of hybrid Portfolios, meaning portfolios with both crypto and traditional financial assets.
- Try to investigate the role of sentiment in predicting cryptocurrency prices and, thereby, construction portfolio management strategies based on that
- How can the methodology proposed in Use case III be applied by a fintech or a commercial bank using internal data?
- Suggestion on which centrality measure should have been included in the portfolio allocation problem from his expertise on network metrics and centrality measures specifically.
- Suggestion to include the so-called residuality coefficient to compares the relative strength of the connections in cryptocurrency returns above and below a threshold distance value, to gain insights on the network structure of cryptocurrencies and to use it to foster portfolio management activities.
- The main feedbacks gathered here are to compare the model proposed with more alternative specifications. In other words, the model produces outcomes customized by the choice of the risk-aversion parameter, which is investor specific.
- Partners have suggested to take into account different figures of the risk-aversion parameter, and try some sensitivity analysis on this specific parameter. The authors have implemented this suggestion and have determined which kind of risk-aversion parameter worked at best with historical data of cryptocurrency prices.

d – United Kingdom BDA, AI and BC

The SupTech BDA, SupTech AI and SupTech BC activities were carried over in a set of meeting hosted by FCA London. At some of these meeting also participants from Bank of England were present. Feedback was unstructured and coherently provided at the meeting itself. Indeed, it was decided that made little sense that we, the academics, would go to one of the most skillful and advanced group of individual working in a world-leading institution devoted to supervision and regulation of markets to 'teach' them how to do their job. Therefore, we resorted in a model where we could share our knowledge and – eventually – our frustrations. We therefore organized days of dialogue with some presentations from both side and a lot of discussions. These discussions have resulted in common research projects and a part-time PhD project by one of the FCA staff done with us. In different format these meetings are continuing nowadays although the need to be remote because COVID has made the whole experience much less enjoyable.

e – BC Germany

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The Third Suptech event in Germany took place online on the 17th of June 2021. The workshop consisted of two parts. The morning session was mainly educational and covered such topics like: introduction to the Blockchain technology and further analysis of such applications of the BC technology like cryptocurrencies and smart contracts. The second part covered three use cases developed by FINTECH-HO2020 Project. 100 participants from 35 European central banks, financial supervisors and international regulators participated in this Workshop, 71 participants have participated in the evaluation poll and gave feedback for the event.

Among others the following questions were actively discussed during the workshop:

- Recently the Chinese government banned crypto mining from all Chinese territory how are these great mining power changes affecting the stability of the coins?
- From an environmental objective, are there ways to mine Cryptocoins in a more efficient way with the objective of saving energy?
- What is the estimated current mining power that comes from renewable sources of energy?
- Comparison of Proof-of-stake and proof-of-work algorithms regarding their robust characteristics and ability of preventing cyber-attacks.
- What do you really get when you buy an NFT?
- DeFi phenomenon: Will it change the ways of banking?

In general participants highly appreciated the workshop and discussion of this emerging technology. All participants (except one person), who took a part at the poll, found the Workshop useful for their work. They highly evaluated use cases: around 80% of respondents (who gave an answer to the question) evaluated all models presented with the high or medium level of perceived utility.

f – BDA AI and BC Slovenia

The use case presented in the Suptechs organised by JSI received top appreciation from all evaluators. The feedback and the appreciation was sent directly to the organisers.

g – Suptech BDA, AI and BC France – different formats and qualitative evaluations

BDA and AI – The event was a special event involving 17 different presentations on topics related to BDA and AI. The event was attended by several stakeholders and aspects related to the use of Big Data, the assessment of the risks involved, the general framework of the AI usage in Finance, etc were discussed. The participants agreed that more than 80% of the use of Big Data is related to the preparation of data. Also Big Data raises important issues related to ownership. Also very important aspects discussed were: audit of the data, storage of the data, changing the format of the date, manipulation of the data, etc.

The AI sessions were structured specially for the French audience and different talks of interest were held. The topics were rated and received averages around 4. For the presented topics (according to the agendas) the level of being understandable and the utility were rated.

A similar approach was also applied for the BC section. The event was again tailored for the French audience and special presentations were included. The presentations were evaluated and for the two criteria and average grades ranged again from less than 3 to 4.3.

h – Suptech AI Cyprus+Greece

During the seminars, concepts used in Fintech were developed with the ultimate goal of building a foundation for understanding the use cases. The level of the workshops and the use cases was high, and many times, the multidiscipline audience had difficulties following.

Supervising authorities must manage a large volume of work in supervising various procedures (e.g., licensing, transactions) and anticipating fraud cases. One of the widely discussed topics was the reporting of OTC transactions and specifically the Trade Repository System (TRS). It would be of particular interest to further develop detecting transactions that should be more closely monitored. In addition, market abuse is a problem that concerns the supervisory authorities (Market Abuse Regulation) and detection of money laundering. We also discussed Web scam methods as many websites deceive the investors.

i – Suptech BC Poland

The feedback for the BC suptech meeting in Warsaw in March 2021 was collected by the internal questionnaire circulated among participants by the Polish Regulator (UNKF). The audience consisted of UNKF employees representing various departments, not only the FinTech department, where all the employees were lawyers. The event was judged as very interesting by the participants. However, the opinions about its usefulness were mixed. The participants expected more elements related to the introduction to the blockchain technology, cryptocurrencies and related regulatory concerns, instead of only research, methodological and coding parts. The technical part of the workshop (R codes to use-cases and Shiny workshop) seemed not to be useful for the FinTech department participants, but more useful for the participants from other departments. As in the case of AI suptech, the interest in the BC suptech exceeded the number of possible training participants (limited by UNKF HR department to 50, due to internal UNKF regulations). Therefore, the suptech was recorded in full range and made available in the UNKF intranet for all interested employees.

Main take-aways resulted from Suptechs-summarized by the Consortium Partners

Big Data Analytics

- + useful introduction
- + construction of a common background
- + very useful to see the use cases with real data from P2P lending platforms
- + hand-on approach and discussions were appreciated
- + sometimes the cases were too technical for the audience
- + more standardized introductory material would have been a real plus
- + use cases were interesting but not fitting completely the needs of the supervisors

Artificial Intelligence

- + construction of a common background
- + useful introductory topics
- + much interest for the topics and specially for the XAI
- + higher quality of the AI use cases
- + sometimes real use of AI was expected by Supervisors
- + more standardized introductory material would have been a real plus
- + use cases were interesting but not fitting completely the needs of the supervisors

Blockchain

- + large interest for BC related topics
- + high interest in stable-coins
- + topics like the ones of risks involved by the ICOs are of high interest
- + more focus on technology and its risks would be useful
- + sometimes the cases were too technical for the audience
- + more standardized introductory material would have been a real plus
- + cybersecurity needs to be covered more since it became central
- + use cases were interesting but not fitting completely the needs of the supervisors

7.4 D7.6 - Intermediate Evaluation report

Deliverable information

WP NO.	WP7
DEL. REL.	D7.6
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TITLE	Intermediate Evaluation Report
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Document information

DATE	30.06.2020
WRITTEN BY	FIRAMIS
APPROVED BY	Paolo Giudici



Intermediate Evaluation Report

By Dr. Jochen Papenbrock, FIRAMIS, FIN-TECH consortium partner and the other consortium partners

Frankfurt, 30.06.2020

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 825215 (Topic: ICT-35-2018 Type of action: CSA)

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1. Acknowledgement

We would like to thank all partners and coordinators who made this project and feedback evaluation report possible. You carried out almost 100 workshops in Europe, developed the contents, did the practical research and established the dialogue with the financial industry and especially their supervisors.

We would like to thank the supervisors for their engagement and involvement in this project. Your curiosity, expertise, knowledge and support turned this project to a success.

We would like to thank the participants from the financial service, technology and consulting industry who followed this project and who actually implement financial technology with a European approach.

Last but not least we would like to thank our international advisors who dedicated their energy to support us, attended many workshops and delivered their feedback.

2. Introduction

This is the re-submission of the first Intermediate Evaluation Report. It is an extended version not only covering period M1-M12 but M1-M15. That means it covers not only the full BDA (Big Data Analytics) part but also a large fraction of the AI (Artificial Intelligence) part. It covers > 100 workshop and event results, received by supervisors, consortium partners and the financial industry. These workshops took place across Europe with many European and national/international supervisors participating. It also covers workshop results and feedbacks from the financial industry as well as from the projects' international advisors. The FIN-TECH project is truly inclusive and state-of-the-art, having mobilized the European financial service ecosystem, including their supervision and cutting edge fintech research. These are the consortium partners who made this happen:

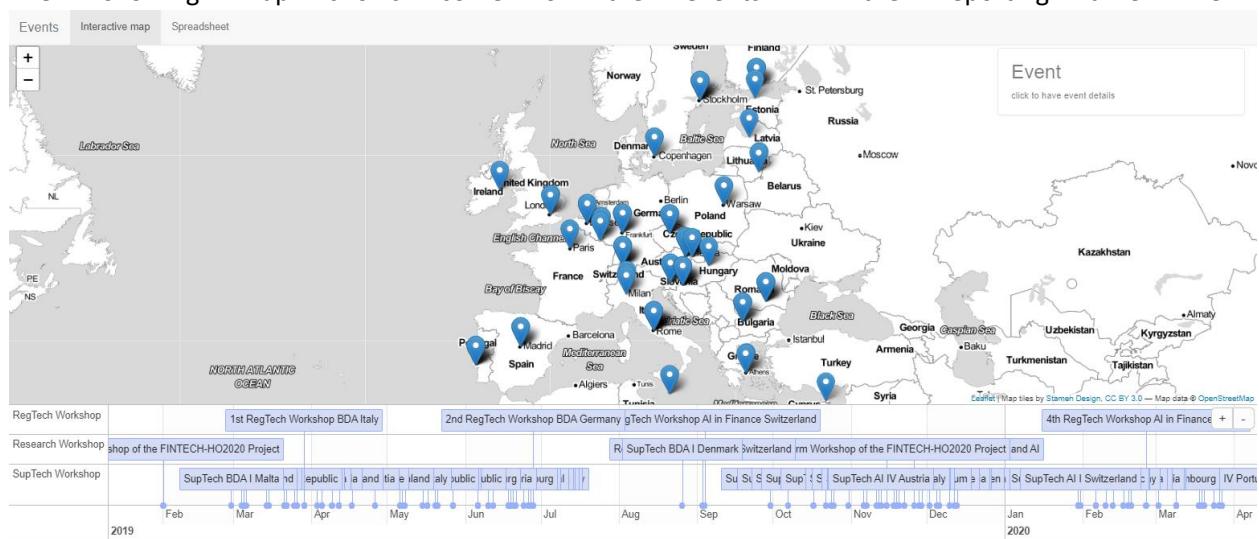
Who are we?



Project partner	Lead	Country
University of Pavia	Paolo Giudici	Italy
Humboldt University Berlin	Wolfgang K. Härdle	Germany
ZHAW Applied Sciences	Jörg Osterrieder	Switzerland
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WU Vienna	Ronald Hochreiter	Austria
Panteion University	Veni Arakelian	Greece
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Politecnico of Milan	Emilio Barucci	Italy
University College Dublin	Andreas Hoepner	Ireland
University of Luxembourg	Radu State	Luxembourg
Jozef Stefan Institute	Marko Grobelnik	Slovenia
University of Warsaw	Piotr Wojcik	Poland
University of Rjeka	Saša Žiković	Croatia
Universidad Complutense de Madrid	Javier Arroyo	Spain
University of Economics in Bratislava	Jana Peliova	Slovakia
Kaunas University of Technology	Audrius Kabasinkas	Lithuania
Masaryk University Brno	Oleg Deev	Czech Republic
Varna University of Economics	Stefan Vachkov	Bulgaria
University of Tampere	Lasse Koskinen	Finland
Modefinance	Valentino Pediroda	Italy
Firamis	Jochen Papenbrock	Germany

1

The following map shows some of the events in the reporting time line:



Here are some project facts, numbers and highlights:

- > 80 SupTech events and almost 10 workshops for RegTech, Research and Validation
- > 20 industry events where FIN-TECH has been presented/introduced
- > 30 financial institutions and associations like involved, including some of the largest commercial banks, consultants and tech companies in Europe (like EBF, Unicredit, Intesa Sanpaolo, Deutsche Börse, Deutsche Bank, Commerzbank, Allianz, Sparkassenverband, BBVA, Ernst&Young, KPMG, Oliver Wyman, NVIDIA, Barclays, HSBC, Santander)
- > 25 national supervisors and European supervisors / central banks involved including ECB, EBA, ESMA, EIOPA
- Several fintech hubs from Europe's financial capitals involved
- > 1300 participants registered, > 550 feedbacks, average workshop rating is 4 out of 5
- > 160 forms prepared to collect workshop feedback from organisers and participants
- > 120 pages of detailed partner feedback about the workshops
- Many supervisory authorities and banks sent their top staff from management and technology
- Knowledge exchange ranging across the European financial landscape like managers, lawyers, economists, fintech experts, AI experts, (data and computer) scientists, researchers, consultants, auditors, chief inspectors, supervisors' association representatives, fintech hubs, local governments
- Some of the most trending technologies in BDA and AI covered (like eXplainable AI, network analysis and graph theory)
- Central project platform for project management, dissemination, evaluation, feedback generation and coding with > 300 users and almost no downtime since project inception in 2019
- Social media posts with high number of views

It can be stated that the knowledge transfer, the trainings, the discussions, the feedback, the research and the practical use cases of this project have been very useful and impacting, especially at this point in time where the financial, technological and regulatory landscape is changing to an almost disruptive extent and where the financial services industry undergoes a major transition towards a fully digital financial economy. Many obstacles to fintech scaling could be identified and the risks and opportunities of financial technologies are better understood now. Communication among all parties, disciplines and EU geographies involved is crucial and this is what this project has enabled.

The perfect storm for change has many amplifying forces: availability, generation and storage of enormous amounts of data, availability of advanced and intelligent analytics, cloud and super-computing capabilities, University teaching and research programs, large global communities of programmers and developers sharing their tools and open-source software, involvement of bigtech companies, innovation and incubation programs in the financial service industry, as well as new data and intelligence-driven business models, ecosystems, investor networks and many other factors. New financial technologies like

Big Data Analysis (BDA) and Artificial Intelligence (AI) are trending and emerging. They carry enormous potential for the European financial industry and their data-driven, analytical, intelligence-driven products and services. They truly disrupt the way banking has been done before, with more customized, inclusive, cheaper, transparent and safer financial services and products for EU citizens and at the same time a prospering and growing financial service ecosystem and industry across the EU.

However, these new financial technologies carry a large risk, they do have their limits and impose enormous challenges, both on the industry as well as for their supervisors and regulators. The EU is currently developing their own approach, governance and guidelines to trustworthy and ethical use of AI and data. Many different stakeholders with very different backgrounds and agendas are engaged. Data, technology, banking business models challenge, regulation, consumer protection and ethics are all involved in this process. The continuous flow of information, the dialogue, the knowledge transfer, the debate and discourse need to be established and cultivated at all times and levels. And this is happening in this project.

This report specifically addresses the following questions: extensive information on the outcome of the workshops/presentations: who are the parties participating, their roles and their responsibilities, how will they stay involved, what is their feedback on the use cases presented, are the selected use cases in the end the ones that meet the expectations and requirements at most?

3. Structure and underlying methodology of this report

The report rests on 5 columns of feedback:

1. Workshop participants' feedback: each workshop/event organized by the partners has participants who is given a form to deliver feedback. Use cases and entire workshops could be evaluated and feedback could be given. Participants of SupTech events are supervisors, participants of Regtech events are supervisors, banks, fintechs and other members of the financial services ecosystem.
2. National supervisor feedback: Each supervisor could deliver a feedback on entire blocks of workshops, categorized by BDA and AI
3. Partner feedback: the organisers and presenters of the workshops could evaluate their workshops, describe the feedback of the audience and report about the dynamic exchange and topics discussed among workshop participants.
4. Feedback has been collected from the financial service industry and the European-level supervisors/regulators
5. Feedback has been collected from the international advisors of the project

A central platform with unified content supports the workshop activity and the feedback culture. More details about this platform can be seen in chapter 'Platform for code-based use cases'.

This report is based on some repositories and background information. Here is a list of them:

Name	Contents	quantity
Event_participation_and_feedback	An automated summary for each event separately. The following information is given: the underlying forms, some summarizing statistics and the contents of the feedback forms.	> 1300 participants registered > 550 feedbacks
Partner_feedback	Partners sent a detailed manual report about the outcome of each events/presentation and addressing the following questions: who are the parties participating, their roles and their responsibilities, how will they stay involved, what is their feedback on the use cases presented, are the selected use cases in the end the ones that meet the expectations and requirements at most? Besides these manual reports there is the a 'forms-based reporting' which includes background information on each workshop collected by a standard form.	> 70 form-based feedbacks > 20 partners prepared manual reports each of which summarises all their event
Supervisor_feedback	This is a forms-based feedback that every partner sends to their supervisor to evaluate an entire block (BDA or AI). Special feedback including statistics has been delivered by Bundesbank/UBER.	> 30 reports by the supervisors on either BDA or AI blocks > extensive

		feedback reports by Bundesbank/UBER
Agendas	The respective agendas for all the events to receive more information about the speakers, the contents and the use cases presented.	> 100 agendas covering all events
Extra_feedback	<p>Advisor Feedback: feedback by our international advisors</p> <p>EY: a presentation by Ernst&Young on XAI which explains the status-quo in the industry</p> <p>Financial Industry Feedback: the feedback acquired by Banks through UNIPV and FIRAMIS: A longer blog XAI including the recent supervisory activities, interview and background information on Brussels workshop</p> <p>International_supervisors: the agendas corresponding to the workshops where feedback was collected</p> <p>PARIS1: special report and feedback on BDA and AI, special involvement in XAI topic by supervisor</p> <p>Press release: one of the press releases of the project involving XAI</p>	<p>4 advisor feedbacks</p> <p>5 industry feedbacks (more are in the pipeline)</p>

Event reporting process

The event reporting and the evaluation structure of the fintech project was set up since the beginning, with different phases and timing of the put in action of the structure.

The workflow started right after the platform technicalities were ready to perform the tasks related to creating registration and evaluation links for each event of the project. (around M2-M4)

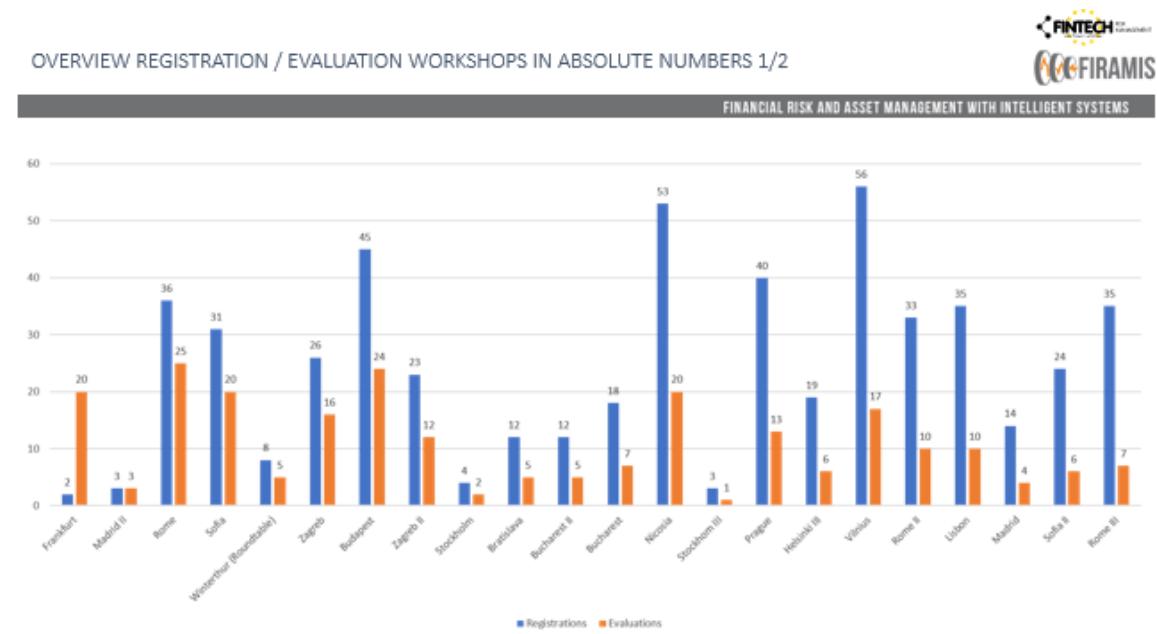
The partners have been instructed since the first Management Board (Kick off 1st of February) about the rules in place for approval of event's agendas and for the structure to be followed in order to collect evaluations from participants. The rationale behind this have been discussed and agreed in the first meeting with the Eu Commission where the key point of mapping the needs of the national regulators, the fintechs and the supervisors is of crucial importance for the sustainability and added value of the project.

In line with this we reformulated the evaluation structure according to main pillars:

- Event reporting
- Feedback reporting:
 - o From participants to event,
 - o From Partners
 - o From National supervisors
 - o From Industry (Banks, Fintechs)

The results regarding the event reporting system has been presented at every Management Board meeting and disseminated within the consortium.

The first event report, presented at the Management Board in Winterthur, 3rd of September covered the M1 – M6 period with summary statistics regarding the number of participants, the number of evaluations from participants and the instructions for partner to accomplish with the event reporting



process.

The second event report has been presented during the Management Board in Bucharest, 15 of November and covered the period M1- M11 where individual statics for each partners has been presented regarding: 1.the number of participants to BDA and AI events sessions 2. the number of evaluations 3. the number of partner's feedback report received and supervisors' feedback report.

Structure of this report

We first present the main achievements of the project and then report the feedback of the official use cases. Then follows a section dedicated to general supervisor feedback, then to the industry feedback and to the feedback by the international supervisors and fintechs.

Then follows a list of ‘ongoing involvement’ extracted from the partner feedbacks. After that we describe the ‘platform for code-based use cases’ which has been one of the tools used in the workshops. Then follows a chapter about the ‘forms engine’ to collect feedback. The chapter ‘feedback by banks, fintechs and international supervisors/regulators’ is based on the activity of UNIPV and FIRAMIS for the dissemination and evaluation work package, including their activity during the acquisition and feedback collection in the financial industry as well as their workshop activity with the international supervisors like ECB, EIOPA, ESMA and EBA.

4. Main achievements

Reviewing the large amount of collected feedback and evaluation data it can be stated the project activity is in line with the project objectives. The workshops/presentations are very useful and the use cases meet the expectations and requirements. The amount and quality of the feedback and evaluation data could be further increased in the last weeks and months.

We have made the following main observations:

the workshops were very much appreciated by the supervisors and the wider public. It is assumed that the industry is currently experiencing major changes and upheavals driven by technology. There are enormous challenges for both those working in the financial industry and for supervisory activities. Knowledge, training and experience in the new financial technologies are of crucial importance. Supervisors are generally very grateful for the introductory knowledge sessions on Big Data Analytics (BDA) and Artificial Intelligence (AI). There is a lot of high-level semi-scientific literature, so it was very welcome that the consortium partners explained in a structured and scientific way how they work, approaches, models and techniques, how they really work and what can be expected from them in terms of outcomes and risks. Technical and especially non-technical supervisors were introduced to the algorithms and approaches for the first time, which was very helpful. They now have a better chance of keeping up with the rapid developments in their financial industry and financial technology.

This transfer of education and knowledge has not always been easy. While the larger part of the workshop participants welcomed the project, there was also a smaller part that had difficulties accepting the knowledge presented. This is completely understandable, as the material presented can be really complicated, as so many different disciplines are involved: Data Science, Computer Science, Fintech Business, Law&Law, etc. The partners of the consortium tried to involve everyone.

Another challenge was that the activities of the supervisors are very diverse and heterogeneous. They range from banking supervision to financial markets. The size and approaches of the supervisory authorities in Europe are also as different as the countries involved. The consortium partners also had to familiarize themselves with the supervisory landscape and their day-to-day business in order to be able to hold more individual workshops, which was sometimes quite a challenge.

Similar to the first observation was the perception about the practical coding. The majority of the workshop participants had their first contact with real computer code and the question how to use it for BDA and AI. The experience was very welcome as they now have a better idea of what drives the new Fintech business models. They now have a better understanding of the rapid changes brought about by software development and AI services in the cloud and the open source and open data revolution. The flipside of this coin was that a minority of the workshop participants rejected these presentations because of their irrelevance to their day-to-day business.

The experiences of 1 and 2 were reflected very well by the partners, and the data show that they have started to change the structure of their workshops and their workshop contents. It has been made more suitable for the addressees, e.g. by dividing the audience into technical and non-technical personnel, by changing the workshop material and by improving the online and offline participation described in some of the next paragraphs.

Workshop participants had many opportunities to get involved and stay involved in the project activity. First of all, there are not only the standard presentations, but also many customer-specific enhancements by the partners. This material is shared on the central platform and made available to the users. The research repositories contain not only the publication activities of the partners, but also many relevant and recommended publications to immerse into the material. The code for some of the use cases is provided together with the presentations and papers, so that participants are able to follow the course material and the extended material 'offline' after the workshops. Many partners established links with the contact persons and the audience of the workshops to maintain dialogue and answer questions. Each workshop day was also introduced by an overview of project activities throughout Europe, so that workshop participants also had the opportunity to travel to other workshop locations and build a network. They were also able to follow the project on the social media channels set up by the project.

The use cases developed by the consortium partners received good feedback and fulfilled the expectations and requirements. It was well understood that BDA is also very complex and dynamic, so it is very important to apply information processing that correctly extracts the essential information in an easily digestible and understandable way. The decision making, predictions and conclusions made by the models must also be transparent. One way to explain a model is to visualize complex data. Some of the focus areas of the use cases of the project were network analysis, graph theory and explainable AI (XAI). It was well understood that such approaches are the key to a trustworthy, responsible and human-centered use of financial technology. This is independently underscored by Gartner's conclusion that graph analysis and XAI will be among the technologies with the greatest trend in the coming years (<https://www.gartner.com/smarterwithgartner/gartner-top-10-data-analytics-trends>). Many workshop participants also understood that not only banks and fintechs should be guided by these principles when using technology. Supervisors themselves have large amounts of structured and unstructured data that should be used for data-driven, digital supervision. Network theory and XAI could also be used by them to take a more trusted, human-in-the-loop approach to the use of these new technologies. It appears that regulators from Germany, France, Spain and the UK, as well as many other EU countries, are very interested in these issues. These include the European Commission (e.g. AI HLEG and Fintech Lab) as well as international regulators and central banks in Europe. We have had personal contact with most of these institutions and received confirmation that our project supports these highly important developments.

Obtaining feedback from supervisors/regulators can be extremely difficult and challenging. The reason for this is that financial regulators need to be extremely careful with their communications, as it is one of their most powerful tools. Discretion and reputation are critical aspects of supervisory activity. Furthermore, supervisors must be neutral in many dimensions, such as technology, market participants and business models. The consortium took a careful approach to build trust and receive feedback in a way that satisfied both regulators and partners.

It can be seen that many regulators are currently launching new initiatives on digitalisation and financial technology. Regulatory teams are very open to input on new technologies such as BDA and AI. They value the freedom, perspective and knowledge of the academic community and like to interact and share with academics. In this respect the project has good timing. However, it must also be noted that some supervisory teams are not yet ready for the AI/BDA age due to a lack of tools, infrastructure and knowledge. However, these teams are now in the process of launching some initiatives, which of course takes time.

5. Feedback regarding the use cases

We first report on a general feedback on the use cases currently available in the platform (BDA 3 use cases, AI 3 use cases). There are very strict rules according to which a use case can be considered as such like an open access peer reviewed paper. There were many more use cases prepared in the platform that were also taught in the workshops but only a few could become official use cases and these are the ones that we discuss here. The underlying feedback is gathered from the workshop participants as well as from the supervisors, partners and industry.

Big Data Analytics Research

The use cases are:

1. Network based scoring models to improve credit risk management in peer to peer lending platforms
2. Factorial Network Models to Improve P2P Credit Risk Management
3. Spatial regression models to improve P2P credit risk management

Use case 1 was most often presented and best rated, followed by use case 2 and 3. The perceived utility, predictive accuracy and explainability were above average. The general feedback was good and met the expectations and requirements.

The use cases have been presented to wide range of functionaries:

Financial Technology and Innovations Department, Supervisory Inspector, Securities Market, Insurance and Pension Savings, Banking and Payment Services Supervision Department, Macroprudential Supervision Department, Consumer protection, Governance, Market and Banking supervision, Transparency regulations, New Products and Services Unit, Legal, IT Risk Supervision, IT auditor, Data Analyst and Analysts in general, Actuaries, Financial Analysts, Researchers, IT & Security, Analysts, Risk Analysis Data Analytics and Reporting, Systemic Risk Department, Funds and Investment Firms Supervision Division, Insurance, Leasing and Factoring Supervision Division, International Regulations and Cooperation Department, Funds and Investment Firms Supervision Division, Pension Funds Supervision Department, Insurance Supervision Department, Investment Funds and Investment Firms Supervision.

On the industry side the following parties were addressed by the use cases: banks, insurance companies, p2p lending, crowdfunding platforms and other actors. The background ranged from risk management (credit risk, market risk, operational risk) to product management, general management, legal®ulation, data science and IT.

It was well understood that the uses cases addressed principles like adding network features, split the dataset into cluster in order to build several better suited models, to combining several complex data sets. The utilization of network analysis, graph theory and clustering can be applied very well in p2p

lending use cases but it can be easily extended to scoring and credit assessment and risk management, e.g. in larger banks.

It was stated that current risk and scoring models lack the notion of contagion which can be addressed with network models, thus improving fintech risk management.

The use cases can also be extended to other fintech business models and use cases, e.g. in robot advisory. It was also understood that there is a fruitful combination of network analysis and clustering with (supervised) machine learning.

The uses cases proved to be very useful for the participants as tools for making them understand some of the research directions and they were excellent starts for brainstorming regarding their impact in practice and the impact they would have on the activity of the supervisor.

The network analysis approach raised much interest as it is a general 'AI tool' to better understand complex and linked financial data sets which can even be temporal and dynamically changing. Supervisors identified the method a very useful also for their own applications in better understanding contagion and spreading of (systemic) risk. Specifically, several participants indicated the possibility of using the presented methodology for tracking central nodes within payment systems and interbank systems.

The network centrality measures guide the user to most relevant points in a huge and complex data set. The transparency and interpretability properties of graph theory / network analysis is very suitable for visualization the complex data sets.

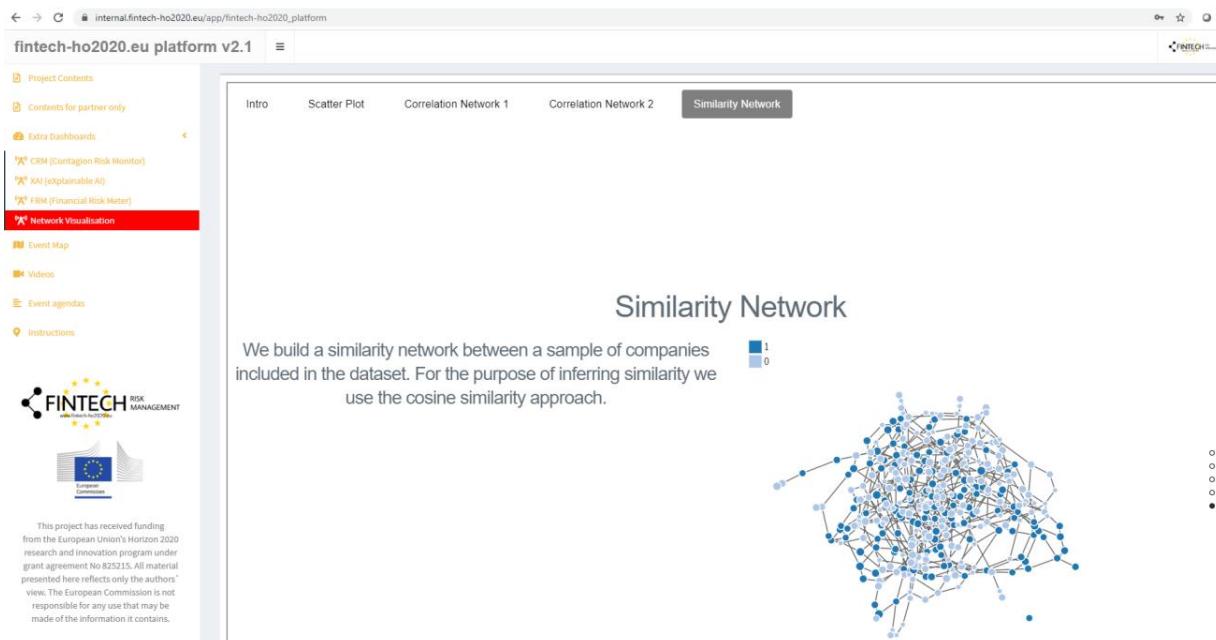
Network analysis and clustering are well-suited to process complex data for the following reasons:

- Advanced Analytics (paths, connectivity / neighborhood, communities / clusters, centrality)
- Visualisation
- Framework for machine intelligence
- Natural fit for financial data like transactions network
- Scientific: analyse complex systems

The use cases plus codes plus visualization enabled very lively and two-sided discussions and involvement with the audience, leading to valuable communication between supervisors and researchers. It was often the basis to also discuss the p2p business models and industry perspectives.

A broader debate was held over the data. Besides the privacy, bias, ownership and ethical discussion it was pointed out that the interpretability and predictive accuracy of the use cases can be improved by adding more features and covering a longer period of data for testing and for identifying changes across the business cycle. It was discussed that it is very hard for academics to get access to data. Several initiatives like 'Kaggles for Europe' or Financial Big Data Clusters and cloud infrastructures supported by EU governments are on their way. Artificial or synthetic data sets could also be a contribution to the solution of the problem.

For most of the supervisory audience the practical link to their day-to-day work was given by the use cases. However, for some of them there was not enough relation to their daily monitoring or implementation in supervisory activities. For a few it was hard to follow and they would have preferred to longer discuss the statistical and econometric basics before proceeding to ML and AI. Partners tried to keep it as simple as possible but needed to move on to the new financial technologies at some point.



This examples shows some network filterings and visualizations produced Branka Hadji Misheva, one of the consortium partners. It can be seen that network models in general are very helpful and interpretable due to their visualization properties and their roots in graph theory.

Artificial Intelligence Research

The use cases are:

1. Network models to enhance automated cryptocurrency portfolio management
2. Convergence and Divergence in European Bond Correlations
3. eXplainable AI (XAI) in Credit Risk Management

Use cases 2 and 3 were almost equally picked and rated similarly well. Use case 1 slightly less prominent. Also here, the perceived utility, predictive accuracy and explainability were above average. The general feedback was good and met the expectations and requirements.

The use cases were able to address a very diverse audience of supervisors and financial industry participants (similar to BDA).

Network models to enhance automated cryptocurrency portfolio management

Use case 1 has been widely discussed in the context of portfolio management, robot advisory and automated finance. Indeed the use of cryptocurrencies and automated consultancy, is widely spreading in the last few years. However, automated consultancy services are not exploiting the potentiality of this nascent market, a class of innovative financial products that could be proposed by financial actors and robot advisors. To this end we propose an extension of the Markowitz model by combining Random

Matrix Theory and network measures, in order to enhance portfolios' risk-return profiles. Overall, the methodology proposed in the use case overperforms several competing alternatives, maintaining a relatively low level of risk. The use case could be applied also to a variety of alternative data sources. For instance, one may consider using other cryptocurrencies for his/her analysis, or he/she might want to consider other types of securities, such as traditional stock markets, bond market, exchange traded funds, and so on.

Use case 1 has been discussed, has been given feedbacks and has improved in various occasions.

First of all, the use case has been developed mostly in the University of Pavia environment. Here, the authors of the use case have received various suggestions from the people from the University of Pavia. Some members of the group of statistics of the department of economics and management have suggested which centrality measure should have been included in the portfolio allocation problem from his expertise on network metrics and centrality measures specifically. Furthermore, another member of the lab suggested to include the so-called residuality coefficient to compares the relative strength of the connections in cryptocurrency returns above and below a threshold distance value, to gain insights on the network structure of cryptocurrencies and to use it to foster portfolio management activities.

Secondly, the use case has been discussed internally with all project partners. The main feedbacks gathered here are to compare the model proposed with more alternative specifications. In other words, the model produces outcomes customized by the choice of the risk-aversion parameter, which is investor specific. Partners have suggested to take into account different figures of the risk-aversion parameter, and try some sensitivity analysis on this specific parameter. The authors have implemented this suggestion and have determined which kind of risk-aversion parameter worked at best with historical data of cryptocurrency prices. Then, partners also gave minor comments to improve the quality and readability of the work.

Thirdly, as one of the co-authors (Gloria Polinesi) of the use case is from "Università Politecnica delle Marche", the use case has been internally presented in the "Università Politecnica delle Marche", both informally and in the occasion of the department of economics and social sciences seminars. Here, an audience of econometricians and academic experts in the field suggested to improve the algorithm by including some filter to the modified correlation matrix of cryptocurrency returns given as an output from the random matrix theory. After some discussion, they referred to many seminal papers in the field of econophysics and suggested the use of techniques such as the minimal spanning tree in order to reduce the link dimensionality in the cryptocurrency network structure and achieve potentially better performance than those obtained by just employing the random matrix theory.

Fourthly, the paper has been presented in the Winterthur regtech, which took place in September 2019, by Paolo Pagnottoni. In this occasion, partners, people from the academia and people from the industry had the occasion to see the use case explanation and code running. The feedbacks were very good and there was much interest from both the academic and industry people. The main comment raised regards the efficient computation of eigenvalues of the correlation matrices in the random matrix approach and the academic person in question from UCL suggested a way to improve this. A second main comment was on the use of the use case with regards to alternative financial instruments, a need which can be easily and satisfactorily addressed.

Fifthly, the use has been presented in the SupTech AI in Malta in November 2019, held by Paolo Giudici and Paolo Pagnottoni, at the Malta Financial Services Authority MFSA. Here the use case was very much

appreciated by the audience, who was mixed in backgrounds, meaning there were both people from the law/regulatory side and people having quantitative background and tasks. The use case was mostly appreciated by the audience with necessary quantitative skills to understand the overall algorithm, however also the other people found it interesting. The main feedback we gathered here is on the alternative model specifications to be used to compare our results with. In other words, the authors have been suggested to use a more powerful and network-related model specification for the portfolio allocation strategy to test whether the portfolio strategy proposed would have still held the primacy in total returns and risk profiles. The authors have consequently employed the Glasso Markowitz portfolio, which combines the Glasso framework with the Markowitz portfolio construction, and they have demonstrated that their proposed asset allocation method still achieves better results in terms of risk-return profiles-

Sixthly and lastly, the authors have submitted the use case to an open access journal and subsequently published on it: "Frontiers in Artificial Intelligence", with special issue "Artificial Intelligence in Finance". Reviewers have made many comments and provided many feedbacks which notably improved the quality of the use case. One main comment was on the benchmark used to evaluate portfolio performances. The authors have been suggested to use the cryptocurrency index CRIX, a market index for cryptocurrencies which follows the Laspeyres construction, to evaluate the portfolio performances against it. This has been useful as the CRIX is a synthetic measure of the dynamics of the cryptocurrency market prices, and it is therefore a sound choice to use as a benchmark. Another main comment was on the evaluation of the risk-return profile of the portfolio. One of the reviewers argued that the sharpe ratio is sometimes not enough accurate to provide a measurement of a portfolio's risk-return profile. Therefore, the reviewer suggested to employ the Rachev ratio. Unlike the sharpe ratio, which is a reward-to-variability metric, the Rachev ratio is a reward-to-risk ratio, as it measures the right tail reward potential relative to the left tail risk instead, in a non-Gaussian framework. The authors have implemented the Rachev ratio and demonstrated that results are qualitatively unchanged: the proposed methodology still outperforms the others maintaining a relatively low level of risk. A last feedback that made the use case notably improve was that of conducting a sensitivity analysis on the starting point of the analysis and on the size of the rolling window used to estimate the model and then produce results. The authors have implemented the sensitivity analysis as suggested by the reviewer and have proved that the proposed asset allocation methodology still overperforms the others in terms of risk-returns profile.

Convergence and Divergence in European Bond Correlations

This use case is addressing contagion in financial markets - an important phenomenon during the European sovereign debt crisis of 2010-2012 that had substantial impact on the Euro area and led to massive central bank interventions and even the setup of new institutions, especially the European Stability Mechanism (ESM). The use case reveals the convergence and divergence of European bond correlations over time in some sort of nearcasting, as market makers parametrize their quote machines for the secondary market with correlations that reflect their risk assessment. Negative correlation parameters between two markets imply a diverging reaction of market prices to future news and therefore already anticipate increasing risk sentiment. The use case could be applied to different markets, asset classes and geographies if data availability and coverage is sufficient.

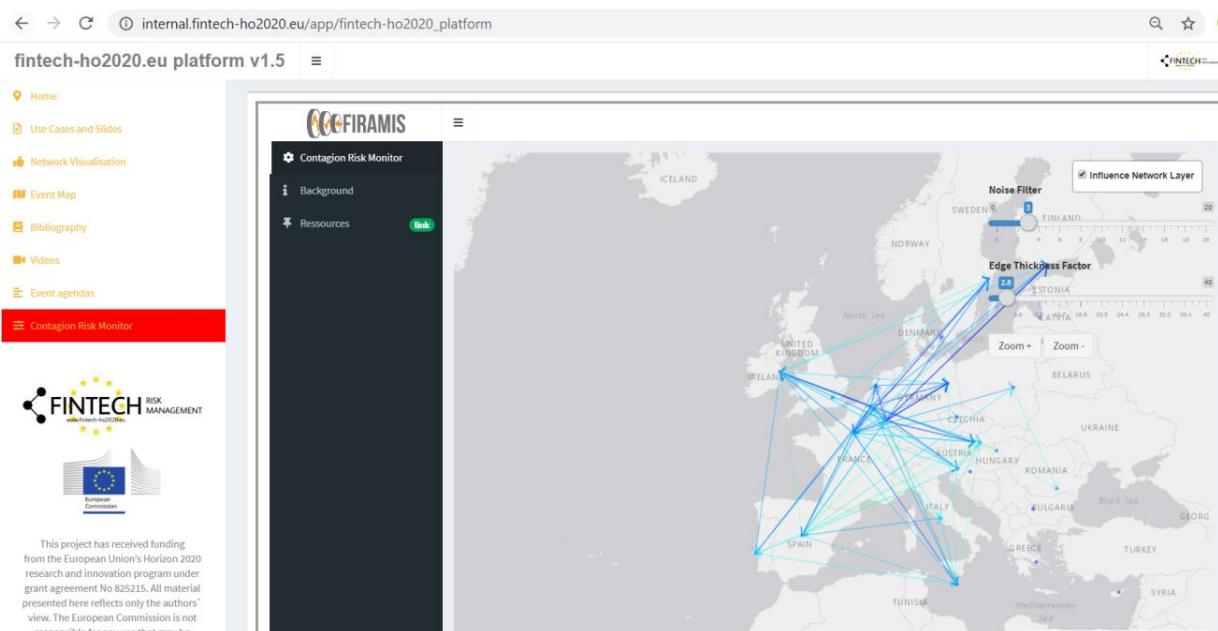
Here is one of the feedbacks:

'Convergence and Divergence in European Bond Correlations and the presentation of this model was clear with the right balance of technical depth being value adding and at the same time provoking the engagement from the audience.'

The feedback of the audience from workshops and conferences was consistent to their background: financial market practitioners and also the regulators during the Copenhagen workshop (August 2019) pointed out the usefulness for the practical assessment of short-term market sentiment. Academic economists were usually hesitant to consider a model without a lag structure. They prefer the standard Diebold-Yilmaz framework or similar approaches. The reviewers from the project questioned if the method qualifies as "AI", as it does not implement a self-learning system. Our working definition of AI includes supervised and unsupervised learning. The suggested use case approach belongs into the group of unsupervised learning methods. Tomaso Aste (UCL) suggested to complement the correlation influence method with transfer entropy (Keskin and Aste 2019). We will follow up on this idea.

Some participants with an economist background gave the feedback that the data could be more granular, focused on the reaction to specific isolated news and the analysis could be mixed with other data like country macro data. Financial market practitioners, on the other hand side, welcomed the absence of macroeconomic data in the approach, as financial markets price assumptions for future economic developments and often preempt macroeconomic changes.

Workshop participants could follow the presentation very well because the use case is structured in an easy ways and can be explained step by step, including the data. The 'clever graphical presentations help in understanding dynamic dependencies':



This use cases is supported by interactive visualizations and dashboards produced by Rshiny on the project platform. This helps to explain the use cases and get intuitive access to the methodology.

The methodology implemented in the use case was developed by ZHAW together with the European Stability Mechanism (ESM). Apart from the academic publication

Schwendner, Peter; Schüle, Martin; Ott, Thomas; Hillebrand, Martin, (2015). European government bond dynamics and stability policies : taming contagion risks. *Journal of Network Theory in Finance*. 1(4), S. 1-25

it was featured on the ESM website:

<https://www.esm.europa.eu/publications/european-government-bond-dynamics-and-stability-policies-taming-contagion-risks>

and in the ESM annual reports 2015 and 2016

ESM Annual Report 2015, p. 59/60, 16.6.2016, www.esm.europa.eu/publications/esm-annual-report-2015

ESM Annual Report 2016, p. 53-55, 15.6.2017,

www.esm.europa.eu/sites/default/files/emergingfinancialtechnologybringsesmchallengesandopportunities.pdf

The FIN-TECH project and the related refined publication with additional applications

Schwendner, Peter; Schüle, Martin; Hillebrand, Martin, (2019). Sentiment analysis of European bonds 2016 - 2018. *Frontiers in Artificial Intelligence*. 2(20)

helped to further disseminate the use case. The authors were invited from ESM to contribute to the technical appendix to the Evaluation Report “Lessons from the Financial Assistance to Greece” that was published on June 11, 2020. The Independent Evaluator, Joaquín Almunia, presented his report to the Board of Governors of the ESM, after more than a year of work and consultation. His evaluation assesses the financial assistance to Greece in terms of relevance, effectiveness, sustainability, efficiency and cooperation. It strongly focuses on the European Stability Mechanism (ESM) supported programme from 2015 to 2018, while taking into account the preceding Greek financial assistance by the European Financial Stability Facility (EFSF). It also assesses the post-programme developments up to end-September 2019.

Reference:

Hillebrand, Martin and Schwendner, Peter: Contribution of Greek financial assistance programmes to reduce spillover risks. Technical Appendix (p.39-43) of: Lessons from Financial Assistance to Greece. Report from the Independent Evaluator Joaquín Almunia (11.6.2020).

Press release: <https://www.esm.europa.eu/press-releases/programme-evaluation-greece-published-today-0>

Evaluation Report: <https://www.esm.europa.eu/financial-assistance/evaluation-efsdesm-programmes>

Technical Appendix:

[https://www.esm.europa.eu/sites/default/files/greece_evaluation_technical_appendix.pdf](http://www.esm.europa.eu/sites/default/files/greece_evaluation_technical_appendix.pdf)

eXplainable AI (XAI) in Credit Risk Management

Use case 3 ‘eXplainable AI (XAI) in Credit Risk Management’ is based on similar data sets as the BDA use cases and combines the network approach with explanation technologies rooted in cooperative game theory (SHAP values) for local and global variable importance. It is basically an unsupervised representation learning on top of the results of a potentially black box supervised learning. It has applications in a wide area just like the BDA use cases (it actually bridges the two packages BDA and AI), namely in p2p lending and credit scoring/assessment/risk management as well as in other financial domains like robot advisory and market risk management (https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3528616). It can also be applied in the context of supervisory machine learning. It is an approach to get access to and visualise the ‘brain of an AI model’.

A related paper has been produced in this project on a different but comparable data set: ‘Explainability of a Machine Learning Granting Scoring Model in Peer-to-Peer Lending’ (<https://ieeexplore.ieee.org/document/9050779>).

This use case is just one example of explaining a black box machine learning model. The use case is a smaller building block of a larger debate around transparency, interpretability and explainability of machine learning models which is currently being discussed among supervisors, regulators and the financial industry worldwide and also in this project, of course. We will report about this debate here because it seems to be very important and was mentioned in a larger number of feedbacks. The projects’ feedback material documents activity and discussion at national supervisors from countries like France, Germany, Spain, Denmark, the UK, and Romania during the workshops. Some supervisors stated that explainability/interpretability of models is a first priority for financial institutions and is very high on the agenda. Therefore, supervisors, show a special interest in the ML and AI interpretability topic. They consider extremely important for the models to be explainable from theoretical point and with parameter values reasonable.

In many decision-making applications, regulatory and transparency concerns slowed down the industry from embracing these new technologies due to the nature of black box of AI models. To overcome this problem, explainable AI models provide details or reasons to make the functioning of AI clear or easy to understand, thus they are potentially suitable in regulated financial services. If XAI is able to report the reasoning to make its functioning clearer to understand by humans, it would be potential to improve regulated financial services. This could be an important contribution to fintech scaling across Europe.

Biases, explainability/interpretability, data privacy and the transition from a development to a deployment stage are issues of the utmost importance and some solutions already exist. Supervisor have contributions to be make in this area and could aim at implementing sound concepts and practices, by getting inspiration from academic work and working closely with those in charge, in the financial sector, of developing operational AI solutions.

The German BaFin states that ‘It is the responsibility of supervised institutions to ensure the explainability and traceability of BDAI-based decisions. At least some insight can be gained into how models work and the reasons behind decisions, even in the case of highly complex models, and there is no need to categorise models as black boxes. For this reason, supervisory authorities will not accept any models presented as an unexplainable black box. Due to the complexity of the applications, it should be considered whether process results, in addition to documentation requirements, should also be examined in the future.’

(https://www.bafin.de/SharedDocs/Veroeffentlichungen/EN/BaFinPerspektiven/2019_01/bp_19-1_Beitrag_SR3_en.html;jsessionid=DDFA1EBC7153FD5A23B710F25C5DAFA0.1_cid393)

Another regulator calls it the ‘explanatory gap of AI’:

‘It is often difficult to know

(i) how reliable the inferred relationship between input and output is and

(ii) which causality exists between them. This is called the explanatory gap of AI. [...]

Supervisors have to adjust their approaches and skills to escort the introduction of AI/ML in banking. Banks have to give supervisors sound explanations of what their AI/ML systems actually do, as well as to what end. (Joachim Wuermeling, Member of the Executive Board, Deutsche Bundesbank, page 158 ff.: https://www.eurofi.net/wp-content/uploads/2020/04/views-the-eurofi-magazine_zagreb_april-2020.pdf)

One can find similar public statements on the black box problem by many other national and international supervisors/banks, for example by Financial Stability Board, Bank of England, and FCA.

One of the most recent publications on ‘Governance of Artificial Intelligence in Finance’ and XAI has been submitted by Banque de France where our consortium partner established a dialogue on XAI and related topics. (<https://acpr.banque-france.fr/en/governance-artificial-intelligence-finance>). The partner from France has also created an extra feedback/white paper about BDA & AI.

Another report by BoE and FCA deals with ‘Machine learning in UK financial services’ (<https://www.bankofengland.co.uk/-/media/boe/files/report/2019/machine-learning-in-uk-financial-services.pdf>) and many practical issues arise, also related to XAI. For some of the workshops we relied on this paper to establish some check lists that could be used in supervisory practice.

The XAI use is also closely connected by two model publications by:

Bank of England: ‘Shapley regressions: a framework for statistical inference on machine learning models’: <https://www.bankofengland.co.uk/-/media/boe/files/working-paper/2019/shapley-regressions-a-framework-for-statistical-inference-on-machine-learning-models.pdf>

Bank of England: ‘Shapley regressions: a framework for statistical inference on machine learning models’: <https://www.bankofengland.co.uk/-/media/boe/files/working-paper/2019/shapley-regressions-a-framework-for-statistical-inference-on-machine-learning-models.pdf>

We also had the chance to present the XAI use case and discuss the topic in smaller on-premise workshops at ECB, EBA, and ESMA. ECB, EBA and EBF also attended our special workshop in Brussels where the XAI use case has been presented. All institutions pointed out that XAI is an important tool to overcome some obstacles of black box machine learning. Due to one of our use case presentations on XAI we were also invited to present at the EIOPA InsureTech task force.

‘Ethics Guidelines for Trustworthy AI’ developed by the High-Level Expert Group on Artificial Intelligence (AI HLEG; <https://ec.europa.eu/futurium/en/ai-alliance-consultation/guidelines>) and the White paper on Artificial Intelligence by the EC (https://ec.europa.eu/info/sites/info/files/commission-white-paper-artificial-intelligence-feb2020_en.pdf) also address XAI. XAI is a building block for trustworthiness, transparency, interpretability, fairness, model de-biasing and model debugging.

‘Europe is well-positioned to tap into the potential of AI by capitalising on Europe’s competitive industrial and professional markets, including financial services, and its digital innovation and research

capacities. At the same time, building an ecosystem of trust is essential. A European approach to AI should ensure that machine-based learning technologies are human-centric, ethical, sustainable and respect fundamental rights and values.' ('The European approach to Artificial Intelligence in Fintech: current efforts and ambitions' , Pēteris Zilgalvis J.D., Head of Unit, Digital Innovation and Blockchain , DG Communications Networks, Content and Technology & Co Chair, FinTech Task Force, European Commission, page 158 ff.: https://www.eurofi.net/wp-content/uploads/2020/04/views-the-eurofi-magazine_zagreb_april-2020.pdf)

More on this is written in the blog of one consortium partner: <https://firamis.de/ai-fintech-riskmanagement-regulation/>. The underlying presentations are part of the material used to communicate the XAI use case and can be found here: 06-Extra_feedback\Firamis\Blog

V29 Legal's Evaluation of the use case can be found in 06-Extra_feedback\V29_Legal. A connection is established to the 'Ethics Guidelines for Trustworthy AI' by the AI HLEG. The company has recently also made a 'contribution to the European Commission's Public Consultation on the White Paper on Artificial Intelligence' where the XAI use case and the FIN-TECH project are mentioned (https://aace002b-1655-41a1-b32a-9ae30cfe1c36.filesusr.com/ugd/c2b398_2b5df13ef91f4f30901e153170bf5248.pdf)

Some of the workshops of XAI have been enriched by the presentation 'Machine Learning in the banking landscape: Market experience, a view on specific risks, controls and audit considerations' by Ernst&Young.

The perceived 'black box' nature of the neural networks methodology also decreases its perceived utility specially when improvements in accuracy are not significant vs more traditional 'white boxes' methodologies. The explainable AI might solve the 'black box' constrain but only if it can be translated into layperson language to explain to front-office, borrowers and non-experts why a certain borrower is considered more or less risky.

Also, the different understandings of the XAI notion should be clarified if the supervisor is to express its expectations in this area.

There are also mentioned causal (cause-effect) or rules-extraction approaches to explain machine learning which can be an extension of the XAI use case presented.



This interactive dashboard and visualization helps to teach the XAI use case in the workshops.

6. General, direct feedback by supervisors

We report the forms-based feedback and extract the most supportive, remarkable as well as controversial feedback.

The feedback by supervisors are summaries for each block BDA and AI. In the form we asked for the topics covered and how comprehensible they were. Then we asked for the main results and how significant they were for the supervisor. The following form was used:

Event summary and report of supervisors and regulators

Title of the workshop

Regulator/Supervisor

The main topics and their comprehensibility
1)
2)
3)
4)
5)

The main results and their significance for your institution
1)
2)
3)
4)
5)

New insights and main take aways

Further remarks

Main topics:

Consortium partners gave overview sessions and general introductions to BDA and AI, as well as to Market Risk and Robot Advisory, Fintech and big tech credit risk analytics, P2P lending market and business, data management, machine learning, explanation of statistical tools applications but also in programming and using open source-based programming tools and Machine Learning for Time Series Forecasting.

Some partners presented a large number of use cases whereas others more concentrated on a few use cases, especially those applied to supervisory issues.

Use cases and topics mentioned often and marked as relevant were those on Interpretability and Explainability, especially as a key concern from the model validation perspective. As outlined in the sections before it is a subject with high priority for supervisors. It is also recognized as feature engineering tool.

There were also other use cases mentioned that are based on network models, namely to improve robot advisory portfolio management, to enhance automated cryptocurrency portfolio management and for sovereign risk analysis. The latter was mentioned several times when it comes to analyzing the Convergence and Divergence in European Bond Correlations.

Topics covered and some results and statements

'How to use data to construct a network, network representation and graph analytics'

'The audience understood how it works P2P lending and how'

'That XAI is also on other people's minds'

'growth of knowledge about artificial intelligence and machine learning'

'Insight into new trend in financial products and financial management'

'Training has increased knowledge of new technologies'

'Detailed information on how statistical learning from big data is applied'

'Good review of the state of the arts this new statistical techniques'

'Better knowledge and understanding of statistical, ML and AI methods used by FinTech companies'

'Understanding how Machine Learning works'

'The Explainable AI concepts are interesting since this technology will definitely start to be used more and more in the future.'

'Understanding of interrelations of different methods available for financial market supervision'

'Understand how and when Machine Learning techniques can be used'

'Network models using centrality measures and contagion patterns are another interesting topic.'

'Deeper understanding of artificial intelligence and robotic advisory'

'Given the gaining popularity of AI solutions in financial decision making, the understanding of such methods and their potential risks are vital for the central bank.'

'The use of big data is an area of active interest in our institution. It is good to hear what others are doing in this area.'

'More understanding among supervisors of new technologies and their effects on banking and insurance activities'

'growth of knowledge about deep learning and P2P lending and crowdfunding platforms'

'Introduction to fast evolving area of FinTech'

'Predictive capacity of future bank failures and crisis'

'Brainstorming of new red flags to be raised in the validation these models'

Good intro to most important aspects

'Detailed explanation, on real life examples, of models underlying the current risk management standard'

'Food for thought on the potential behind these models, and their risks embedded'

'We consider workshops a good basis for improving supervision and risk management frameworks of supervised entities'

'The audience understood the main risks in P2P lending'

'Good focus on main supervisory aspects and challenges'

'The conference was an opportunity to provide a very comprehensive and up-to-date analysis of the subject from different perspectives : technical, operational, statistical and legal.'

'Information on the workshop program, agenda and speakers were disseminated very well in advance. The information on the content of the workshop was fully consistent with the effective presentations and the final take away of participants.'

New insights and main takeaways

'The main insight will be the legal part and how the future P2P companies will start working in the local market.'

'awareness of relevant impact of new technologies in development of fintech sector'

'We [...] had a very positive experience and reactions from our staff being able to immediately implement the theoretical notions explained in the lectures on real life examples.'

'New models and how they are build, where to look for more information on possible risks stemming from the model'

‘People from risk Units, market conduct, financial innovation, and research attended the workshop. It is a new field of interest specially for micro.prudential regulation.’

‘Change of financial market Dynamics. Driving forces. Necessary changes needed in the supervisory competence pool.’

‘Better understanding of interlinkages of different topics (ML, AI, Big Data, FinTech, P2P) and methods (supervised, unsupervised learning, network analysis for financial risk management)’

‘New technology can be useful for our mission. Great problem: explainability’

‘Developing of technical skills for Supervisors is of future interest. More collaboration between Supervisors, academia and the business environment would be useful. More international collaboration.’

‘The possibilities of artificial intelligence are currently incomprehensible, and at the same time it is a big leap into the unknown field.’

‘The abovementioned topics and the following discussion was significant for us in terms of building further understanding and expertise, and would eventually help us to initiate the implementation of internal innovative projects.’

‘The conference was an opportunity to provide a very comprehensive and up-to-date analysis of the subject from different perspectives: technical, operational, statistical and legal.’

‘All new research in interpretable ML applied to financial services would be welcome.’

‘Explainable AI. The subject is a priority for us, and the presentation was well suited for the general audience.’

Positive feedback

‘In terms of whole organization, the FINTECH HO 2020 program can undoubtedly be defined as effective and efficient.’

‘Network models to improve robot advisory portfolio management – Good’

‘Big Data Analytics: the topic was introduced with a direct focus on the risks and each speaker shared its analysis from its domain of expertise (lawyer, statistician, etc.) while presenting concrete applications from which the risks might arise.’

‘It was a good introduction to the foundations for big data analytics.’

‘Opening and introduction to Artificial Intelligence - Very good’

‘Financial Actors and Fintechs: very interesting insights form the banks and startups that participate in the development of big data and artificial intelligence technologies for financial applications.’

'Visualization of complex relationships. This was new to many people, and it was nice to have it presented visually instead of in coding.'

'Network models to enhance automated cryptocurrency portfolio management - the presentation of this model was clear with the right balance of technical depth being value adding and at the same time provoking the engagement from the audience.'

'The concepts related to Artificial Intelligence are very interesting and useful.'

'Introduction to Market Risk assessment – Good'

'Network analysis and clustering models. A good introduction. The more general aspects were well received.'

'Paper on Stablecoins (still in research) - the presentation of this model was clear with the right balance of technical depth being value adding and at the same time provoking the engagement from the audience.'

'AI/ML across banks: This presentation from EY was spot on what we, as more or less lay people, can comprehend. They focused in on the big topics and gave a few examples. Just enough detail to let us learn but not so much that we were left behind.'

'The uses cases are interesting and help get a better understanding of the opportunities and challenges brought by AI. Sometimes the presentation was too technical.'

'Network models to improve robot advisory portfolio management – Good'

'Research topics around AI: an understandable presentation by researchers on the most discussed risks and on controversial definitions of the literature.'

'xAI: This part is perhaps one of the more \down to earth\ parts, and was quite instructive. A further focus on \what should a regulator look for\ would have been appreciated, but all in all this part was really good'

'Machine Learning for Time Series Forecasting - Very good'

'I have heard from the few participants, that it was helpful in their further work.'

'Are cryptocurrencies connected to forex? - Very good'

'Outstanding, we received a very good overview about the fields of this technology'

'Our main goal was to make people interested in the subject, and all in all, I believe we succeeded. [...] the overall focus was fine to this effect.'

'Significant' (several times)

'Outstanding, we were informed about the working mechanism of this lending platform, and we could deep dive into the relevant risks, and opportunities.'

'The mix of public and private sector perspectives on regulation was valuable.'

'Significant '

'Network models: outstanding, good. '

'Per our request, the last part of the workshop was devoted to the implementation of machine learning techniques in text mining. It was a great overview of potential techniques for the analysis of text documents available at the central bank. '

'Training program has potential to increase the efficiency of supervisory activities and update knowledge of the newest financial technologies. '

'The presented use cases were very useful from a supervisor's point of view. '

'Great lectures that allowed to expand your sight. '

'Highly experienced teachers'

'In general, both topics allow our institution to improve our analysis and understanding the dynamic of financial markets, with a special focus on financial stability issues.'

'I would like to thank the presenters for additional comprehensive discussion on the EU AI strategy'

It was great to hear more about available data sources on fintech and big tech credit.

Aspects that should be corrected

'Data science [...]: I believe that this part of the day was much too detailed. '

'We, as lay people, are not in a position to cope with such detail. It would have been better, if the focus had been much more high level/broad picture. '

'Sometimes the presentation was too technical. ' (several times)

'Perhaps too much focus on actual coding and too little on interpretation'

'Presentation on Tree Models - should be improved'

'Presentation on Random Forest - should be improved'

'More focus on Supertech concepts would be useful.'

'Various coding sessions - these parts of the agenda was too focus on coding, and as only a small handful in the audience knows coding, the information content was sadly lost on almost everyone. '

'Topic (data on consumer credit) not relevant for Belgium, because not in the remit of the regulator '

'A few presentations were much too detailed [...]'

'Unfortunately, a couple of existing [...] platforms do not implement any advanced statistical methods for portfolio optimization, but such workshop is nevertheless beneficial for us as a preparation for future development in industry solutions.'

'Mismatch between targeted audience and people present at this workshop. Unfortunately due to the abovementioned reasons no new insights and thus no added value. '

'A result is to make a split for the next session, to have actual coding separate from the high level session'

'Standard content delivered by the project was not relevant for [...] , if stick to the imposed program, [...] regulators might drop out of such workshops. Also, the envisaged length of the workshop (16h) is not feasible nor desirable. Should be organized in a more efficient way and much more hands on and related to the mission of the regulators. For the upcoming AI SupTech, we demand another much more tailored approach and are trying to work together with [...] to achieve this.'

'We were generally satisfied but had some complaints regarding the very steep learning curve that is expected from our staff in order to be able to follow and implement the presented cases.'

'Keep it simple - at least when trying to reach a broad audience that is not working with the subject matter on a day to day basis.'

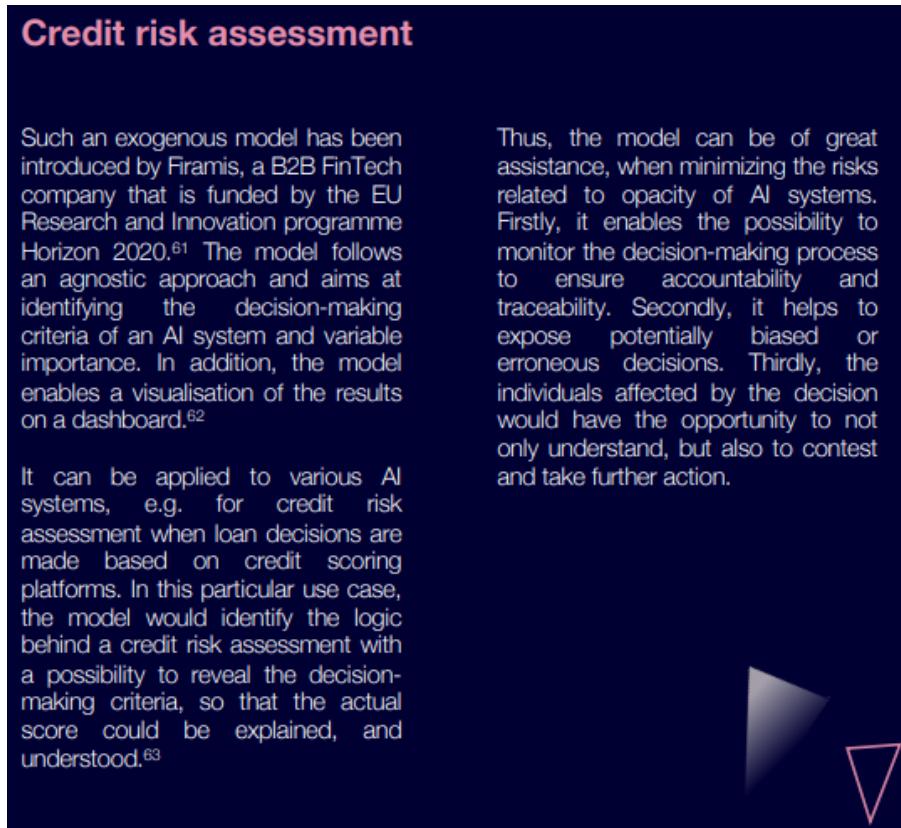
'More interaction with colleagues from the network would be useful. More interaction with the business environment would be useful.'

7. Feedback by the industry

Feedback by V29 Legal

V29 Legal is a boutique law firm specializing in international dispute resolution as well as legal matters related to modern technologies.⁶¹ With regards to artificial intelligence (AI), V29 Legal works with innovators to drive change and shape the development and deployment of technology which is and will continue changing our life tremendously.

The company made a contribution to the European Commission's Public Consultation on the White Paper on Artificial Intelligence, also referring to the XAI use case (https://aace002b-1655-41a1-b32a-9ae30cfe1c36.filesusr.com/ugd/c2b398_2b5df13ef91f4f30901e153170bf5248.pdf):



Credit risk assessment

Such an exogenous model has been introduced by Firamis, a B2B FinTech company that is funded by the EU Research and Innovation programme Horizon 2020.⁶¹ The model follows an agnostic approach and aims at identifying the decision-making criteria of an AI system and variable importance. In addition, the model enables a visualisation of the results on a dashboard.⁶²

It can be applied to various AI systems, e.g. for credit risk assessment when loan decisions are made based on credit scoring platforms. In this particular use case, the model would identify the logic behind a credit risk assessment with a possibility to reveal the decision-making criteria, so that the actual score could be explained, and understood.⁶³

Thus, the model can be of great assistance, when minimizing the risks related to opacity of AI systems. Firstly, it enables the possibility to monitor the decision-making process to ensure accountability and traceability. Secondly, it helps to expose potentially biased or erroneous decisions. Thirdly, the individuals affected by the decision would have the opportunity to not only understand, but also to contest and take further action.

In their Evaluation of the paper "Explainable AI in credit risk management" for this project they have similar findings. Also, they analyse if the XAI approach helps to implement or comply with existing or upcoming regulations. These questions are answered (mostly positive) along the Ethics Guidelines for Trustworthy AI.

Feedback by Bain&Company and DZ Bank

Bain & Company is an American management consultancy headquartered in Boston, Massachusetts. It is one of the "Big Three" elite management consultancies (besides McKinsey and BCG).

DZ Bank AG is the second largest bank in Germany by asset size and the central institution for more than 900 co-operative banks and their 12,000 branch offices.

The feedback is based a public LinkedIn Pulse article that summarises the Special Brussels Workshop organized by FIRAMIS which had been attended by c-level representatives of those two companies. Here is the LinkedIn article: https://www.linkedin.com/pulse/big-data-analytics-artificial-intelligence-sebastian-fritz-morgenthal/?trk=related_artice_Big%20Data%20Analytics%20and%20Artificial%20Intelligence_article-card_title

It can be observed that XAI has been a topic in most presentations (ECB, EBA, FIRAMIS). The day was rounded up by a panel discussion with Gilles Bouvier (ECB), Andreas Papaetis (EBA), Barak Chizi (KBC Bank), Davide Corda (Intesa Sanpaolo), Peter Neu (DZ Bank) and Sebastian Fritz-Morgenthal (Bain & Company)—the moderator: 'The discussion then moved on to the question of explainability of AI-based models. Explainability is key for banks as customers and regulators will expect their decisions to be transparent and well documented.'

The article ends with questions asking for engagement: 'Should algorithms be fair? Can they be trusted if they are not fair? Are fairness and discriminatory power not contradictory? We are interested in your opinions.'

These questions were further discussed in the AI roundtable of FIRM (Frankfurt Institute for Risk Management and Regulation) which Sebastian Fritz-Morgenthal and FIRAMIS head. FIRM is a high level group of risk experts in the financial industry: <https://www.firm.fm/en/firm/members.html>

Many banks including Commerzbank engaged in this discussion. In one of the next session we have German BaFin invited and also the French supervisor, discussing also the risk of AI in Fintech.

Feedback by NordLB

NordLB had been acquired as industry evaluator during the Special Brussels Workshop by FIRAMIS. They delivered an informal feedback presentation on the 3 BDA use cases that does not represent their official opinion.

Use case 1: 'The minimal spanning tree seems to be a good visualization for concentration risk. Maybe it would be possible to derive a simple algorithmic network area with high risk in order to obtain an easy indicator for risky loans.'

Use case 2: Sample size seems to be significant. 'Could the results from the factor segmentation be helpful for the explanation of the result?'

Use case 3: 'It's not completely clear, what is new according to the work of Calabrese et al. (2017).'

Feedback by Creval

Creval is part of our research evaluators group and Fabio Salis itself, the author of the feedback, has been engaged with our project since the Kick- off in Pavia the 1st of February 2019

Creval is a Parent Company of Credito Valtellinese Banking Group - Register of Banking Groups No. 5216.7 and member of the National Interbank Deposit Guarantee Fund and of the National Compensation Fund.

The Chief Risk officer of the group organized the feedback according to a process in which after participating to our kick - off and to events in which the BDA UseCase were disseminated he made some general comments relatively to possible improvements of the model design of the p2p lending use case:

- Small access to borrower's data: the model development is based only on the behavioral information of the counterparty. A possible solution to improve the credit assessment methodology is to evaluate the counterparty not in terms of rating classes, but in accordance with the "good or bad approach", by defining a cut-off under which the credit is not granted.
- Rating review: since the predictive accuracy of the model is particularly sensitive to the borrower's behavior, the rating should be reviewed frequently, at least on a quarterly basis.
- Adoption of a definition of default based on a "delinquency approach", taking into consideration the cases in which the borrower is late or overdue on a payment.
- Application of multi-year time series: in order to improve the predictive capacity, the model should be based on historical time series of balance sheet and income statement data which include at least 5-10 years of observations.
- The model should take into account also behavioral information. A possible way of improvement can be represented by the inclusion of historical trends of the ratio used in the regression as additional inputs (for example QoQ or YoY variation).
- The model should take into account also behavioral information. A possible way of improvement can be represented by the inclusion of historical trends of the ratio used in the regression as additional inputs (for example QoQ or YoY variation).
- in order to better align the P2P credit scoring model to the banks models, it could be useful to integrate the original dataset based only on financial information with a qualitative set of information that takes into account, for example, the valuation of the management of the companies, long-term strategies and market size.
- Another way of improvement could be the develop of a cut-off of the scoring in rating classes, in order to better express the different risk underneath the single counterparty. It could be also added a traffic-light approach to measure the quality of the cut-off.
- It would be useful to clearly explain the definition of default adopted, in accordance with the regulatory framework.
- A possible additional area of improvement is connected to the valuation of the sensitivity of the model to the change of default definition (see EBA/GL/2016/07 - "EBA Guidelines on the application of the definition of default")

Feedback by Intesa San Paolo

USE CASE: Explainable AI in credit risk management

- Interesting approach to enrich the well-known Shapley values method for a supervised learning model leveraging an unsupervised method
- Comment more on the choice on the number of clusters from the hierarchical clustering. Do so many clusters correspond to different configurations of the Shapley values?
- Show the MST colouring it with a scale of the predicted probabilities rather than the actual default values. This could further show how the unsupervised method explains the supervised one rather than showing whether the clustering corresponds to the binary response or not
- Clarify in what ways the proposed method based on MST network clustering is useful for the explainability the scoring model
- Clarify in what ways the proposed method enhances or at least differs from other clustering methods in the Shapley valuespace
- Compare with this clustering approach “Hierarchical clustering in minimum spanning trees - Meichen Yu, Arjan Hillebrand, Prejaas Tewarie, Jil Meier, Bob van Dijk,Piet Van Mieghem, and Cornelis Jan Stam”
- Compare to a clustering (e.g. SOM 2D) on the original data observation
- Show computational cost in run and retraining phase

Use case: Network based scoring models to improve credit risk management in peer to peer lending platforms

- Similarity networks may be computed according to many different metrics or edge definition. Using the MST derived from the standardized Euclidean distance between the features' vectors is an interesting one
- Network measures are probably brand new information with respect to the standard balance-sheet ratios. Could this be supported by some statistical evidence? What about the coefficient and p-value in the logistic regression?
- Poor evidence that the proposed methodology actually reaches an improvement over the non-network scoring model: what about some statistical comparison?
- In some contexts, it may be important to analyze the results with a specific threshold/number of predicted positives or setting a maximum on the false positive rate. In future applications, this could be considered in the performance evaluation
- Specify the advance of the balance-sheet ratios with respect to the observation date(in particular for borrowers that defaulted in a specific date e.g. 1 year before, 2 years before ..)

Feedback by Illimity

Illimity team Claudio Nordio – Chief Risk Officer and Giacomo Le Pera – Head of Risk Analytics examined the paper <https://doi.org/10.3389/frai.2019.00003> and submitted some preliminary remarks.

The proposed models apply to ECAI peer-to-peer lending data some machine learning techniques aimed at predicting the default of the borrowers. Indeed, it is well known that the application of machine learning leads to particularly favorable results in terms of accuracy and discriminating capacity. Furthermore, the paper defines a topology in the space of the features of the borrowers, that visually appears effective in grouping the defaulted borrowers locally in space, and therefore it is suggested that the "proximity" could itself constitute a feature.

However, the models show a substantial invariance in terms of final metrics after introducing those "proximity features", but in our view, this could be linked to the choice of the performance metrics, which may be affected by the unbalance of the sample (note that all Accuracies result around 1- default rate). In this sense it would be interesting to examine the results in terms of precision, recall, F1, etc. and moreover, the outcome of random forest or neural network models with and without the introduction of that features, in order to test if the ability of such models to capture nonlinear relationships would experience a substantial improvement.

Anyway, although the inclusion of the "proximity features" does not improve materially the performance metrics, they could still be used in the practical assessments of the creditworthiness of companies, especially in the presence of simplified (linear) default probability models vs more complex topologies (for instance, those underlying the supply chain of a firm or group of firms).

As an aside remark, it is not clear from the paper if the topology is estimated once and for all throughout the validation folds: this case would result in leakage that we would suggest to remove.

Feedback from Fintech companies collected by Modefinance

Fintech partners' and participants' feedbacks,
RegTech Workshop I, Milan 29th March 2019

By a former General Manager @ ItaliaFintech:

RegTech and Fintech are strictly interconnected: one of the biggest challenges in making finance smarter and more accessible is to preserve the accuracy and reliability of systems and solutions to the current regulation. The project, by opening a constructive and cross-country dialogue, allowed for a practical and theoretical conversation on how not only to preserve but improve the risk management in innovative credit scoring models.

Credit scoring models are a very crucial use case for the entire sector, allowing for faster and better access to finance for individuals and SMEs.

By a Business Development Director @ Fintech District:

Fintech has evolved fast and quite chaotically in the past years, and while most of the news about the sector have been dedicated to neo-banks side, technologies such as AI has allowed the discovery of new technological regimes such as Insurtech and Regtech. These are new subjects that require deep study and observation, and that is why we have decided to host the RegTech Workshop I session in Milan. The session held in Milan has been one-of-a-kind representation for our community, involving all the actors of the ecosystem: FinTech companies, institutions, banks and universities. One of the biggest challenges outlined has been to become more and more accurate and transparent, evolving in reliability of digital solutions, and helping regulators to learn and apply this to a renewed and effective law. The project persuaded more than 60 participants to take part to a practical and theoretical conversation on how to improve the risk management thanks to innovative credit scoring models. Credit scores represent just one of the many models, governed by AI and data science, crucial for the entire finance and economics world -no more seen as a competitor but a partner from the traditional finance and banks- allowing a rapid and more democratic access to advanced tech solutions, to SMEs and professionals worldwide.

By a former Head of Data @ Moneymour -acquired by Klarna- (participant)

The event has provided a full overview of the fintech needs, presenting interesting topics mixing the research and real business cases.

It has been interesting see how networks models fits well real case scenarios as credit scoring, observing not just direct connection but looking also for hidden patterns.

The application of AI and advance analytics techniques makes steps forward with event like this, where interesting use cases are presented and well explained. With these opportunities it is possible to understand how to create real value starting from data.

Currently we expect 2 more evaluations, namely Commerzbank and Ernst&Young

8. Feedback by the international advisors

Summary of report of advisor 1

'The concept of FinTech-ho2020 Project is very innovative. I am very pleased to see that under this project, people from different field and background could meet together to exchange the knowledge, discuss the new ideas, and train the young researchers for the future prosperity of fintech.'

'The conference was very well organized by bringing the participants from different backgrounds together to share their views on all these very critical issues from different perspectives.'

'The participation by people from different background dramatically increases the visibility and influence of the project. Moreover, the papers presented at academic session have very good potentials by using advanced methodologies like social network analysis, AI, machine learnings, etc.'

Suggestions:

Inviting Bigtech (cloud) companies in the future, given that financial industry might be dominated them.

- ➔ FIRAMIS established contact to Deutsche Telekom and other cloud providers. Deutsche Telekom did present their AI and BDA approach at the London virtual meeting.

Application of blockchain technology and issuance of digital currencies by central banks are gaining increasingly attentions. FinTech-ho2020 may include such topics in the future workshops.

- ➔ That is the blockchain part to come.

Summary of report of advisor 2

'The FinTech-HO2020 project is on a good pathway. The expertise of the project partners is diverse and interdisciplinary.'

'[...] the project has built up an international and interdisciplinary platform to develop and deep understanding and exchange on the research and implementation in FinTech and RegTech.'

'There are a number of achievements including past and future events on the highly relevant topics that boost the influence of the team. Some innovative thinking especially the idea of having an online teaching platform in addition to the lectures given at the industry partners has potential to provide long term contribution from the project, lasting even after the completion of the project itself.'

- ➔ FIRAMIS has initiated an intense exploitation phase outlined in this document. The platform created by FIRAMIS is constructed in a way that it is harmonized with modern open-source (cloud) infrastructures, using docker for example. It is compatible with most cloud systems so it can have a long-term, lasting contribution even after the project, being used as teaching and use case development platform.

'The talks were interesting and suited for both academia and industry, stimulating prospective academic-industrial collaborations.'

'In summary, the project is running very well and has the potential to become an excellent example of cooperation within Europe. I would like to congratulate the team to their success and look forward to the further steps.'

Summary of report of advisor 3

First, the advisors summarized the project:

'The FIN-TECH Horizon2020 project aims at the development of a European fintech risk management framework that can encourage innovations while protecting consumers and investors. A framework that can close the gap between technical and regulatory expertise, providing risk management procedures common to Regtech and Suptech, and uniform across countries. The FIN-TECH Horizon2020 project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 825215.

In the context of the project, use cases are produced and disseminated through a web-based platform, that describe new fintech risk management methods. These use cases are presented and discussed in workshops that are held across different European countries during the 2-year project period.'

Then comments on the research workshop attended: 'The workshop took place at the ZHAW, and included speakers from industry, academia and regulators, as well as presentation of some of the use cases. I found the variety of speakers to be very complementary and one that provided a good balance across the different dimensions of the issues discussed. Three use cases developed in the context of the project were presented and discussed. I find these to be a great start and in the right direction to achieve the ultimate goals of the project. I find that tackling the important issues targeted by the project can only be achieved by the right collaboration across industry, regulators, and academics. Regarding the platform developed for the project, I think it is a very important tool to disseminate the products and deliverables of the project. I would encourage the project team to further develop it and its content to enhance its value and usefulness. I am looking forward to observing future activities of the project.'

Summary of report of advisor 4

'The project is obviously valuable, as currently, the identification and assessment of the risk profile of FinTech solutions is a necessity, knowing that the financial industry is increasing its investments in technological solutions and increasingly depending on them.'

'The collaboration fostered by this project between researchers, regulators and industry specialists is vital for such desired outcome.'

Now discussing project participants specialties:

'The workshop at Bucharest included a diverse and interdisciplinary audience [...]'

'Conclusion:

1. The workshop delivered the promised expertise diversity provided by its participants.
2. The expertise of the project partners is diverse and interdisciplinary.

3. Orientation, knowledge and experience are opened to young students and researches in terms of the importance of opportunities that FinTech provides.'

Now discussing the workshop attended:

'Conclusion:

The workshop provided research papers that work within the project three main technologies that drive the FinTech innovations. The speakers were provided a good knowledge base across the different dimensions of the issues discussed.'

Now discussing the project network:

'Conclusion:

It was noticeable the amount of effort that is dedicated by the local project team to organize and establish friendly network relations between participants. In addition, several participants embraced the collaboration opportunities opened for them through the project network.'

Now discussing the project platform:

'The project portal design is friendly; it allows for the navigation in an easy manner through the different links and folders.

'Portal needs to be improved in Bibliography section.'

'The Network Visualization Section seems to still be under construction' -> FIRAMIS: that is right. Visualisations now work properly and more dashboards and visualisations have been added in the meantime.

Now a final comment on the 'Outcome Sustainability Prospects':

'The project continued its successful progress through the workshop attended in Bucharest, and is expected to continue doing so in the future. The project has great potential to further host innovative work and research ideas, such as providing an open eLearning platform delivered by academics and FinTech industry representatives. The project can also continue as a main European FinTech hub that fosters collaborations between academics, industries and regulators.'

In general, the project is running in a very good manner despite the withdrawal of France and the very few underperforming partners. If the project continues with its successful progress, it is expected to become essential in supporting the European cooperation and integration process.'

9. Feedback by the fintechs

Two longer questionnaires had been developed (recent one is this one: https://www.fintech-ho2020.eu/free/app/fintech_questionnaire) and may fintechs in the partner network and fintech hubs were addressed. More than 20 had the time to fill in the forms. Here are some summarizing results:

Are of activity of the Fintechs: Lending, AI, Open Banking, Payments

Most of the fintechs have revenues < 2 Million

Country_headquarters: Italy, Belgium, Germany, Spain, etc.

Supervisors are mostly characterised as collaborative

In how many countries are the fintechs active on average: 6.1

Importance BDA: 3.125/4

Importance AI: 3.5

Importance Blockchain: 2.25/4

Awareness of regulators of these topics: 2/4

Percentage of revenue spent on regulation: 5-10% sometimes up to 20%

Do you experience consistency across countries in the approach of the regulator towards fintech innovation? Answers range from 'no' to 'most of the time'

Has your business model suffered as a result of regulatory issues? If yes, how? What would you list as the main regulatory challenges that your company currently faces (or might face in the future)? Answers:

- 'We decided to adopt a model that outsources regulated activities.'
- Increasing complexity and costs and time spent
- regulations are sometimes contradictory from one country to another
- Regulators should be more aware of new tech possibilities and react faster.
- Some restrictions the regulator imposes actually go further than the law states.

Also considering your answers to previous questions, do you have any suggestions to improve the relations between regulators and FinTechs in the EU? 'Armonisation of rules. For example: non regulated asset-based lending and restricting "ban on assignment" on receivables.'

Some answers on sandboxes:

- 'Only a few working groups that are actually on the market have almost no actual Fintechs working in them.'
- 'They only have associations and there have truly been no important movements in the EU to help Fintechs.'
- 'No regulatory sandbox in the home country'

Major benefits from sandbox

- Better knowledge of regulatory and supervisory mechanisms
- Economic advantages
- Better product outcomes
- Contacts with regulators
- Better reputation towards consumers/end-users
- Reduction of planning uncertainty

Here some feedback to the former PO on feedback suggestions from the sup tech sessions regarding fintech regulatory obstacles to scaling:¹

1. NEED TO UNDERSTAND FINTECH RISKS AND THEIR MEASUREMENT: National supervisors need to understand what BDA, AI and Blockchain mean in terms of risks and related risk management procedures. While the effect of technologies on business models is clearer, the associated risks are not so clear, especially with regards to blockchain.
2. NEED TO CLOSE THE DISTANCE BETWEEN FINTECHS AND REGULATORS: It is perceived that the variety of business fintech models, and their globalisation, does simply the need to understand how they work in an operational way, and this can be achieved through a dialogue with fintechs. The perception is that, at the moment, fintechs may be afraid of regulations and of regulators and so the dialogue may be "difficult"
3. NEED OF A EUROPEAN PERSPECTIVE: A common perceived weak point is the lack of general, European indications. While national initiatives are welcome there is fear that this may create unfair competitive advantages. Common principles would be welcome especially considered that, likely, no country has enough scale for a specific fintech sector to be sustainable.
4. VALIDATION: They ask whether and how the use cases will be validated. We said though the banking system and this seems to be welcome as there is familiarity with bank risk management models.
5. INTERNATIONAL BENCHMARKS: A number of participants liked our classification of fintechs and of fintech risks. They find it helpful. They would like to know how our proposed fintech risk management procedures compare with those developed in America and Asia, and if there are similar experiences there. And, finally, if there are international benchmarks, on the regulator side.

¹ **From:** Paolo Giudici [mailto:paolo.giudici@unipv.it]
Sent: Tuesday, March 19, 2019 6:39 PM
To: MAZZONE Chiara (CNECT)
Cc: Dominique GUEGAN; ANCA MIRELA TOMA; Arianna Agosto; Dave Remue; Dr. Jochen Papenbrock; Antti Talonen; Audrius Kabasinskas; Oleg Deev
Subject: Re: Submission of FinTech project amendments

10. Ongoing involvement

Engagement level for workshop participants are manifold, ranging from online to offline, from personal to digital.

Each workshop is accompanied by a set of presentation slides with both standardised and customized decks. Some workshop participants received the material even beforehand for preparation. The material is shared during and after the workshops. Workshop participants have access to the platform where they can not only access their workshop material but also material from other and past workshops.

The platform also has further background material and repositories of own and other research papers. The platform also has code-based use cases which can be studied online or downloaded for offline use and extension.

Some of the workshop participants stay in contact with the partners to exchange ideas or even work on joint projects and publications. Sometimes material is shared and disseminated inside the supervisory organization. Some supervisors also prepare data and use cases to discuss them in the next workshops.

The website and platform have information about future events there has been a lot of regional exchange where supervisors attend other supervisor's workshops to broaden the network and exchange ideas. Partners also regularly inform about the past and futures activities and ambitions of the FIN-TECH projects in the workshops.

Some partners are committed to providing participants with a report that collects comments and feedback from the same seminars in other EU countries.

There are also special workshops like the one in Brussels (see chapters below), the one in Romania and the final workshop in Berlin. Besides the program there are many opportunities to network and exchange. There will not only be the national and international supervisors, but also many partners, academics, researchers, financial industry experts and our international advisors.

Some supervisors also embedded some FIN-TECH workshops into their broader research and education programs. In some cases, the audience became very large.

There are also many bilateral connections that were established during the project. Supervisors profit from the intellectual freedom, open communication and independence of the researchers and researchers in turn learn about supervisory practice and latest developments in the industry.

11. Platform for code-based use cases

The code-based use cases are prepared and maintained in a login-protected platform which has been created in line with the so-called Regtech framework.

The RegTech framework aims to create an operational fintech risk management expertise through knowledge exchange workshops dedicated to fintechs. Each workshop will allow participants to test possible solutions for automatized compliance. The RegTech material is based on the same material shared in WP5 and will add practical aspects through the development of coding examples on the project use cases. During the regtech sessions, open source language software will be used, thus ensuring the project's overall neutral and non-commercial nature. While the SupTech workshops are decentralised in each of the considered European countries, RegTech workshops will be organised at the European level, at the premises of fintech hubs, to encourage uniform fintech risk management practices across Europe.

The objectives of this work package are: To develop technical solutions to automate compliance of fintech companies (RegTech); To test different technical solutions for automated compliance using open source papers, software and real data.

The work is divided into the following tasks: Creation of a unified content. For the purpose of developing common understanding concerning the technical aspects of fintech risk management models, the content of the RegTech workshops will be material relative to the use cases (as in WP5), divided into three topics: big data analytics, artificial intelligence and blockchain application.

Creation of a research and development environment, creating a coding technical infrastructure that is scalable and extendable in a modular approach. The basis for the infrastructure will be open-source projects like R which gives access to developed machine learning projects. These research and development environments will be made available in a dedicated cloud server environment to manage the code, scripts, GUIs, models, users' access rights, software interaction and workflows.

The following languages and (open-source) tools are combined:

- Ubuntu
- Nginx
- Docker
- Shinyproxy
- R
- Rstudio
- Rshiny
- Hugo/R-blogdown
- LDAP server

The platform uses Ubuntu as OS and Docker for containerization of the applications. We use modular docker containers that contain R code, files, input data and all environment packages and variables needed. Each use case exists in such a container and also has an Integrated Development Environment (IDE) like Rstudio.

Each use case is prepared in a way that all libraries and packages required for its execution are already provided in the same container. This provides an infrastructure with least possible entry barriers to run the use cases. This is important as can be seen from the feedback as many users see the code and a modern coding infrastructure for the first time. Users only need a modern Web browser and platform access to instantly run the code.

Besides the code there are other containers whose purpose is to run R-Shiny applications. This is used for flexible dash-boarding, interactive visualization, file browsing, file previews and file downloading.

The modular platform can scale by using Docker Swarm technology. For example, there can be several hundred nodes each of which is reserved for one or more users. In this way, there can be live and online trainings for several hundred people at the same time. The amount of nodes has to be reserved and managed during the event.

The platform has served hundreds of users since beginning of 2019, supporting Regtech and SupTech workshops as well as the evaluation and dissemination process. It had almost zero downtime since beginning of 2019. For information about the platform architecture can be found here: https://firamis.de/data_science_platform/

The workflow for new code-based use cases is the following:

Firamis receives the new code from the partners and checks which open-source software packages and libraries are involved in total. A docker container is then created that contains the downloaded libraries. Additionally, some extra packages for Ubuntu have to be installed to be able to run those libraries. In a first test it is checked if all libraries load properly. Then the partners' code is added in a second docker container that includes the first one. The code is checked line by line and analysed in two directions: 1) to see if it executed properly or if there are conflicts with package versions, or errors or warnings. 2) the code results are compared to the underlying paper results. At this point the paper also has to be understood regarding the AI, BDA or blockchain use case. Graphics and figures have to be checked and a welcome text has to be created that points to the right file to start and execute the use case. After the use case is checked and finished we upload the docker container to the platform, and link it to the general file structure. We then ask the responsible partners to check their use case on the platform. If positive the new use case can be officially added to the use case portfolio and it can be picked by the workshop organisers. In some cases, we enrich the use case by an interactive dashboard and visualisation as in the case of Financial Risk Meter and Contagion Risk Monitor.

This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 825215. All material presented here reflects only the authors' view. The European Commission is not responsible for any use that may be made of the information it contains.

```

# Clean the environment
graphics.off()
rm(list = ls(all = TRUE))

# set working directory to folder "Material"
setwd("~/home/rstudio")
#setwd("C:/Users/JP/Documents/Paolo/platform_experiments/filemanagement/files/1- Supregtech_material/SUPREGTEC
H_BDA Use Cases/Use Case I/Replication code BDA I")

# Pre-load the packages and model_perf function

libraries = c("readr", "e1071", "MLmetrics", "stargazer", "dplyr", "purrr", "xtable", "base", "ggplot2", "Desc
Tools", "stylo", "igraph", "MASS", "ROCR", "rpart", "e1071",
"SDMTools", "caret", "MLmetrics", "igraph", "clusterSim", "randomForest", "Hmisc", "networkD3",
"emtreeR")
lapply(libraries, library, quietly = TRUE, character.only = TRUE)

source("model_perf.R")

#####
##### GENERATE THE DATASETS #####
#####

# Import the dataset "final_dataset_smes.csv"
dataset = read_csv('smaller_dataset.csv')
dataset = dataset[,c(3:22)] # keep financial ratios plus the response variable "status" which takes value 0 if
the company has not defaulted and 1 if it has.
dataset = dataset[complete.cases(dataset),]

# We define a metric@0that provides the relative distance between
# companies by applying the standardized Euclidean distance between each pair (xi,xj)
# of institutions feature vectors
dist = as.matrix(dist(scale(dataset[-20])))

n = nnard.distances.default metric@0 = "nnardist" weighted = TRUE bias defining the mask

```

Platform landing page with side menu and file browsing functionality. Most file types can be previewed and all files can be downloaded. Whenever there is a prepared R use case, another button appears that opens a new tab with IDE and the preloaded use case as in the screenshot below.

```

# Clean the environment
graphics.off()
rm(list = ls(all = TRUE))

# set working directory to folder "Material"
setwd("~/home/rstudio")
#setwd("C:/Users/JP/Documents/Paolo/platform_experiments/filemanagement/files/1- Supregtech_material/SUPREGTEC
H_BDA Use Cases/Use Case I/Replication code BDA I")

# Pre-load the packages and model_perf function

libraries = c("readr", "e1071", "MLmetrics", "stargazer", "dplyr", "purrr", "xtable", "base", "ggplot2", "Desc
Tools", "stylo", "igraph", "MASS", "ROCR", "rpart", "e1071",
"SDMTools", "caret", "MLmetrics", "igraph", "clusterSim", "randomForest", "Hmisc", "networkD3",
"emtreeR")
lapply(libraries, library, quietly = TRUE, character.only = TRUE)

source("model_perf.R")

#####
##### GENERATE THE DATASETS #####
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# Import the dataset "final_dataset_smes.csv"
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the company has not defaulted and 1 if it has.
dataset = dataset[complete.cases(dataset),]

# We define a metric@0that provides the relative distance between
# companies by applying the standardized Euclidean distance between each pair (xi,xj)
# of institutions feature vectors
dist = as.matrix(dist(scale(dataset[-20])))

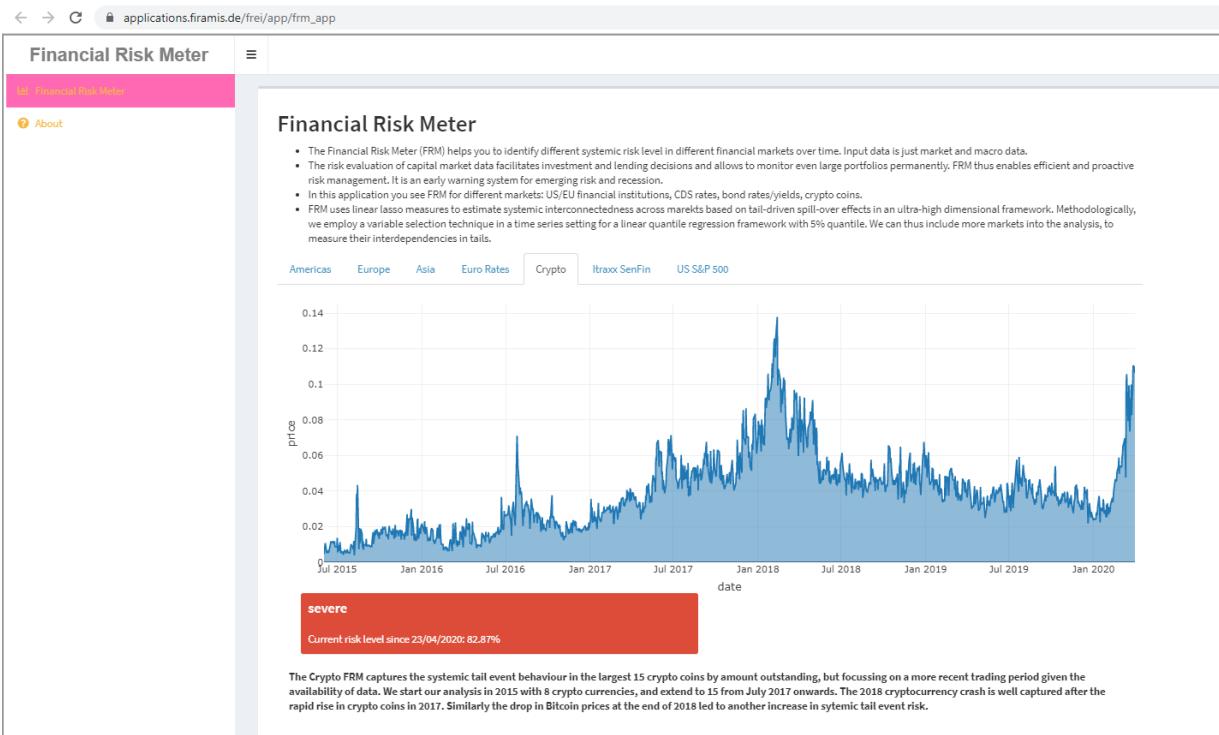
n = nnard.distances.default metric@0 = "nnardist" weighted = TRUE bias defining the mask

```

This is the git-based coding infrastructure where several developers can collaborate. A code versioning system supports the joint development work. It is hosted on the FIN-TECH server.

The seafile file exchange system is similar to Dropbox but is hosted on the FIN-TECH servers. For each user it can be defined which files can be seen, changed and shared. It also includes a versioning system.

This LDAP dashboard supports the login management of the platform, the git-structure and the file exchange system. Inside each tool there can be different groups with different access rights to data, files and applications. External evaluators receive access to the use cases and material of the platform and in return they deliver the use case evaluations and feedback.



This examples shows the use case related to the Financial Risk Meter by UBER.

The automatic emailing has the following text:

Dear {{Name}} {{Surname}},

Welcome to the EU Horizon 2020 FIN-TECH project.

We are happy to have you as a member of our community.

The European FIN-TECH project coordination team hereby confirms your successful registration to use our online platform.

You can now login to the PLATFORM at <https://www.fintech-ho2020.eu/links/> using the following email-address and static password:

- email-adress: {{email}}
- password: {{Password}}

Please contact us at info@fintech-ho2020.eu if you have any questions. During the registration process we have registered the following Information about you:

your name, email, password, affiliation, department, position, and role.

We need this data so you can use our online platform without any problems and without delay. The reason for this is that we will use this online platform to carry out the FIN-TECH project training courses.

In order to guarantee the security of our online platform, a login is mandatory, for which we need the above data.

The processing of your personal data is based on Art. 6 para. 1 f) GDPR (General Data Protection Regulation). Our legitimate interest, in particular with regard to the storage of your data, lies in the secure maintenance of our online platform. This requires a login and prior registration.

Please note that your data will be stored on the server of our carefully selected IT company Baden-IT, located in Freiburg (Germany), i.e. in the EU. We will not pass on your personal data to so-called third-party providers.

We store your data as long as your user profile is stored in our online platform. This means that if your user profile is deleted, we will also delete your personal data immediately.

Alternatively, you can contact us at any time to delete your personal data without stating any reasons. The contact details of our responsible person within the meaning of the GDPR are as follows:

*Prof. Paolo Guidici
University of Pavia
Strada Nuova 65
27100 Pavia
Italy
Phone: 0039-382 98 4351
Email: paolo.giudici@unipv.it*

If you should wish this, our responsible person in the sense of the GDPR will also inform you at any time about your relevant rights of information, correction, deletion and objection according to the GDPR. In addition, Prof. Paolo Guidici will inform you, in case of your corresponding request, about a possible restriction of the described data processing of our project as well as about your right to data transfer.

For the sake of completeness, we would like to point out that we do not engage in profiling within the meaning of Art. 22 GDPR.

Yours sincerely

European FIN-TECH project coordination team

The platform has the following welcome text:

Disclaimer: The material contained here is the result of research and development of the partners of the fintech project. The material could be used only for the same purposes, acknowledging the source papers. Each user that is not a partner of the project, or a supervisor, is expected to write an intermediate and a final feedback report.

12. Forms engine

The forms engine enables a digital process for building repositories (workshop participants and participant feedback), collecting feedback and generating flexible reports for feedbacks and summary statistics.

Based on Rshiny, we can set up new forms in minutes and add them to the automatic reporting. The engines collect feedback from supervisors, banks, fintechs, and other participant.

The forms engine has supported more than 200 forms in dozens of events/workshops (repositories, reports, statistics, documentation) since beginning of 2019. Here is an overview of the forms generated:



A typical registration form can be seen here: (<https://www.fintech-ho2020.eu/free/app/registration-suptech-stockholm-6>)

fintech-ho2020.eu/free/app/registration-suptech-stockholm-6



A FINancial supervision and TECHnology compliance training programme
 SUPTECH WORKSHOP III, AI, Market Risk and financial Robo-Advisory, Stockholm, December 10th 2019, SWE-FSA
 Registration Form

Name and Surname of Participant *

Affiliation *

Department *

Position *

Role *

 Fintech Consortium Partner

E-mail of Contact Person *

In order to submit, please fill out all mandatory fields marked as *

Data protection is of a particularly high priority for the management of the FIN-TECH project. All regulations of the GDPR are observed.

A typical suptech evaluation form can be seen here: (<https://www.fintech-ho2020.eu/free/app/evaluation-suptech-stockholm-6>)

fintech-ho2020.eu/free/app/evaluation-suptech-stockholm-6



A FINancial supervision and TECHnology compliance training programme
 SUPTECH WORKSHOP III, AI, Market Risk and financial Robo-Advisory, Stockholm, December 10th 2019, SWE-FSA
 Evaluation Form

Role *

 Consortium partner

Please evaluate the contents of the workshop with comments on specific parts and suggestions for future events.

Please indicate which use case was best (if there was more than one):
 Convergence and Divergence in European bond Cderivatives - Schmidhofer/Uebelholz
 On the effectiveness of Portfolio Composition techniques to build stable and sound Robo-Advisory Portfolios - Hochreiter
 Are cryptocurrencies connected to a quantile cross-sectional approach - Baumhöfer
 Network models to enhance automated crypotocurrency portfolio management - Gudlaugsson/Vilhjalmsson
 Dominance-based Decision Rule for Reserve Fund Selection - Katsoulakis/Durante/Reinartz/Loizeau
 no use case covered

Please evaluate the use cases explainability on a 1-5 scale (low; 5=high):
 1
 2
 3
 4
 5
 no use case covered

Please evaluate the use cases practicality on a 1-5 scale (low; 5=high):
 1
 2
 3
 4
 5
 no use case covered

Please evaluate the use cases perceived utility on a 1-5 scale (low; 5=high):
 1
 2
 3
 4
 5
 no use case covered

Besides the usual Suptech and Regtech evaluation and registration forms there are special forms for collecting partner feedback for each event/workshop (more than 80 workshops supported so far): (https://www.fintech-ho2020.eu/free/app/form_summary)

The screenshot shows a web-based form titled "Event summary and report of partners". The form is divided into several sections:

- Title of the workshop:** A text input field.
- Venue:** A text input field.
- Date:** A text input field.
- Hosting university:** A text input field.
- Regulator/supervisor:** A text input field.
- The speakers:** Three text input fields labeled 1), 2), and 3).
- Number of participants:** A text input field containing the value "0".
- The main topics:** Three text input fields labeled 1), 2), and 3).
- The main results:** Three text input fields labeled 1), 2), and 3).
- New insights and main take aways:** A large text area with a scroll bar.
- Further remarks:** A large text area with a scroll bar.
- Submit:** A button at the bottom right of the form.

And for collecting feedback from supervisors (the workshop coordinators) (<https://www.fintech-ho2020.eu/free/app/event-summary-supervisors-regulators>):

The screenshot shows a web form titled "Event summary and report of supervisors and regulators". The form fields include:

- "Title of the workshop" (text input)
- "Regulator/Supervisor" (text input)
- "The main topics and their comprehensibility" (list input, numbered 1 to 5)
- "The main results and their significance for your institution" (list input, numbered 1 to 5)
- "New insights and main take aways" (text area)
- "Further remarks" (text area)
- "Submit" button

For the fintechs there is an older and newer version of forms (see below). It is directed towards understanding the obstacles to fintech scaling in Europe.

https://www.fintech-ho2020.eu/free/app/survey_impact_regulation

https://www.fintech-ho2020.eu/free/app/fintech_questionnaire

The forms are aggregated automatically on the server every minute by a script based to create a folder structure of csv files:

Name	Size (KB)	Last modified	Owner	Group	Access
..					
collected_responses	2019-06-09 ...	ubuntu	ubuntu	ubuntu	drwxrwxr-x
evaluation-bda-use-cases-1-3	2019-12-16 ...	ubuntu	ubuntu	ubuntu	drwxr-xr-x
evaluation-midterm-bucharest	2019-12-05 ...	ubuntu	ubuntu	ubuntu	drwxr-xr-x
evaluation-regtech-ai-london-1	2020-05-23 ...	root	root	root	drwxr-xr-x
evaluation-regtech-frankfurt	2019-07-09 ...	ubuntu	ubuntu	ubuntu	drwxr-xr-x
evaluation-regtech-milan	2019-04-08 ...	ubuntu	ubuntu	ubuntu	drwxr-xr-x
evaluation-regtech-milan-new	2019-04-08 ...	ubuntu	ubuntu	ubuntu	drwxr-xr-x
evaluation-regtech-vienna	2020-02-26 ...	ubuntu	ubuntu	ubuntu	drwxr-xr-x
evaluation-regtech-winterthur	2020-06-09 ...	ubuntu	ubuntu	ubuntu	drwxr-xr-x
evaluation-regtech-winterthur...	2020-06-05 ...	ubuntu	ubuntu	ubuntu	drwxr-xr-x
evaluation-research_and_eva...	2019-06-12 ...	ubuntu	ubuntu	ubuntu	drwxr-xr-x
evaluation-research_and_vali...	2020-06-09 ...	ubuntu	ubuntu	ubuntu	drwxr-xr-x
evaluation-research_and_vali...	2019-10-31 ...	ubuntu	ubuntu	ubuntu	drwxr-xr-x
evaluation-special-brussels	2019-12-03 ...	ubuntu	ubuntu	ubuntu	drwxr-xr-x
evaluation-suptech-ai-bratisla...	2020-05-15 ...	root	root	root	drwxr-xr-x
evaluation-suptech-ai-madrid...	2020-05-26 ...	root	root	root	drwxr-xr-x
evaluation-suptech-ai-madrid...	2020-05-26 ...	root	root	root	drwxr-xr-x
evaluation-suptech-athens	2020-06-03 ...	ubuntu	ubuntu	ubuntu	drwxr-xr-x
evaluation-suptech-attard-2	2019-11-25 ...	ubuntu	ubuntu	ubuntu	drwxr-xr-x
evaluation-suptech-bank_of_i...	2019-06-17 ...	ubuntu	ubuntu	ubuntu	drwxr-xr-x
evaluation-suptech-bda-bratis...	2020-05-15 ...	root	root	root	drwxr-xr-x
evaluation-suptech-bda-madri...	2020-06-09 ...	root	root	root	drwxr-xr-x
evaluation-suptech-bratislava	2019-06-26 ...	ubuntu	ubuntu	ubuntu	drwxr-xr-x
evaluation-suptech-brussels	2019-06-20 ...	ubuntu	ubuntu	ubuntu	drwxr-xr-x
evaluation-suptech-brussels-2	2019-12-02 ...	ubuntu	ubuntu	ubuntu	drwxr-xr-x
evaluation-suptech-bucharest	2019-05-30 ...	ubuntu	ubuntu	ubuntu	drwxr-xr-x
evaluation-suptech-bucharest-2	2019-07-01 ...	ubuntu	ubuntu	ubuntu	drwxr-xr-x
evaluation-suptech-bucharest-3	2020-04-01 ...	ubuntu	ubuntu	ubuntu	drwxr-xr-x
evaluation-suptech-copenhagen	2019-09-04 ...	ubuntu	ubuntu	ubuntu	drwxr-xr-x
evaluation-suptech-copenhag...	2020-03-24 ...	ubuntu	ubuntu	ubuntu	drwxr-xr-x
evaluation-suptech-cyprus	2019-04-30 ...	ubuntu	ubuntu	ubuntu	drwxr-xr-x
evaluation-suptech-dublin	2020-06-01 ...	ubuntu	ubuntu	ubuntu	drwxr-xr-x
evaluation-suptech-dublin-2	2020-05-27 ...	ubuntu	ubuntu	ubuntu	drwxr-xr-x
evaluation-suptech-france	2019-05-20 ...	ubuntu	ubuntu	ubuntu	drwxr-xr-x

These raw files are then processed by tools for statistical analysis and interactive HTML reports of arbitrary granularity. The following screenshot shows a number of reports uploaded to the dissemination platform where they can be viewed and downloaded by specific users. The report shows some basic statistics:

The preview window for the report '1 SupTech AI II Luxembourg' shows the following details:

- Role:** Overall contents of the workshop
- which_was_the_best**
- evaluate_usecase_e**
- evaluate_usecase_p**
- Evaluation Results**
- Registrations**
- Form**

Role bar chart data:

Role	Freq
Consortium partner	3
FinTech/Bank	2
National supervisor	5

The same report is displayed here in the platform's preview window and in this example the list of specific feedback entries can be visualized. The partners can view and extract the feedback which was given in their workshops by each workshop participant:

internal.fintech-ho2020.eu/app/fintech-ho2020_platform

fintech-ho2020.eu platform v2.1

- Project Contents
- Contents for partner only**
- Extra Dashboards
- Event Map
- Videos
- Event agendas
- Instructions

FINTECH RISK MANAGEMENT

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Disclaimer: The material contained here is the result of research and development of the partners of the fintech project. The material could be used only for the same purposes, acknowledging the source of the material. If a partner is not a supervisor, it is expected to write an intermediate and a final feedback report.

Download

02-Event_participation_and_feedback_repos

- 001 SupTech AI II Luxembourg.html
- 002 SupTech AI I Luxembourg.html
- 003 4th RegTech Workshop AI in Finance Austria.html
- 004 SupTech AI II Romania.html
- 005 SupTech AI I Dublin.html
- 007 SupTech AI I Romania.html
- 008 SupTech AI I Germany.html
- 009 SupTech AI I Latvia.html
- 010 SupTech AI I Denmark.html
- 011 SupTech AI I Switzerland.html
- 012 SupTech AI II Czech Republic.html
- 013 SupTech AI I Estonia.html
- 014 SupTech AI III Croatia.html
- 015 SupTech AI IV Italy.html
- 016 SupTech AI III Sweden.html
- 017 SupTech AI II Croatia.html
- 018 SupTech AI I Slovenia.html
- 019 SupTech AI I Spain.html
- 020 SupTech BDA II Greece.html
- 021 SupTech AI I Belgium.html
- 022 Validation Workshop for Bankers & Insurers BDA and AI.html
- 023 SupTech AI I Croatia.html
- 024 SupTech AI I Malta.html
- 025 SupTech AI II Sweden.html
- 026 SupTech Special I Italy.html
- 027 Mid-Term Workshop of the FINTECH-HO2020 Project.html
- 029 SupTech AI II Finland.html
- 030 SupTech AI I Italy.html
- 031 SupTech AI II Italy.html
- 033 SupTech AI I Italy.html

1 SupTech AI II Luxembourg

Role

Overall contents of the workshop

which_was_the_best
evaluate_usecase_e
evaluate_usecase_p
evaluate_usecase_p

Evaluation Results

role	evaluate	evaluate_usecase_explainability	evaluate_use
1 National supervisor	4 4	4	
2 National supervisor	5 2	4	
3 Consortium partner	5 4	4	
4 Consortium partner	4 3	4	
5 Consortium partner	5 4	4	
6 National supervisor	4 4	4	
7 National supervisor	2 no use case covered	no use case c	
8 National supervisor	4 4	4	
9 FinTech/Bank	4 4	no use case c	
10 FinTech/Bank	5 5	5	

Evaluation Results

Registrations

affiliation	
1 Banque Centrale du Luxembourg	Human
2 Banque centrale du Luxembourg	Internal
3 BCL	Finance
4 BCL	Economi statistic
5 bcl	
6 Banque centrale du Luxembourg (BCL, Central Bank of Luxembourg)	Internati Finance
7 Banque Centrale Luxembourg	Finance
8 Banque centrale du Luxembourg	Market i
9 Banque Centrale du Luxembourg	ORM

13. Feedback by banks, fintechs and international supervisors/regulators

This chapter is more written from the perspective of the WP7 leader FIRAMIS. We worked closely with partners like UNIPV and many others to get feedback from by banks, fintechs and international supervisors/regulators.

Before approaching them we executed research on industry relevance of the project papers and use cases. We wanted to find out how relevant network models, graph theory and eXplainable AI is in the industry, how it is used, what are the risks and what publications exist by financial industry representatives, as well as by national and European supervisors. We also screened more than 400 articles, papers and websites related to these topics and use cases.

Also it was important to study the industry view on these topics, to set them into business context and develop a narrative to approach them and get feedback.

Nevertheless, it was not easy to recruit banks and fintechs as obviously they are extremely busy during their day-to-day business. We had access to a broad network and a connection to European fintech ecosystems based on our activity in this industry for more than 15 years.

One of the preparations was to establish contact the ECB and to the 3 European supervisory authorities (ESAs), namely:

- the European Banking Authority (EBA)
- the European Securities and Markets Authority (ESMA)
- the European Insurance and Occupational Pensions Authority (EIOPA)

The ECB offered a two-day ‘Fintech dialogue’ that we participated in and where we established contact to supervisors, banks and fintechs. We recognized that the intention of the ECB program was similar to ours so there were very several internal meetings and workshops.

Collecting feedback from the financial industry

FIRAMIS organized a special workshop in Brussels for the following reasons:

- find banks and fintechs willing to evaluate the use cases
- connect to European supervisors, financial industry, EBF, local Hessian government
- Learn latest insights by European supervisors on BDA and AI
- Test the importance of XAI

**Special Workshop Brussels organised by FIRAMIS
SPECIAL WORKSHOP FOR BANKERS & INSURERS on BDA AND AI**

November 26th, 2019

With the friendly support of the Representation of the State of Hessen to the EU

In collaboration with EBF



Agenda:

Opening

Jochen Papenbrock & Prof. Paolo Giudici – The FINTECH project
Felix Holefleisch, Head of Unit- Hessian Ministry of Economics, Energy, Transport
and Housing, Representation of the State of Hessen to the EU

Perspective of a European regulator / supervisor on modern Big Data and AI approaches

Gilles Bouvier, ECB

EBA's report on Big Data and Advanced Analytics

Andreas Papaetis, EBA

Big Data Analytics and Artificial Intelligence – risks and opportunities

Sébastien de Brouwer, EBF

The concept of Explainable AI

Jochen Papenbrock, FIRAMIS

Dimitri Marinelli, FIRAMIS

Panel

Moderator: Sebastian Fritz-Morgenthal, Bain &

Company

Gilles Bouvier, ECB

Andreas Papaetis, EBA

Barak Chizi, KBC

Davide Corda, Intesa Sanpaolo

Peter Neu, DZ Bank

More information and feedback on this workshop can be found in this LinkedIn article created by workshop participants from DZ Bank and Bain&Company in the attachment 'DZ Bank_12.12.19.pdf' to the intermediate evaluation report as well as in the press release 'Brussels_special.pdf' also part of the intermediate evaluation report.

Parties participating, their roles and their responsibilities:

- European Central Bank
- AREA42 - Credendo
- CredaRate Solutions GmbH
- ESBG
- Professional Risk Managers International Association / FIS GLOBAL
- European Central Bank
- Austrian Savings Banks Association
- European Banking Federation
- National Bank of Belgium
- NVIDIA GmbH Germany
- European Commission
- European Banking Federation
- Deutsche Börse AG
- Deutsche Bank AG
- Landesbank Hessen-Thüringen
- DZ BANK
- Allianz SE
- ESBG
- NORD/LB
- Oliver Wyman GmbH
- Austrian Savings Banks Association
- Cicero Group
- European Association of Co-operative Banks

- ICLA In-house Competition Lawyers' Association
- AML
- BBVA
- European Banking Authority
- Intesa Sanpaolo
- Tetralog systems AG
- Banca MPS
- Bain & Company
- Ernst & Young GmbH
- ESBG-WSBI
- Intesa Sanpaolo
- KBC

Departments:

- Banking Supervision
- Innovation
- Internal Rating Models
- Digital, Retail and Markets Regulation
- Risk Management
- DG-MSIII
- European Affairs
- Policy
- Banking supervision
- Sales
- WWFO
- DG Connect
- Policy
- Department of Economics and Management
- Capital Markets Academy
- Regulatory Affairs
- Risk controlling
- Strategy & Corporate Development
- Group Regulatory and Public Affairs
- Regulatory Affairs
- Department
- Risk Control
- Commission
- Financial Services
- Brussels Office
- EU Public Affairs
- Retail Banking, Payments and Financial Markets
- Competition
- Risk and compliance

- European Public Affairs
- CEO Office
- Banking Markets, Innovation and Products Unit
- Group Data Office
- Partner
- Organization Area
- Economics
- Global Risk
- Machine Learning
- Management
- Intys FSA
- FSO Advisory - Quantitative and Analytics Services
- Regulatory Affairs
- European Regulatory and Public Affairs
- BDA and AI
- fintech partnerships
- KBC
- Bacon
- Algo Trading

Positions:

- Analyst
- Manager
- CEO
- Digital & Retail policy adviser
- Managing Director
- Supervisor
- Head
- Chief Policy Officer
- Financial & Risk Analyst
- Account Manager
- Sr. Solution Architect FSI-EMEA
- Policy Officer
- Policy Adviser
- Assistant Professor
- Team Head
- Regulatory Policy & Advocacy - Digital
- Head of portfolio methods
- Division Head, Managing Director
- Head of European Affairs Office
- Legal Advisor
- Senior Financial Services Correspondent
- Head of RiskLab

- Policy officer
- Partner
- EU Adviser
- Associate (focused on Fintech)
- Senior Adviser, Retail Banking and Consumer Policy
- ICLA Italia Chairman
- Software architect
- Head of EU Digital Public Affairs
- CEO
- Policy expert
- Head of Data Transformation
- Research Consultant
- Head of Process Innovation
- Professor
- Head of Global Risk
- Data scientist and quantitative analyst
- CLO
- Manager
- Partner
- Adviser
- Policy Adviser
- General manager big data, data analytics and AI
- partner
- GM AI and Big Data
- Producer
- Asst Vice President

How will they stay involved?

The event was intended, among other reasons, to connect each other and to strengthen the project network and ecosystem. Workshop participants had the opportunity to connect to each other in interactive sessions like the panel discussion.

Also, we invited people to follow the project in the future and to acquire them as evaluators of the project use cases, granting access to the platform.

Back in Frankfurt we connected several of the participants by local physical meetings or by email/phone. They receive updates regarding the future activities of the project and how to engage.

What is their feedback on the use cases presented? Are the selected use cases in the end the ones that meet the expectations and requirements at most?

The event was a success. Many participants from a very heterogeneous background were involved. Several banks could be acquired to deliver a feedback on the XAI use case and the

network analysis use cases. Some banks invited us to deliver follow-up presentations on these topics. To some of them it was to learn about the potential to open black box models and to explain them.

The event preparation had begun several months before the event and was directed to activate a large group of relevant people to follow the activity. We could not only reach banks and fintech but also groups representing the financial service industry on European level. We use the FIRAMIS and UNIPV network for as well as social media like LinkedIn as well as our meetings with ECB, EBA, EIOPA and other authorities

Here some direct feedback by the participants:

'great event'

'Excellent workshop - very insightful even for a non-technical person. Found extremely interesting the part presented by FIRAMIS on how to overcome trade off between accuracy and description in models.'

'Discussions were very good, mix between Roles was good.'

'Good overview of current project status and activities for new (fintech)participants'

Further dissemination activities

A large number of channels, multiplicators and events was used to inform the public and the consortium partners about the project activities and related developments. It was used to spread the objective of the project, to create a network and ecosystem around it, to acquire new supporters and experts giving feedback, and find further partners e.g. for the exploitation phase. The following shows a list of activities (excerpt):

Section Frontiers Journal on AI in Financial Services: It is an open-access journal where Professor Giudici and Dr. Jochen Papenbrock are co-editors. A larger number of papers from this project have been published there:

<https://www.frontiersin.org/journals/artificial-intelligence/sections/artificial-intelligence-in-finance>

The BDA network-based use cases are in this journal as well as the XAI use case and this editorial: R. Hochreiter, P. Giudici, J. Osterrieder, J. Papenbrock, P. Schwendner. Editorial: AI and Financial Technology. *Frontiers in Artificial Intelligence* 2, 25. 2019.
(<https://www.frontiersin.org/articles/10.3389/frai.2019.00025/full>)

Events, external workshops, conferences, seminars etc.:

6th of december 2019, xai-presentation at EIOPA insurtech task force in Frankfurt (XAI and FIN-TECH presentation)

11th of december 2019, representing fin-tech and XAI project at eu fintech lab in brussels (most other fintech startups had XAI on the agenda as well)

ESMA morning 3rd Feb (presentation of use cases)

EBA afternoon 3rd Feb (presentation of use cases)

Banque de France (Autorité de contrôle prudentiel et de resolution) discussion on XAI

ECB January 30th (presentation of use cases)

EBC Fintech Dialogue (2 days)

Two trips to Brussels meeting the EC

Acquisition of Evaluators (Banks, Fintechs, Associations, Fintech Hubs, etc.): by email, phone, by personal visit and by extra events like the one in Brussels

Dashboard visualisations for the Financial Risk Meter (prof. Härdle from UBER) and Contagion Risk Monitor (Prof. Schwendner from ZHAW)

Press release: <https://www.openaccessgovernment.org/artificial-intelligence-apps/72323/>

Blog: <https://firamis.de/ai-fintech-riskmanagement-regulation/>

Partnering/Exploitation discussion by FIRAMIS:

Deutsche Telekom (Cloud): <https://open-telekom-cloud.com/de>)

Microsoft (Cloud/ML,XAI)

EBF

<https://www.infinitech-h2020.eu/>

<https://bigdatastack.eu/>

<https://www.big-data-value.eu/>

Dell

Fujitsu

Tagetik

FIRM: <https://www.firm.fm/en.html> (presenting the project at 2 AI Roundtables in front of risk management executives in the financial services industry)

AlinFS (<https://www.aiinfs.com/>) Meetup activity also presenting the project

BDC and State of Hessen Ministry of Economics

Blockchain Sandner and EU Observatory

AI4EU

www.v29.tech

<https://frankfurt-digital-finance.de/>

<https://techquartier.com/>

<https://www.frankfurt-school.de/home/research/centres/blockchain>

<https://appliedai.de/>

Several Associations of German/European Banks

Deloitte

Ernst&Young

Unicredit (XAI and network analysis with interest, recently with network on high prio to analyse the COVID shifts in clients behaviour)

Intesa (XAI and network analysis with high interest)

Oliver Wyman

DZ Bank

Allianz Investment Managers

Deutsche Bank

Quoniam

Commerzbank

PWC AI Meetup

Frankfurt Data Science Meetup

Social media activity:

Promoting the project through FIRAMIS social media channels (some of them > 10.000 views):

https://www.linkedin.com/posts/jochenpapenbrock_horizon2020-p2plending-crowdfunding-activity-6663010417968717824-tkck

https://www.linkedin.com/posts/jochenpapenbrock_three-quant-lessons-from-covid-19-activity-6649223042629152768-ivNu/

Further event activity:

<https://frankfurt-digital-finance.de/speakers/jochen-papenbrock/>

Frankfurt digital finance -> we approached by Mr Wuermeling from Bundesbank who confirmed the 'explainability gap of AI'





Euro Finance Week: <https://www.dfv-eurofinance.com/archiv/22-euro-finance-week-2019/die-euro-finance-week-im-uberblick/mittwoch-20-november-2019-innovation/industry-4-0-meets-finance/sprecher/dr-jochen-papenbrock>

dfv Euro Finance Group

Impressum | Verantwortungen und Kooperationspartner | Presseanfragen | Eltern- und Bildungsservice | Archiv | Impressum

Grunderkiche | GRUNDERSCENE | Blockchain HELIX | BI

Industry 4.0 meets Finance | 22 Euro Finance week | 2019 | Die Euro Finance week findet vom 19. bis 22. Februar statt | Impressum | Presseanfragen | Eltern- und Bildungsservice | Archiv | Impressum

Dr. Jochen Papenbrock

DATA Kinetic Founder and vice chairman of the association AI in Financial Services, Frankfurt am Main

Impressionen:

- Impressionen
- Sprecher
- Partner
- Partner werden
- Information
- Kontakt

Dr. Jochen Papenbrock is a German fintech entrepreneur and researcher. He studied at the University of Regensburg and holds a doctorate degree from the Hochschule Ingolstadt. He is a CD and founder of Finance GmbH. This B2B fintech company offers consulting services and software solutions on artificial intelligence and data science for the financial services industry. His customers include Europe's leading asset managers, hedge funds and insurance companies. Dr. Jochen Papenbrock is also partner of the EU project "Fintech Risk Management" (Swiss Fintech Hub) and a member of the board of the association "AI in Financial Services". He is also a member of the "Blockchain in Finance" association "AI in Financial Services" (<http://www.aifinfs.com>) and vice chairman of the association "AI in Financial Services" (<http://www.aifinfs.com>)

Konferenzen:

Industry 4.0 meets Finance

22 Euro Finance Week 2019
19. - 22. Februar 2019
(Grunderkiche, Frankfurt am Main)

Impressionen 22.000 €
maximale Anzahl Besucher

14. Background information on the paper ‘Explainable AI in credit risk management’

Paper download: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3506274

This research has received funding from the European Union’s Horizon 2020 research and innovation program "FIN-TECH: A Financial supervision and Technology compliance training programme" under the grant agreement No 825215. Firamis acknowledges the NVIDIA Inception DACH program for the computational GPU resources.

The machine-learning-based and visual procedure proposed in the paper processes the outcomes of another arbitrary machine learning model. It provides more insight, control and transparency to a trained, potentially black box machine learning model.

It utilises a model-agnostic method aiming at identifying the decision-making criteria of an AI system in the form of variable importance (individual input variable contributions) with applications in credit risk assessment and management as well as in other (financial) areas.

A key concept is the Shapley value decomposition of a model, a pay-off concept from cooperative game theory. To the best of our knowledge it is so far the only XAI (explainable AI) approach rooted in an economic foundation.

The approach offers a breakdown of variable contributions to the forecast probability. That means that every data point (e.g. a credit or loan customer in a portfolio) is not only represented by input features (the input of the machine learning model) but also by variable contributions to the prediction of the trained machine learning model.

The new contribution of the paper

Similar combinations of variable contributions are mapped into spatial neighborhoods on a map. This means that the data points are arranged on a map such that neighboring data points exhibit similar decision making mechanisms of the trained machine learning model.

The similarity/proximity of variable contributions (the paper uses an Euclidean Distance matrix) is expressed as a symmetric matrix of dimension $n \times n$ where n is the number of data points in the (train) data set. Each entry of the matrix measures how similar or distant a pair of data points is in terms of their profile or combination of variable contributions.

This matrix can be used for visual mapping based on dimensionality reduction techniques (like PCA, MDS, t-SNE), or for representation learning like clustering and graph-analytics (like community detection).

Those data-driven, learned representations reveal segmentations of data points (customers) where each of those clusters contains very similar decision making whereas data points in other clusters exhibit very different decision making

(Hierarchical) Clustering and especially graph theory and network analytics are very well suited to study complex systems. Those systems are characterized by emergent, self-organizing properties. Our approach treats the variable contribution outcome of a (black box) machine learning model as a complex system and further analyses its properties by graph theory and cluster analysis. In this way the user gets a better and deeper understanding of what exactly a black box machine learning has learned. The following phenomena inside the black box model can be analysed and understood: trends, anomalies, hot spots, emergent effects and tipping points. Since our methodology is model agnostic it can be applied to any machine learning model. This also enables a comparison of

several machine learning models trained on the same data. The complex system of decision-making mechanisms that belong to a set of machine learning models can be compared to each other.

XAI and Graph Analytics are some of the most trending approaches, currently becoming very relevant in the financial service industry, both for regulatory and economic reasons. This is underlined by the conclusion of Gartner that graph analytics and XAI will be some of the most trending technologies in the next years (<https://www.gartner.com/smarterwithgartner/gartner-top-10-data-analytics-trends/>).

Paper uses TreeSHAP, a consistent and accurate method, available in open-source packages. Tree SHAP is a fast algorithm that can exactly compute SHAP values for trees in polynomial time instead of the classical exponential runtime (<https://arxiv.org/abs/1802.03888>)

Our Paper does not follow a causal approach. However, it brings transparency to the statistical inference of a potential black box machine learning in mapping and learning representations of the model's decision making mechanisms which in turn are based on the variable contributions produced by the black box model.

For the xgboost part of our model we use NVIDIA GPUs to considerably speed up the computations. The TeeSHAP method can quickly extract the information from the xgboost model.

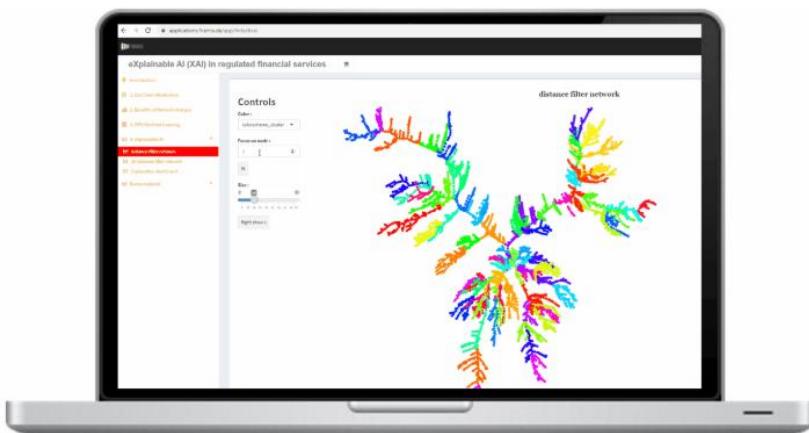
The paper is based on the SHAP concept:

S Lundberg, S.-I Lee. 'A unified approach to interpreting model predictions', Advances in Neural Information Processing Systems, volume 30, p. 4765 – 4774, <https://arxiv.org/abs/1705.07874>

The paper is related to:

- Bank of England: 'Machine learning explainability in finance: an application to default risk analysis' <https://www.bankofengland.co.uk/working-paper/2019/machine-learning-explainability-in-finance-an-application-to-default-risk-analysis>
- Bank of England: 'Shapley regressions: a framework for statistical inference on machine learning models': <https://www.bankofengland.co.uk/-/media/boe/files/working-paper/2019/shapley-regressions-a-framework-for-statistical-inference-on-machine-learning-models.pdf>

Further information and the following visualisations of the XAI web-application can be found here: <https://firamis.de/ai-fintech-riskmanagement-regulation/>



Visualising the 'brain' of an arbitrary (black-box) AI model. Explainable AI is one of the key technologies for human-centric, trustworthy and responsible AI made in Europe. Among others there are two focus areas in this EU Horizon2020 project and also in the fintech company Firamis GmbH: Graph analytics and eXplainable AI (XAI). Nodes are customers of a credit portfolio. The links connect similar AI-decision-making for groups of customers. Similar decision making is color coded in the nodes.



Demonstrations of the XAI application to find and potentially explain buggy 'areas' of the machine learning model.

15. Self-reporting statistics by partners

This is a feedback by the partners about their deliverables. It is mainly to check if all material the partners sent has been handed in and recognised.

0) Partner name:	POUML	Tampere University	ASE	KTU	UCM (Madrid)	ZHAW	Parthenon	WU Vienna	FI RAMS	Masaryk University	UNIPV	UBER	Rijeka, Croatia	INESC TEC	WARSZAWA	Modenafinance	UCD	UCL	Varna
1) # of SupTech workshops organised (break down by BDA and AI):	BDA AI	4 4	6 6	2 1	1 3	3 2	5 1	3 0	extra rep extra rep	1 1	2 2	2 1	1 3	4 1	1 1	1 1	1 1	3 2	
2) Total # of participants and # of feedbacks in all your workshops organised:	BDA AI	158 69	174 43	34 13	152 48	29 21	136 72	100 38	159 73	92 39	140 35	38 32	135 115	36 10	17 5	61 14	15 15	22 24	59 50
3) Partner feedback (based on form AND as text file) for all your SupTech workshops organised delivered (yes or no):	YES	YES	YES	YES	YES	YES	YES	extra rep	YES	YES	YES	YES	YES	YES	NO	YES	YES	YES	
4) Supervisors feedbacks delivered? (answer separately for BDA and AI):	BDA AI	YES YES	YES YES	YES YES	YES NO	YES NO	extra rep extra rep	extra rep YES	YES YES	YES YES	YES YES	YES YES	YES YES	YES YES	NO NO	YES YES	NO NO	YES YES	
5) # of industry feedback reports collected:	NONE	NONE	NONE	NONE	NONE	NONE	Pending	NONE	extra rep 3	NONE	NONE	NONE	NONE	NONE	3	NONE	NONE	NONE	
6) Extra feedback provided? (yes or no):	NONE	NONE	NONE	NONE	NONE	NONE	extra rep	YES	NONE	YES	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	

7.5 D7.7 - Final Evaluation report

Deliverable information

WP NO.	WP 7
DEL.	D7.7
DEL. NO.	D25
TITLE	Final evaluation Report
DESCRIPTION	ASE Bucuresti, based on the information received from all partners, will provide a final evaluation report on the risk management methodologies developed in the project, based on all received feedbacks, from supervisors, fintechs and banks. This includes the feedbacks collected from the participants to SupTech and RegTech workshops.
NATURE	Report
EST. DEL. DATE	30 June 2021

Document information

DATE	28/06/2021
WRITTEN BY	Bucharest University of Economic Studies
APPROVED BY	Anca Mirela TOMA

Summary use cases



Big Data Analytics

- Rank 1** - Network based scoring models to improve credit risk management in peer to peer lending platforms
- Rank 2** - Factorial Network Models to Improve P2P Credit Risk Management
- Rank 3** - Spatial regression models to improve P2P credit risk management

Artificial Intelligence

- Rank 1** – Explainable AI in Credit Risk Management
- Rank 2** – Convergence and Divergence in European Bond Correlations
- Rank 3** - Network models to enhance automated cryptocurrency portfolio management

Blockchain

- Rank 1** – Initial Coin Offerings: risk or opportunity?
- Rank 2** – Libra or Librae?
- Rank 3** - Are Cryptos becoming alternative Assets? (A Statistical Classification of Cryptocurrencies)
- Rank 4** - Analysis of the cryptocurrency market applying different prototype-based clustering techniques
- Rank 5** – Financial Risk Meter
- Rank 6** - Cyber risk ordering with rank-based statistical models

This deliverable D7.7 will be organized on the following topics:

- **Methodologies for BDA (Big Data Analytics) – use cases** (3 dimensions: Explainability / Predictive Accuracy / Utility)
- **Methodologies for AI (Artificial Intelligence) – use cases** (3 dimensions: Explainability / Predictive Accuracy / Utility)
- **Methodologies for BC (Blockchain) – use cases** (3 dimensions: Explainability / Predictive Accuracy / Utility)
- **Interactions with other EU projects and Cost Action**

1. Methodologies developed for BDA – Use Cases.

1.1. Use Case 1 - Network based scoring models to improve credit risk management in peer to peer lending platforms

Brief description of the Use Case:

Financial intermediation has changed extensively over the course of the last two decades. One of the most significant change has been the emergence of Fintech. In the context of credit services, Fintech peer to peer lenders have introduced many opportunities, among which improved speed, better customer experience and reduced costs. However, peer-to-peer lending platforms lead to higher risks, among which higher credit risk: not owned by the lenders, and systemic risks: due to the high interconnectedness among borrowers generated by the platform. This calls for new and more accurate credit risk models to protect consumers and preserve financial stability. In this paper we propose to enhance credit risk accuracy of peer-to-peer platforms by leveraging topological information embedded into similarity networks, derived from borrowers' financial information. Topological coefficients describing borrowers' importance and community structures are employed as additional explanatory variables, leading to an improved predictive performance of credit scoring models.

- ✓ *29 of SupTech events where the Use Case was presented.*
- ✓ *1 RegTech + 3 Spin-offs events where the Use Case was presented.*
- ✓ *Best Use Case: 152 votes, considered best use case in BDA pillar.*

Main points of received feedback and future developments of the Use Case

- The proposed methodology is innovative and can help the process of credit scoring.
- The use case identifies an approach for improving the predictive utility of credit risk models that is also practical. Often there is a trade-off between model complexity and usability. Most financial intermediaries are not willing to fundamentally change their approach or IT setting for slight improvements in predictive power.
- The use case presents a methodology founded in the traditional approaches already in place while at the same time improves predictive utility.
- ✓ The model is highly influenced by the methodology and data used to estimate the network of borrowers. Information on the financial flows existing between platforms' agents should be used to derive the underlying network.
- ✓ The prime focus of the case is to propose a novel methodology for credit scoring, drawing on concepts from graph theory, that would improve the predictive accuracy of the model. In addition to accuracy, regulators are becoming increasingly concerned about models' transparency and explainability. In this context, the work has been extended through the

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 825215 (Topic: ICT-35-2018 Type of action: CSA)

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application of post-hoc explainability techniques that provide insights into the marginal impact of the input features to the model's predictions.

1.2. Use Case 2 - Factorial Network Models to Improve P2P Credit Risk Management

Brief description of the Use Case:

This use case investigates how to improve statistical-based credit scoring of SMEs involved in P2P lending. The methodology discussed in the use case is a factor network-based segmentation for credit score modeling. The approach first constructs a network of SMEs where links emerge from co-movement of latent factors, which allows us to segment the heterogeneous population into clusters. We then build a credit score model for each cluster via lasso logistic regression. We compare our approach with the conventional logistic model by analyzing the credit score of over 15000 SMEs engaged in P2P lending services across Europe. The result reveals that credit risk modeling using our network-based segmentation achieves higher predictive performance than the conventional model.

- ✓ *29 of Suptech events where the Use Case was presented.*
- ✓ *1 Regtech event where the Use Case was presented.*
- ✓ *Best Use Case: 98 votes received and ranked second in the BDA pillar*

Main points of received feedback and future developments of the Use Case

- A new approach that can improve statistical-based scoring for SMEs participating in a P2P system.
- By identifying separate clusters of SMEs (derived on the basis of the similarities of their financial characteristics), the approach can be used by any financial intermediary to build high-performing credit scoring models for each sub-population.
- The approach is practical as it draws on established methods already used by financial intermediaries for the task of credit scoring.
- ✓ The approach currently identifies only two sub-populations of connected and not-connected companies. The approach can be improved by considering higher number of clusters.
- ✓ The underlying networks are highly influenced by the information used to derive the latent factors. Augmenting the data set used can lead to different conclusions and provide further evidence of the usefulness of the approach.
- ✓ The practicality of the approach is also depended on the number of borrowers included in the dataset so its practicality can be affected by increasing the sample size.

1.3. Use Case 3 - Spatial regression models to improve P2P credit risk management

Brief description of the Use Case:

Calabrese et al. (2017) have shown how binary spatial regression models can be exploited to measure contagion effects in credit risk arising from bank failures. To illustrate their methodology, the authors of the use case have employed the Bank for International Settlements' data on flows between country banking systems. Here we apply a binary spatial regression model to measure contagion effects arising from corporate failures. To derive interconnectedness measures, we use the World Input-Output Trade (WIOT) statistics between economic sectors. Our application is based on a sample of 1185 Italian companies. We provide evidence of high levels of contagion risk, which increases the individual credit risk of each company.

- ✓ *29 of Suptech events where the Use Case was presented:*

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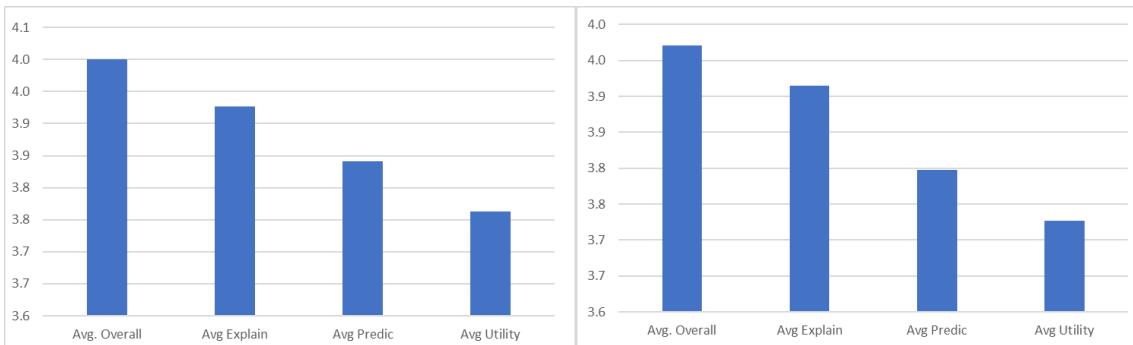
- ✓ 1 Regtech where the Use Case was presented:
- ✓ Best Use Case: 79 votes received, ranked third in the BDA pillar

Main points of received feedback and future developments of the Use Case

- The methodology is quite intensive in terms of code run time – for real world usability this would likely need to be improved to have reasonable run time of analysis.
- Some more graphical insights might also be useful to illustrate nodes in the network that are ‘riskier’.
- More details on policy implications for supervisors / regulators should be added.
- ✓ An initial step would be to search for methodological / computing solutions to the code run times when handling large data.
- ✓ More consideration on what are the implications for supervisors or regulators to better inform policy.

Overall rating of BDA Use Cases:

Average evaluations for BDA Suptechs – all evaluations/without Consortium Partners



Main Open feedback received from the Participants to Suptech events and other Stakeholders:

The Big Data Analytics use cases were appreciated by the majority of the attendees as being interesting materials which bring under scrutiny interesting approaches. Some participants mentioned that the workshop was useful in giving context and details about analytics to the audience and also very useful information about risk models.

The audience appreciated also the presentation of the R code and the use of R. This aspect was appreciated by the more technical participants and on the other hand was sometimes considered a minus by the non-technical members of the audience.

One other strong point identified by the attendees was the fact that the BDA workshops contributed to structuring the critical thinking about the credit risk aspects.

On the other hand, participants signaled that the Workshops and therefore the use cases should have been developed more in the direction of practical examples. Being too theoretical and without too much straightforward practical utility for the supervisors and for the regulators was another aspect mentioned by the participants. Some have expressed the desire to see a lower focus on the technical mathematical and statistical aspects and more discussions on the practical implications of the results and of the findings of the use cases.

Another positive aspect identified by the participants for some workshops was related to the introductory materials prepared by some partners (materials related to R, statistical concepts and methods, risk measures, etc.).

2. Methodologies developed for AI – Use Cases.

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2.1. Use Case 1 - Network models to enhance automated cryptocurrency portfolio management

Brief description of the Use Case:

The usage of cryptocurrencies, together with that of financial automated consultancy, is widely spreading in the last few years. However, automated consultancy services are not yet exploiting the potentiality of this nascent market, which represents a class of innovative financial products that can be proposed by robo-advisors. For this reason, we propose a novel approach to build efficient portfolio allocation strategies involving volatile financial instruments such as cryptocurrencies. In other words, we develop an extension of the traditional Markowitz model which combines Random Matrix Theory and network measures, in order to achieve portfolio weights enhancing portfolios' risk-return profiles. The results show that overall our model over-performs several competing alternatives, maintaining a relatively low level of risk.

18 of Suptech events where the Use Case was presented.

2 Regtech + 4 Spin-off events where the Use Case was presented.

Best Use Case: received 27 nominations and was ranked third.

Main points of received feedback and future developments of the Use Case

- Regulators, academics and fintechs liked the approach and the application, and they have suggested to test it into hybrid portfolios
- Some people in the audience wanted to know more about cryptocurrencies themselves and how to invest in such innovative financial technologies
- Observations on the use of different network centralities were made
 - ✓ the use of different modelling paradigms for asset network importance (spillover measures, Bayesian graphical models, etc.)
 - ✓ the use of different approaches complementary or alternative to the Markowitz portfolio, such as higher-moments portfolio allocation
 - ✓ the extension to hybrid portfolio, composed of alternative assets and cryptocurrencies

2.2. Use Case 2 - Convergence and Divergence in European Bond Correlations

Brief description of the Use Case:

We revisit the discussion of market sentiment in European sovereign bonds using a correlation analysis toolkit based on influence networks and hierarchical clustering. We focus on three case studies of political interest. In the case of the 2016 Brexit referendum, the market showed negative correlations between core and periphery only in the week before the referendum. Before the French presidential elections in 2017, the French bond spread widened together with the estimated Le Pen election probability, but the position of French bonds in the correlation blocks did not weaken. In summer 2018, during the budget negotiations within the new Italian coalition, the Italian bonds reacted very sensitively to changing political messages but did not show contagion risk to Spain or Portugal for several months. The situation changed during the week from October 22 to 26, as a spillover pattern of negative sentiment also to the other peripheral countries emerged.

21 of Suptech events where the Use Case was presented.

2 Regtech events where the Use Case was presented.

Best Use Case: received 59 nominations and was ranked second.

Main points of received feedback and future developments of the Use Case

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- It was presented at about 20 international conferences and workshops in Europe and at the IMF in Washington.
- The use case paper was cited in the technical appendix «Contribution of Greek financial assistance programs to reduce spillover risks» of the report «Lessons from Financial Assistance to Greece» from the Independent Evaluator Joaquín Almunia on the ESM programme and at the ESM blog.
- In general, practitioners with financial market experience pointed out the usefulness of the tool to extract the statistically significant correlation influences for synchronous cross-sectional bond market movements and the possible application of the tool to deliver a risk signal for cross-sectional market divergence.
- ✓ Linking the resulting correlation influences to specific news events.
- ✓ Linking the resulting correlation influences to a quantitative indicator of news sentiment.
- ✓ Linking the resulting correlation influences to a VAR scheme for (co)-variance propagation across time using a lead-lag relationship that enables a causal analysis.

2.3. Use Case 3 - Explainable Machine Learning in Credit Risk Management

Brief description of the Use Case:

The paper proposes an explainable Artificial Intelligence model that can be used in credit risk management and, in particular, in measuring the risks that arise when credit is borrowed employing peer to peer lending platforms. The model applies correlation networks to Shapley values so that Artificial Intelligence predictions are grouped according to the similarity in the underlying explanations. The empirical analysis of 15,000 small and medium companies asking for credit reveals that both risky and not risky borrowers can be grouped according to a set of similar financial characteristics, which can be employed to explain their credit score and, therefore, to predict their future behavior.

12 of Suptech events where the Use Case was presented.

1 Regtech + 5 Spin-off events where the Use Case was presented.

Best Use Case: received 67 nominations and was ranked first.

Main points of received feedback and future developments of the Use Case

- Larger realistic data set
- Tool for workflow guidance to support a larger range of use cases emerging from the initial XAI approach
- ✓ Initiating and leading a project on trustworthy, explainable AI in the GAIA-X Finance & Insurance Data Space where the XAI use case is included and further developed
- ✓ Transforming the XAI use case to applications in asset management and publishing them in journals.
- ✓ A team of NVIDIA engineers imported the use case in several directs: much larger data set of millions of records (more realistic size of real-world problems), GPU-acceleration for considerable speeded-up of computation time for use in real business, interactive visualizations and dashboards to support a larger range of use cases
- ✓ Presentation of the XAI use case and its main idea at numerous events, including the global GTC21.

2.4. Other proposed Use Cases presented in Suptechs but discarded from the final list of Use Cases

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 825215 (Topic: ICT-35-2018 Type of action: CSA)

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2.4.1. Sovereign Risk Zones in Europe During and After the Debt Crisis

Brief description of the Use Cases:

Authors: Veni Arakelian, Petros Dellaportas, Roberto Savona and Marika Vezzoli

We employ a machine learning approach to build a European sovereign risk stratification using macroeconomic fundamentals and contagion measures, proxied by copula-based credit default swap (CDS) dependencies over the period 2008-2017, for France, Germany, Greece, Ireland, Italy, Portugal, and Spain. By adopting a recursive, partitioning strategy we detect specific risk zones varying from safe to high risk based on key predictors, and we construct their specification by assigning specific risk thresholds. While key macroeconomic fundamentals such as Debt/GDP and the unemployment rate remained the same and maintained the same risk thresholds during the sub-periods 2008-2013 and 2013-2017, the CDS spreads contagion dropped significantly over the post-Quantitative Easing years, lowering the corresponding risk thresholds. We estimate an impact on CDS spreads approximately of \$-105\$ basis points in the period 2013-2017 due to contagion mitigation.

Main points of received feedback and future developments of the Use Case

- Apply it also to other assets (e.g. stocks, bonds, mutual funds).
- ✓ Work should be done to modify the model to be used for asset allocation. In addition, to apply it to mutual funds, research should be conducted to identify the exogenous variables used at the random forest.

2.4.2. Dominance-Based Decision Rules for Pension Fund Selection under Different Distributional Assumptions

Brief description of the Use Cases:

Authors: Audrius Kabašinskas, Kristina Šutienė, Miloš Kopa, Kęstutis Lukšys and Kazimieras Bagdonas

The pension landscape is changing due to the market situation, and technological change has enabled financial innovations. Pension savers usually seek financial advice to make a personalised decision in selecting the right pension fund for them. As such, decision rules based on the assumed risk profile of the decision maker could be generated by making use of stochastic dominance (SD). In the Use Case, the second-pillar pension funds operating in Lithuania and Slovakia were analysed according to SD rules. The importance of the distributional assumption is explored while comparing the results of empirical, student-*t*, Hyperbolic and Normal Inverse Gaussian distributions to generate SD-based rules that could be integrated into an advisory solution. Moreover, due to the differences in SD results under different distributional assumptions, a new SD ratio is proposed that condenses the dominance-based relations for all considered dominance orders and probability distributions. The empirical results indicate that this new SD ratio efficiently characterises not only the preference of each fund individually but also of a group of funds with the same attributes, thus enabling multi-risk and multi-country comparisons.

Main points of received feedback and future developments of the Use Case

- The first recommendation (after presentation to Estonian supervisor) was to extend the scale of research and show how pension funds in Baltic States could be ranked. This was done and for Latvian and Lithuanian supervisors the extended version was presented. However, this improvement was not published in the paper.

- As the calculation time of third order Stochastic Dominance is extremely dependant on selection of probability distribution the second recommendation was to reduce calculation time
- Third recommendation was to show how the proposed technique could be useful in portfolio management
- One more recommendation is related to fundamental research in field of multivariate Stochastic Dominance
- The decisions taken by the approach requires explainability, i. e. what are the reasons why some funds have been ranked high or low.
- The probability or confidence level of provided estimates for pension funds
- The recommendations for practical implementation such as how often calculations should be updated, what is the minimum data sample required, sensitivity analysis
- ✓ The prosed “ratio” was not perfect and required improvement because the meaning of it was a little bit misleading. This is now corrected and will be introduced in new paper that we plan to submit by the end of August 2021
- ✓ Moreover, we plan to extend the scale of instruments used and show how to use SD ratio to rank crypto-currencies.
- ✓ Robustness and Sensitivity analysis under some economic and financial developments should be done
- ✓ Use of some explainability technique to interpret obtained solutions

2.4.3. Individual Machine Learning-based Robo Advisory Portfolio Strategy Selection

Brief description of the Use Cases:

Authors: Ronald Hochreiter

We examine the problem of portfolio optimization in a contemporary and dynamic Robo-Advisory asset allocation framework to allow for further studies of the market risk impact if Robo-Advisory becomes mainstream. The question of how to optimally match various mid-term and long-term expectations of individuals using interpretable Machine Learning methods on top of various classical portfolio selection methods from Finance and OR, e.g. optimization-based risk modelling is considered. The main task is to enable individualized strategies for each client while allowing to combine each individual strategy easily into the tactical asset allocation of the investment company and is additionally accepted by the respective financial regulator.

Main points of received feedback and future developments of the Use Case

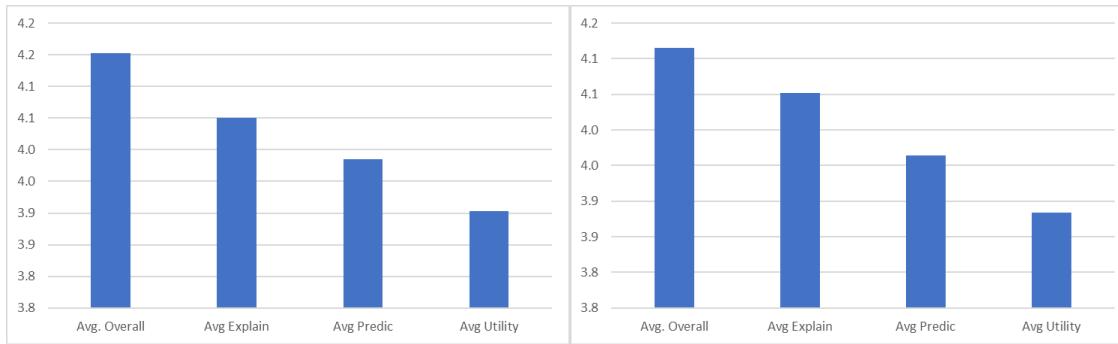
- All stakeholders are covered by the use case which makes the use case broadly useable
- Great to see what is possible in contemporary Robo Advisory using ML
- Might be even interesting to use for ESG purposes
- ✓ Explain the Machine Learning concepts behind the use-case in more detail
- ✓ Provide a rather complete simulation framework for regulators (not included now)
- ✓ Add a Machine Learning model comparison

Overall rating of AI Use Cases:

Average evaluations for AI Supertechnologies – all evaluations/without Consortium Partners

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Main Open feedback received from the Participants to Suptech events and other Stakeholders:

The XAI use case was appreciated by the majority of the audience of the Suptechs as being very interesting and useful and as focusing on one of the most important topics of the moment from the perspective of regulations and supervision. Another use case considered interesting but probably more suitable for central banks than for supervisors of the insurance sector was the FRM. The industry presentations (E.g. EY in Denmark) were considered very useful and interesting by the audience and were considered (where they were included) as an added value to the academic-technical presentation of the use cases.

Also for the Artificial Intelligence Suptechs the audience considered that sometimes the use cases were presented in a too technical manner and the sometimes the slides were not structured to facilitate the understanding for a non-technical audience (too much math).

The topics selected for the use cases were considered as having a high level of relevance and were in line with the important topics of the moment but sometimes more connections with the sector of supervision would have been a plus. These connections would have been very useful and should have been linked with the results and the findings of the papers-use cases. Therefore, an future direction that might be approached in the future is to start with the presented use cases and to go more in depth towards practical usability.

3. Methodologies developed for BC – Use Cases.

3.1. Use Case 1 - Initial Coin Offerings: risk or opportunity?

Brief description of the Use Cases:

Initial coin offerings (ICOs) are one of the several by-products of the cryptocurrencies world. Start-ups and existing businesses are turning to alternative sources of capital as opposed to classical channels like banks or venture capitalists. They can offer the inner value of their business by selling ‘tokens’, i.e. units of the chosen cryptocurrency, like a regular firm would do by means of an Initial Public Offering (IPO). The investors, of course, hope for an increase in the value of the token in the short term, provided a solid and valid business idea typically described by the ICO issuers in a white paper. However, fraudulent activities perpetrated by unscrupulous actors are frequent and it would be crucial to highlight in advance clear signs of illegal money raising. In this paper, we employ statistical approaches to detect what characteristics of ICOs are significantly related to fraudulent behavior.

We leverage a number of different variables like: entrepreneurial skills, Telegram chats and relative sentiment for each ICO, type of business, issuing country, team characteristics. Through logistic regression, multinomial logistic regression and text analysis, we are able to shed light on the riskiest ICOs.

14 of Suptech events where the Use Case was presented.

2 Regtech events where the Use Case was presented.

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Best Use Case: received 111 nominations and was ranked 1

Main points of received feedback and future developments of the Use Case

- The Methodology can be applied to ICO data with different features at disposal
- The results are useful for taking care of particular aspect relative to regulation and investors protection
- Utility relies on taking awareness of asymmetries of information
- Community behaviour proxies through textual analysis are useful for completing the available type of information
- ✓ Main improvement applied during research is the increase of sample
- ✓ The methodology of cross checking data revealed to be useful for fraud confirmation of many cases.
- ✓ The textual mining methodology revealed useful for different applications, such as credit scoring.
- ✓ Analysing features regarding the geopolitical and regulation situation might add a value.
- ✓ Analysing the ex post ICOs performances might be an added value.

3.2. Use Case 2 - Are Cryptos becoming alternative Assets? (A Statistical Classification of Cryptocurrencies)

Brief description of the Use Cases:

This use case provides insights for the separation of cryptocurrencies from other assets. Using dimensionality reduction techniques, we show that most of the variation among cryptocurrencies, stocks, exchange rates and commodities can be explained by tail, moment and memory factors of their log-returns. By applying various classification models, we are able to classify cryptocurrencies as a separate asset class, mainly due to the tail factor. The main result is the complete separation of cryptocurrencies from the other asset types, using the Maximum Variance Components Split method. Additionally, we show that cryptocurrencies tend to exhibit similar characteristics over time and become more distinguished from other asset classes (synchronic evolution).

15 of Suptech events where the Use Case was presented.

2 Regtech events where the Use Case was presented.

Best Use Case: received 41 nominations and was ranked 3rd.

Main points of received feedback and future developments of the Use Case

- The main difference between cryptocurrencies and classical assets, in terms of properties of the distribution of daily log-returns, is the tail behaviour.
- Cryptocurrencies exhibit a synchronic evolution i.e. individual cryptocurrencies develop similar statistical characteristics over time, allowing them to differentiate from classical assets.
- Cryptocurrencies may not be suitable for risk-averse investors, especially in bear market circumstances.
- Because of their high exposure to tail risk, conventional inference based on normal distribution appears to be inappropriate when it comes to the prudential treatment of cryptocurrencies.

- Furthermore, since the volatility of cryptocurrencies and traditional assets differs by a factor of about 10, cryptocurrencies may require extra attention and monitoring, as their high volatility could jeopardize overall financial stability.
- ✓ In-depth analysis on market risk indicators for cryptocurrencies vs. classical assets.

3.3. Use Case 3 - Libra or Librae? Basket based stable coins to mitigate foreign exchange volatility spillovers

Brief description of the Use Cases:

The use case aims to assess, from an empirical viewpoint, the advantages of a stable-coin whose value is derived from a basket of underlying currencies, against a stable-coin which is pegged to the value of one major currency, such as the dollar. To this aim, we first find the optimal weights of the currencies that can comprise our basket. We then employ volatility spillover decomposition methods to understand which foreign currency mostly drives the others. We then look at how the stability of either stable-coin is affected by currency shocks, by means of VAR models and impulse response functions. Our empirical findings show that our basket based stable-coin is less volatile than all single currencies. This results are fundamental for policy making, and especially for emerging markets with a high level of remittances: a librae (basket based stable coin) can preserve their value during turbulent times better than a libra (single currency based stable coin).

15 of Suptech events where the Use Case was presented.

2 Regtech + 1 Spin-off, events where the Use Case was presented.

Best Use Case: received 47 nominations and was ranked 2nd.

Main points of received feedback and future developments of the Use Case

- The methodology provides a robust statistical framework but more details on economic implications would also be interesting.
- Following on from the previous point, more details on policy implications for supervisors / regulators of the impact of the libra stable-coin.
- ✓ Provide more details on the economics and policy implications of stable-coins.
- ✓ Regarding the methodology, it would be interesting to see it applied to different asset classes to compare various types of stable-coins.
- ✓ Moreover, it would be interesting to do some additional exercises to study how such a mechanism could work in practice.

3.4. Use Case 4 - Financial Risk Meter

Brief description of the Use Cases:

A systemic risk measure is proposed accounting for links and mutual dependencies between financial institutions utilizing tail event information. FRM (Financial Risk Meter) is based on Lasso quantile regression designed to capture tail event co-movements. The FRM focus lies on understanding active set data characteristics and the presentation of interdependencies in a network topology. The FRM indices detect systemic risk at selected areas and identify risk factors. In practice, FRM is applied to the return time series of selected financial institutions and macroeconomic risk factors. We identify

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companies with extreme "co-stress", and "activators" of stress. We present FRM@Americas and FRM@Europe as main examples. With the SRM@EuroArea and the FRM@iT raxx we extend to the government bonds and credit default swaps. We also show FRM-implied recession probabilities to predict recessions. Thereby, FRM indicates tail event behavior in a network of financial risk factors.

11 of Suptech events where the Use Case was presented.

2 Regtech events where the Use Case was presented.

Best Use Case: received 18 nominations and was ranked 5th.

Main points of received feedback and future developments of the Use Case

- Other measures appear more rapid in reaction, e.g. VIX, implied volatility. FRM is backward looking.
- FRM does not perform well for out-of-sample prediction
- The choice of Macro variables must be better explained and verified
- Explain the choice and conduct sensibility tests for different lengths of time window
- Application of FRM risk measure for financial applications beyond the systemic risk prediction
- ✓ A few follow-up projects with application of FRM for different channels were initiated, which take into the account received comments and recommendations. For example:
 - ✓ FRM Crypto focuses on out-of-sample testing (e.g. R^2, volatility of CRIX with different lags)
 - ✓ FRM Crypto Conducts Robustness check of results for length of time windows
 - ✓ FRM Asia conducts Testing of significance of macroeconomic risk variables in general and for different tau levels, analysis of dynamics and regimes detection for certain macroeconomic variables over time
 - ✓ FRM Financial Risk Meter for Emerging Markets utilize FRM network centrality information in Lopez DePrado HRP-spirit portfolio allocation strategies
 - ✓ A new portfolio allocation framework: Tail-event co-movement portfolio construction (TEC) utilizes FRM as a risk measure in Markowitz optimization problem

3.5. Use Case 5 - Analysis of the cryptocurrency market applying different prototype-based clustering techniques

Brief description of the Use Cases:

Since the appearance of Bitcoin, cryptocurrencies have experienced enormous growth not only in terms of capitalization but also in number. As a result, the cryptocurrency market can be an attractive arena for investors as it offers many possibilities, but a difficult one to understand as well. In this work, we aim to summarize and segment the whole cryptocurrency market in 2018 with the help of data analysis tools. We will use three different partitional clustering algorithms each of them using a different representation for cryptocurrencies, namely: yearly mean and standard deviation of the returns, distribution of returns, and time series of returns. Since each representation will provide a different and complementary perspective of the market, we will also explore the combination of the three clustering results to obtain a fine-grained analysis of the main trends of the market. Finally, we will analyses the association of the clustering results with other descriptive features of the cryptocurrencies, including the age, technological attributes, and financial ratios derived from them. This will help to enhance the profiling of the clusters with additional insights. As a result, this work offers a description of the market and a methodology that can be reproduced by investors that want to understand the main trends on the market

7 of Suptech events where the Use Case was presented.

2 Regtech events where the Use Case was presented.

Best Use Case: received 22 nominations and was ranked 4th.

Main points of received feedback and future developments of the Use Case

- The regulators were interested in understanding the details of the implementation and the three-fold perspective obtained from analysing the first moments, the histogram and the time series was appreciated.
- The feedback of regulators also mentioned that it was a timely topic as regulators are setting up the 'dashboards' to monitor the crypto market.
- The approach on the study rely mostly on data mining techniques but actually many of the considered crypto assets has no interest from financial perspective as they cannot be directly traded on the market so it should be interesting to gather the findings more focus on the cryptocurrencies interesting from an investor perspective.
- ✓ Update the study using a more extended time window verifying the robustness or persistence on the associations in a dynamic way.
- ✓ Show how the clustering results could be used in a risk management or investment strategy. For example, how to use the information from the identified clusters for market risk estimation, for regulatory purposes or portfolio optimization in the cryptocurrency market.
- ✓ Apply the findings of the investigation to improve the performance of prediction models

3.6. Use Case 6 - Cyber risk ordering with rank-based statistical models

Brief description of the Use Cases:

In a world that is increasingly connected on-line, cyber risks become critical. Cyber risk management is very difficult; as cyber loss data are typically not disclosed. To mitigate the reputational risks associated with their disclosure, loss data may be collected in terms of ordered severity levels. However, to date, there are no risk models for ordinal cyber data. We fill the gap, proposing a rank-based statistical model aimed at predicting the severity levels of cyber risks. The application of our approach to a real-world case shows that the proposed models are, while statistically sound, simple to implement and interpret.

10 of Suptech events where the Use Case was presented.

2 Regtech events where the Use Case was presented.

Best Use Case: received 16 nominations and was ranked 6th.

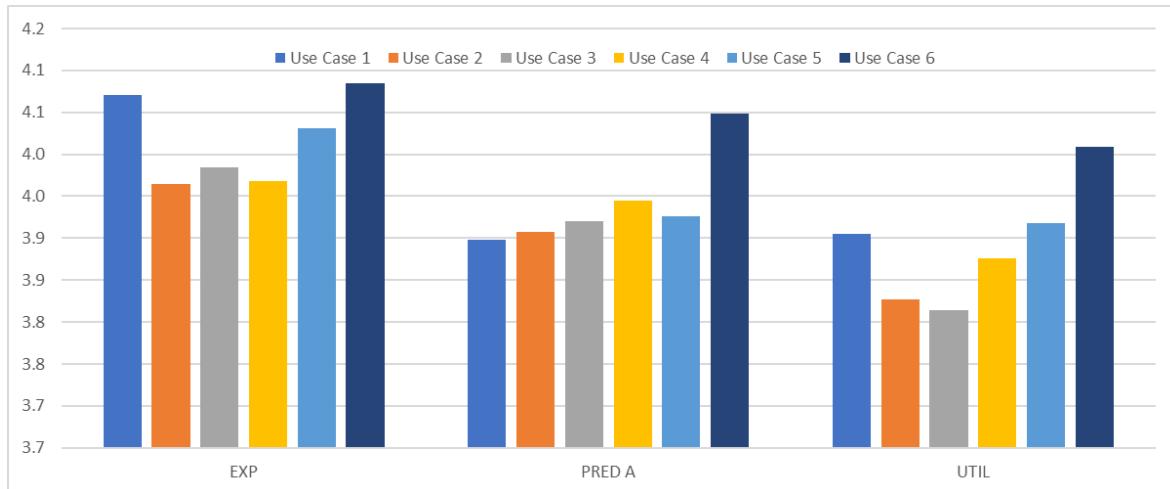
Main points of received feedback and future developments of the Use Case

- extension of the proposed approach to additional machine learning models different from our proposed rank regression model when dealing with cyber data expressed according to ordinal levels describing the severity degree of cyber-attacks;
- extension of the proposed approach also to data expressed into a continuous scale (if available) and expressing the monetary losses caused by the occurrence of cyber-attacks.
- ✓ comparison with other explainable artificial intelligence methods (LIME, etc.), in addition to the standard Shapley value-based approach;
- ✓ application of the proposed approach to real cyber loss data expressed in terms of monetary losses (if available);

- ✓ further investigation about the main properties associated with our approach (accurately predictive, explainable and robust) when implemented to data characterised by continuous nature rather than ordinal nature.

Overall rating of BC Use Cases:

Average evaluations for BC Suptechs – all evaluations/without Consortium Partners



Main Open feedback received from the Participants to Suptech events and other Stakeholders:

Basic presentation about blockchain technology are a very important plus for the non-technical audience activating in the field. Sometimes the basic information is much more useful than the very complex mathematical/statistical models for the understanding of the problem. The use cases should be presented less theoretical with a greater focus on the result and on their practical implications. Important added value would come from more interactions with the industry. More practical cases would have been a plus. Sometimes the explanations and the models presented are too technical. Sometimes simpler explanations from practitioners would have been a real plus. Sometimes the use cases seemed to be more work in progress than final conclusions and results. Therefore, would be very interesting to see further developments. Information about the cryptocurrencies are useful and increase the general knowledge. Presentation of the Ethereum is very informative. Fraud detection mechanism and initial coin offerings topics are of an increased interest. More information about cyber security and crypto-crimes would be of interest. More details about the smart contracts would be of interest. More information on the legal side and maybe the legal implications of the problem would be of high interest for the regulators and supervisors. Security related aspects would be very interesting to discuss in future events.

Interactions with other projects and Cost Action project

One important unintended output of the project is the **Cost Action 19130 - Fintech and Artificial Intelligence in Finance - Towards a transparent financial industry**. The Cost Action was created on the backbone of the Fintech Horizon 2020 project. The CA enlarges the network and is currently the largest Cost Action Network. The CA also takes also one of the pillars of the Fintech Horizon 2020 project and further develops it - <https://fin-ai.eu/>

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During the project we have also worked together with other Horizon2020 initiatives. Cybersecurity in Finance 30 October 2020: Fintech has been joined by several other H2020 projects tackling cybersecurity, including **SOTER**, **CRITICAL-CHAINS**, **FINSEC**, **CyberSec4Europe**, **CONCORDIA** and **SPARTA (CAPE Programme)**, to exchange knowledge, lessons learned and best practices on cybersecurity with a focus on the financial sector. The joint virtual event was attended by 80 participants.

Recent Security Advances in the Finance Sector 4 January 2021. The event has been an online training workshop on finance with the aim of understanding better the main security challenges faced nowadays by financial organizations and the newest solutions available to tackle them. The workshop stimulated a discussion about novel approaches in risk assessment and mitigation and help understand the role of leading technologies like Artificial Intelligence and Machine Learning in the resilience of financial institutions. During the workshop, H2020 projects SOTER, FIN-SEC and FIN-TECH presented their research on cybersecurity in the finance sector. The joint virtual event was attended by 50 participants.

Big Data Analytics - Final assessment of the methodologies presented in the Use Cases

The Big Data Analytics use cases were appreciated as being interesting materials which bring under scrutiny interesting approaches. The presentations were useful in giving context and details about analytics to the audience and very useful information about risk models.

A strong point is presentation of the R code and the use of R. This aspect was appreciated by the more technical participants to the workshops and on the other hand was sometimes considered a minus by the non-technical members of the audience.

One other strong point identified by the workshops attendees was the fact that the BDA workshops contributed to structuring the critical thinking about the credit risk aspects.

On the other hand, participants signaled that the Workshops and therefore the use cases should have been developed more in the direction of practical examples. Being too theoretical and without too much straightforward practical utility for the supervisors and for the regulators was another aspect mentioned by the participants. Some have expressed the desire to see a lower focus on the technical mathematical and statistical aspects and more discussions on the practical implications of the results and of the findings of the use cases.

Another positive aspect identified by the participants for some workshops was related to the introductory materials prepared by some partners (materials related to R, statistical concepts and methods, risk measures, etc.).

Another layer of feedback points out the idea to have an overview over a larger set of cases, especially as the cases were almost all centered around P2P lending, which is interesting but a restricted topic. Thorough understanding of modeling process is needed in managing the model risk related to nontraditional (AI or data driven) fintech models. Since the artificial intelligence affects insurance and financial sector in really many ways – speed and video recognition and statistical modelling will be (or are already) used. Ethical and legal aspects must be considered in early stage when introducing a new AI process and these would be of interest for supervisors. Two main directions are of interest: 1) AI technologies and 2) graphical illustrations of dependences between different processes powered by technology.

Artificial Intelligence - Final assessment of the methodologies presented in the Use Cases

The XAI use case was appreciated by the majority of the audience of the Suptechs as being very interesting and useful and as focusing on one of the most important topics of the moment from the perspective of regulations and supervision. The topic was considered very useful and interesting by the audience and seen as an added value to the academic-technical presentation of the use cases. Also for the Artificial Intelligence Suptechs the audience considered that sometimes the use cases were presented in a too technical manner.

The topics selected for the use cases were considered as having a high level of relevance and were in line with the important topics of the moment but sometimes more connections with the sector of supervision would have been a plus. These connections would have been very useful and should have been linked with the results and the findings of the papers-use cases. Therefore, a future direction that might be approached in the future is to start with the presented use cases and to go more in depth towards practical usability.

The general feedback points out on the use of various machine learning models (e.g. for Robo Advisory) and comparison with classical statistical tools.

Also, a larger realistic data set is required, and to initiate a project on trustworthy, explainable AI in the GAIA-X Finance & Insurance Data Space where the XAI use case is included and further developed.

Blockchain technologies - Final assessment of the methodologies presented in the Use Cases

Basic presentation about blockchain technology is a very important plus for the non-technical audience activating in the field. Sometimes the basic information is much more useful than the very complex mathematical/statistical models for the understanding of the problem. The use cases should be presented less theoretical with a greater focus on the result and on their practical implications. Important added value would come from more interactions with the industry. More practical cases would have been a plus. Sometimes the explanations and the models presented are too technical. Sometimes simpler explanations from practitioners would have been a real plus.

Information about the cryptocurrencies are useful and increase the general knowledge. Fraud detection mechanism, initial coin offerings, cyber security and crypto-crimes, smart contracts topics are of an increased interest. More information on the legal side and maybe the legal implications of the problem would be of high interest for the regulators and supervisors, also the security related aspects. In-depth analysis on market risk indicators for cryptocurrencies vs. classical assets would be beneficial.

Feedback received from various stakeholders points out to that the use cases could benefit from using additional machine learning models and explainable artificial intelligence methods. The use cases have a robust statistical framework but more details on economic implications would also be interesting. Also, the stakeholders would like to see more details on policy implications for supervisors / regulators.

7.6 D7.8 - Advisory Board report

Deliverable information

WP NO.	WP 7
DEL.	D7.8
DEL. NO.	D26
TITLE	Advisory Board Report
DESCRIPTION	The Advisory Board, composed by five non-European experts, after receiving all the project deliverables as well as the feedbacks given by the participants to the project events, will provide a final evaluation report.
NATURE	Report
EST. DEL. DATE	30 June 2021

Document information

DATE	28/06/2021
WRITTEN BY	Bucharest University of Economic Studies
APPROVED BY	Anca Mirela TOMA

The **Advisory Board** of the Fintech Horizon2020 Project consisted of 5 International Experts in the field coming from prestigious institutions outside Europe:

1. **ABM: Ying Chen** - Associate Professor at the National University of Singapore: Department of Mathematics, Faculty of Science.
2. **ABM: Dror Kenett** - Senior Economist at FINRA, Washington, District of Columbia, United States
3. **ABM: Daniel Heller** - Head of Regulatory Affairs at FNALTY, Zurich, Switzerland
4. **ABM: Shatha Qamhieh** - An-Najah National University (Palestine), Research Professional at the Palestinian Authority
5. **ABM: Bihong Huang** – Asian Development Bank

The five members of the Advisory Board have attended various activities of the Fintech Horizon 2020 Project both in person and virtually, once the activity was switched online.





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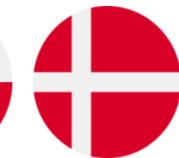
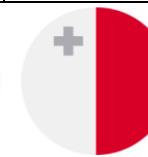
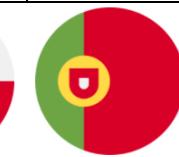


<p>FINTECH Horizon 2020 Kick-off PAVIA 01.02.2019</p>	<p>Research Event Big Data Analytics WINTHERTUR 03.09.2019 *UBER co-organizer</p>	<p>Research Event Mild-Term Workshop BUCHAREST 13.11.2019</p>
 University College London	 ZHAW Zurich university for applied science	 Humboldt University of Berlin
<p>Research Event Artificial Intelligence LONDON 19.05.2020</p>	<p>Research Event Blockchain WINTHERTUR 25.03.2021</p>	<p>FINTECH Horizon 2020 Closing Event BERLIN 18.06.2021</p>
 modefinance	 Firamis GmbH	 ZHAW Zurich university for applied science
<p>RegTech MILANO 29.03.2019 Big Data Analytics</p>	<p>RegTech FRANKFURT 28.06.2019 Big Data Analytics</p>	<p>RegTech WINTERTHUR 04.09.2019 Arficial Inteligence</p>
 WU Vienna University of Economics and Business	 Universidad Complutense de Madrid	 Pantheon-Sorbonne University
<p>RegTech WIEN 26.02.2020 Artificial Inteligence</p>	<p>RegTech MADRID 23.10.2020 Blockchain</p>	<p>RegTech PARIS 24.03-01.04.2021 Blockchain</p>

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Big Data Analytics
Artificial Intelligence
Blockchain

						
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ITALY	LATVIA	LITHUANIA	LUXEMBURG	MALTA	POLAND	PORTUGAL
						
ROMANIA	SLOVAKIA	SLOVENIA	SPAIN	SWEDEN	SWITZERLAND	UNITED KINGDOM

3 Use Cases in the Big Data Analytics pillar

Use Case 1 - Network based scoring models to improve credit risk management in peer to peer lending platforms

Use Case 2 - Factorial Network Models to Improve P2P Credit Risk Management

Use Case 3 - Spatial regression models to improve P2P credit risk management

Advisory Board Member - ABM
ABM:

Big data provides rich information and deliver insights that plays an important role in decision-making process in FinTech as well as many other areas. When using big data and IoT technologies extensively to conduct risk analysis and provide advanced service, it requires fast and robust operations on the vast amounts of data. The three use cases provided timely methodologies and showcase how to apply these risk management methodologies in peer-to-peer lending. As an

important and fast growing FinTech products, P2P lending provides benefits and opportunities to complement traditional financial activities. However, it also involves a lot not-well understood risks and further regulation challenges to investors, market and regulators.

The use cases provided well justified models and elaborated their importance and applications clearly with supporting real data analysis. The topics are explicitly engaged with the needs of regulators to evaluate and manage systemic risks in the fast growing lending platforms. In particular, Giudici, Hadji-Misheva and Spelta (2019) proposed a credit scoring predictive model to investigate systemic risks in the peer-to-peer lending platforms. By leveraging topological information embedded into similarity networks that reflects borrowers' importance and community structures, it improved credit risk accuracy. Ahelegbey, Giudici and Hadji-Misheva (2019) focused on credit scoring of over 15000 SMEs engaged in P2P lending services across Europe. It developed a factor network-based segmentation for credit score modeling, which segment the heterogeneous population into more homogeneous clusters and then build a credit score model for each cluster via lasso logistic regression. The result reveals the network-based segmentation achieves higher predictive performance than the conventional model. Agosto, Giudici and Leach (2019) proposed a binary spatial regression models to measure contagion effects in credit risk of 1185 Italian companies arising from corporate failures. By employing the Bank for International Settlements' data on flows between country banking systems and the World Input-Output Trade (WIOT) statistics between economic sectors, it provided evidence of high levels of contagion risk, which increases the individual credit risk of each company.

Moreover, the use cases share related resources, which not only contribute to society by promoting research in the direction, but also attract attention of professionals in the recent study of big data Fintech. The use cases as well as replication codes are public available at https://github.com/danpele/FINTECH_HO_2020/, which is consistent to the objective of the project by elaborating detailed understanding of the risk management models that can be applied to financial technologies.

References

- Giudici, P., Hadji-Misheva, B., & Spelta, A. (2019). Network based scoring models to improve credit risk management in peer to peer lending platforms. *Frontiers in Artificial Intelligence*, 2, 3.
- Ahelegbey, D. F., Giudici, P., & Hadji-Misheva, B. (2019). Factorial Network Models To Improve P2P Credit Risk Management. *Frontiers in Artificial Intelligence*, 2, 8.
- Agosto, A., Giudici, P., & Leach, T. (2019). Spatial regression models to improve P2P credit risk management. *Frontiers in Artificial Intelligence*, 2, 6.

ABM:

I was very excited about the project's pillar focused on the area of big data analytics, and was happy to have had the opportunity to see them present in person, in the fall of 2019. The focus of the case studies was predominantly on peer to peer lending, and the case studies were interesting, and presented some interesting insights into this important mechanism for dis-intermediated lending channel. I was able to provide some feedback on the case studies, and regret not having the chance to have more dialogue with the team to help them further in building in the work that was done. While I agree with the importance of this topic, I also would have liked to see some additional topics addressed in this pillar, as well as the inclusion of additional academics and regulators. Finally, since the original presentation in 2019, it is hard to identify significant progress and development of the pillar. I think that additional efforts on this front would have enhanced the success and impact of the pillar.

ABM:

This section contains three applications of big data analytics (BDA) to peer-to-peer (P2P) lending networks. This area of research is highly relevant, in particular in light of the recent retraction of banks from lending to firms and households. The papers recognize a fundamental fact that asymmetric information in lending markets puts P2P lending at a disadvantage vis-à-vis bank lending since banks specialize in assessing and monitoring borrowers. The losses of LendingClub in 2017 are an illustration of the risk involved in P2P lending. Thus, sound risk management of P2P lending networks is essential for their long-term success and sustainability. At the same time P2P platforms seem to have a competitive advantage in the sense that they can operate with lower capital requirements and don't have to contribute to deposit insurance.

While there is evidence that P2P lending is growing, relevant data seem to be limited. The three papers use datasets from an Italian and Southern European platforms for SMEs. In general, a more detailed description of the data would have been welcome. For instance, Table 1 in Giudici-Hadjı, isn't very accessible to the reader. Also, it remains unclear whether the data cover more than one year (2015) which seems to be necessary to receive robust results.

The papers show various approaches of how risk management could be enhanced in P2P lending platforms. One leverages on topological information embedded in similarity networks. The other one is a factor network based segmentation for modelling a credit score. The third applies spatial regression models. All papers make a very welcome and valuable contribution since they show how P2P lending platforms can improve their risk management. Research of this sort will be essential for the future development of new forms of lending.

ABM:

1. Giudici P., Hadji-Misheva B., Spelta A. Network based scoring models to improve credit risk management in peer-to-peer lending platforms (Focus: credit risk management). The authors improved the predictive performance of credit scoring models for peer-to-peer platforms by using the topological coefficients of similarity networks as additional explanatory variables to describe the borrower importance and the community structures.
2. Ahelegbey D.F., Giudici p., Hadji-Misheva b. Factorial Network Models to Improve P2P Credit Risk Management (Focus: credit risk management). The authors improve credit risk modelling by first segmenting a network of SMEs that are engaged in P2P lending services into clusters based on linkages that represent the co-movement of latent factors, then they build a credit score model for each cluster via lasso logistic regression to achieve an improvement in the default predictive performance.
3. Agosto a., Giudici p., Leach t. Spatial Regression Models to Improve P2P Credit Risk Management (Focus: systemic risk management / contagion risk). The authors apply a binary spatial regression model to measure contagion effects arising from corporate failures and they provide evidence of high levels of contagion risk, which increases the individual credit risk of each company.

ABM:

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modeling by first segmenting a network of SMEs that are engaged in P2P lending services into clusters based on linkages that represent the co-movement of latent factors, then they build a credit score model for each cluster via lasso logistic regression to achieve an improvement in the default predictive performance.

3. Agosto a., Giudici p., Leach t. Spatial Regression Models to Improve P2P Credit Risk Management (Focus: systemic risk management / contagion risk) The authors apply a binary spatial regression model to measure contagion effects arising from corporate failures and provide evidence of high levels of contagion risk, which increases the individual credit risk of each company.

Key aspects

Well justified models.

The pillar could have addressed more topics and continue the good start in 2019.

The research presented touches on important aspects for the further development of the new forms of lending

3 Use Cases in the Artificial Intelligence Pillar

Use Case 1 - Network models to enhance automated cryptocurrency portfolio management

Use Case 2 - Convergence and Divergence in European Bond Correlations

Use Case 3 - Explainable Machine Learning in Credit Risk Management

ABM:

Over the past few years, financial industry has initiated adopting AI solutions to cope with the industry's fast changing landscape. AI have almost thoroughly infiltrated almost every area in FinTech, with showcases especially in Robo-advisors, sentiments, cryptos. The use cases demonstrated some of the contributions of the project during this exciting period. For example, Giudici, Pagnoncelli and Polinesi (2020) proposed a network model to extend the Markowitz model with Random Matrix Theory and network measures to build efficient portfolio allocation strategies involving cryptocurrencies. The algorithms can be easily used for Robo-advisors to automatically match investors' risk profile with specific class of financial assets and build an efficient portfolio allocation for specific client. The results show that overall our model over-performs several competing alternatives, maintaining a relatively low level of risk. Schwendner, Schüle and Hillebrand (2019) investigated market sentiment in European sovereign bonds using a correlation analysis toolkit based on influence networks and hierarchical clustering. Several case studies including the 2016 Brexit referendum, the French presidential elections in 2017, during the budget negotiations within the new Italian coalition in 2018, sentiments delivered reasonable interpretations. Bussmann, Giudici, Marinelli and Papenbrock (2021) proposed an explainable Artificial Intelligence model that can be used in credit risk management. Among others, it illustrated how to use the model in measuring the risks that arise when credit is borrowed employing peer to peer lending platforms. Empirical analysis of 15,000 small and medium companies demonstrated that both risky and not risky borrowers can be grouped according to a set of similar financial characteristics, which can be employed to explain their credit score.

The use cases as well as replication codes are public available at <https://github.com/danpele/FINTECH HO 2020/>,

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All material presented here reflects only the authors' view. The European Commission is not responsible for any use that may be made of the information it contains.

References:

- Giudici, P., Pagnoncelli, P., & Polinesi, G. (2020). Network Models to Enhance Automated Cryptocurrency Portfolio Management. *Frontiers Artif. Intell.*, 3, 22.
- Schwendner, P., Schüle, M., & Hillebrand, M. (2019). Sentiment Analysis of European Bonds 2016–2018. *Frontiers in Artificial Intelligence*, 2, 20.
- Bussmann, N., Giudici, P., Marinelli, D., & Papenbrock, J. (2021). Explainable machine learning in credit risk management. *Computational Economics*, 57(1), 203–216

ABM:

The second pillar addresses an additional area of great importance and many efforts across regulators, academics, and practitioners. This is a broad area and the project team dedicated some of its resources in this area and developed very interesting work. I think that the topic of explainable AI in particular, as well as the issue of AI related ethics, is of high value and importance and is getting a lot of attention. As in my previous comments, I think greater impact and success of this pillar would have come from greater engagement across the three different groups of stakeholders. I do find the deliverables of the use cases to be of value, and congratulate the team on their success and all of their efforts.

ABM:

The papers in the AI block cover a diverse set of topics. The first paper shows how super volatile assets like cryptocurrencies can be integrated into automated consultancy (robo advisory). It finds that an “extended” Markowitz model can lead to superior results.

The second looks at the market sentiment during three recent events in the European bond market (Brexit in 2016, French elections in 2017 and Italian budget negotiations in 2018).

The third paper proposes a network based explainable Artificial Intelligence model for measuring credit risk in P2P lending markets for Small and Medium Enterprises.

All three papers apply sophisticated technical tools to relevant policy questions. They nicely show the heterogeneity of relevant topics.

ABM:

1. Giudici, P. Pagnoncelli, P. Polinesi, G. Network models to enhance automated cryptocurrency portfolio management (Focus: investment risk management). The authors provide an extension for the efficient portfolio allocation strategies of Markowitz model. They combine Random Matrix Theory and network measures to extract the portfolio weights that allow to enhance the risk-return outcome of portfolios that include volatile financial instruments such as cryptocurrencies.

2. Schwendner, P. Schüle, M. Hillebrand, M. Convergence and Divergence in European Bond Correlations (Focus: market spillover risk management / sovereign risk). The authors use noise-filtered partial correlation influences to capture the time structure of the correlation matrix between the yield changes of the euro area government bonds. This time dependency is evaluated and visualized using network graphs.

3. Bussmann, N. Giudici, P. Marinelli, D. Papenbrock, J. Explainable AI in Credit Risk Management (Focus: credit risk management). The authors provide an explainable AI model for credit risk prediction that arises from using credit scoring platforms by SMEs. They apply similarity networks to Shapley values and group predictions based on similarities in the underlying explanatory financial characteristics variables.



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Key aspects

The use cases touch upon some of the hottest areas of the domain.

The pillar would have had a greater success if a greater engagement across the three different groups of stakeholders would have been achieved.

Applying sophisticated technical tools, the use cases cover a diverse set of topics.

.6 Use Cases in the Blockchain Pillar

Use Case 1 - Initial Coin Offerings: risk or opportunity?

Use Case 2 - Are Cryptos becoming alternative Assets?

Use Case 3 - Libra or Librae? Basket based stable coins to mitigate foreign exchange volatility spillovers

Use Case 4 - Financial Risk Meter

Use Case 5 - Analysis of the cryptocurrency market applying different prototype-based clustering techniques

Use Case 6 - Cyber risk ordering with rank-based statistical models

ABM:

Blockchain has been considered by financial institutions and regulators one of the fundamental technologies for the future of risk management. Meanwhile, it raises questions given the still limited knowledge on blockchain-based business models such as whether the innovative product will expose company and market to new types of risk and if so how to measure and mitigate these risks. There are 6 use cases in the Blockchain pillar, which covers wide spectrum of blockchain risk management including e.g. fraudulent activities detection in Initial Coin Offerings (Toma and Cerchiello, 2020), stochastic behavior comparison between cryptos and other assets in tails, moment and memory factors (Pele, Wesselhoeft, Härdle, Kolossiatis and Yatracos 2020), construction of stable coin based on basket currencies or single currency (Giudici, Leach and Pagnontoni, 2020), development of systemic risk metric accounting for links and mutual dependencies between financial institutions (Mihoci, Althof, Chen and Härdle, 2020), partitional clustering and association analysis of cryptocurrency market (Lorenzo and Gallardo, 2021), risk management model for connected on-line ordinal cyber data (Giudici and Raffinetti, 2020). The studies provide both high quality methodological tools and comprehensive empirical evidence for researchers, professionals and regulators to understand and manage risks related to blockchain that will help to make a better decision while utilizing blockchain to drive efficiency in business activities and alleviate certain existing risks.

The use cases as well as replication codes are public available at <https://github.com/danpele/FINTECH HO 2020/>,

References:

- Toma, A. M. and Cerchiello, P. (2020). Initial Coin Offerings: Risk or Opportunity? *Frontiers in artificial intelligence*, 3, 18.
- Pele, D.T., Wesselhoeft, N., Härdle, W.K., Kolossiatis, M. and Yatracos, Y.G. (2020). Are Cryptos becoming alternative Assets? Working paper.
- Giudici, P., Leach, T. and Pagnontoni, P. (2020). Libra or Librae? Basket based stablecoins to mitigate foreign exchange volatility spillovers. Working paper.
- Mihoci, A., Althof, M., Chen, C. Y. H., and Härdle, W. K. (2020). FRM financial risk meter. In *The Econometrics of Networks*. Emerald Publishing Limited.
- Lorenzo, Á. L. and Gallardo, J. A. (2021). Analysis of the cryptocurrency market applying different prototype-based clustering techniques. *Financial Innovation*.
- Giudici, P., and Raffinetti, E. (2020). Cyber risk ordering with rank-based statistical models. *ASTA Advances in Statistical Analysis*, 1-16.

ABM:

In comparisons to the other two pillars of the project, the third pillar addresses the youngest and perhaps the most dynamic of topics. The pillar touches on the uses and applications of blockchain, but with the focus on the tokens themselves, and their implications in finance. I like this aspect the most about the use cases, given that a lot of the literature has focused in this area on the technical aspects of blockchain or DLT. The accelerated growth of the token space is affecting the classical finance world in ways that are still being understood, and such use cases are of value and provide interesting insights. I find the code and deliverables provided with the use cases to be of value and applaud the team for all their efforts.

ABM:

The blockchain section contains six papers. The first paper looks into risks and opportunities of Initial Coin Offerings (ICOs). It uses statistical methods to detect fraudulent ICOs. The paper defines success of an ICO that the targeted hard cap for fundraising is reached. But as history has shown many ICOs have turned out to be “fraudulent” or have failed only after the ICO has been successful.



The second uses various classification techniques to distinguish crypto currencies from classical assets. Most variation can be explained by three factors (tail, moment, memory).

The third paper looks at the properties of the original Libra proposal to create a payment asset/currency that is stable vis-à-vis a basket of currencies such as the IMF's Special Drawing Right (SDR). Using VAR models the authors find that the currency basket is less volatile in case of exchange rate shocks than single currencies. While this finding isn't really surprising, it doesn't mean that the original Libra proposal would have appealed to consumers who are currently not exposed to exchange rate shocks (i.e. those whose income and expenditures are in the same currency).

The fourth paper proposes a new systemic risk measure accounting for links and dependencies between financial institutions. Such measures are highly relevant for banking supervisors for determining adequate capital requirements for times of systemic distress, e.g. in determining countercyclical capital buffers.

The fifth paper analyses cryptocurrency markets applying different clustering techniques. This research could allow investors in cryptocurrencies to detect big trends in the crypto market.

The last paper deals with cyber risks, an increasingly acknowledged risk in global financial markets. The paper provides a statistical model aimed at predicting the ordinal severity levels of cyber risks. All use cases provide sound research on blockchain related topics. But they also show how quickly changes are happening. ICOs are essentially have turned into a marginal field due to entrepreneurial shortcomings or enforcement actions of market authorities. And of course, one would be very interested to learn how the recent boom and bust market for bitcoin and ether would have influenced the results.

ABM:

1. Toma, A. Cerchiello, P. Initial Coin Offerings: risk or opportunity? (Focus: operational risk management / fraudulent risk management) The authors use statistical approaches to detect the characteristics of ICOs that are significantly related to fraudulent behaviour to reduce illegal money raising. They use classical statistical classification models on structured data to determine if the ICO is a success, a failure, or a scam, in addition to using textual analysis on telegram chats.
2. Pele, D. Wesselhofft, N. Hardle, W. Kolossiatis, M. Yatracos, Y. Are Cryptos becoming alternative Assets? (Focus: market risk management / investment risk management) The authors use the dimensionality reduction technique of the Maximum Variance Components Split method to show that most of the variation among asset types can be explained by tail, moment and memory factors of their log-returns. Their findings classify cryptocurrencies as a separate asset class based on tail factors but show that cryptocurrencies have synchronic evolution.
3. Giudici, P. Leach, T. Pagnuttoni, P. Libra or Librae? Basket based stable coins to mitigate foreign exchange volatility spillovers (Focus: market risk management / investment risk management). The authors empirically compare the advantage of a stablecoin that has a diversified currency basket, to the advantage of a stablecoin of a single currency. The authors first find the optimal weights of the currencies in the diversified basket, next they determine the foreign currency that drives the exchange rate of other currencies using the volatility spillover decomposition methods, finally they verify the stability of both stablecoins under currency shocks using VAR models and impulse response functions.
4. Mihoci, A. Althof, M. Chen, C. Hardle, W. FRM Financial Risk Meter (Focus: systemic risk management) The authors propose a Financial Risk Meter (FRM) based on Lasso quantile regression that is designed to capture tail event co-movements. They use FRM to indicate tail event behaviour

in a network of financial risk factors by accounting for links and mutual dependencies between financial institutions utilizing tail event information. The FRM focus is understanding active set data characteristics and the presentation of interdependencies in a network topology.

5. Lorenzo, L. Arroyo, J. Analysis of the cryptocurrency market applying different prototype-based clustering techniques (Focus: market risk management / investment risk management)

The authors aim is to help investors in understanding the main trends in the cryptocurrency market, and to select cryptocurrencies with different financial performance. For this purpose, they use three complementary different market perspectives based on three different partitional clustering algorithms, in addition to the perspective from the combination of the three clustering results. They finally enhance the clusters profiling by analyzing the association of the clustering results with other descriptive features of the cryptocurrencies.

6. Giudici, P. Raffinetti, E. Cyber risk ordering with rank-based statistical models. (Focus: operational risk management / cyber risks management). The authors aim is to provide a cyber-risk management model. For this purpose, they propose a rank-based statistical model aimed at predicting the severity levels of cyber risks. In the application of their model on ordinal cyber data from a real-world case, they show that the model simple to implement and interpret.

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Key aspects

The use cases cover a wide area of aspects connected with the hottest technology of the moment.

The pillar touches on the uses and applications of blockchain, but with the focus on the tokens themselves, and their implications in finance and not on the technology itself.

The use cases provide sound research and their variety shows how quickly the changes are happening in the field.

Over 87 Suptech events and over 5000 registrations (participants)	6 Research events and 519 registrations (participants)	6 Regtech events and 599 registrations (participants)
Over 11 Spin-off events and over 20 other special events	Over 13 podcasts and 940 views	Over 325 LinkedIn posts and 1160 followers

events of the project, website and social media presence

ABM:

The Fintech Horizon2020 Project organized a series of influential activities, including 6 Research events, 6 Regtech events, 87 Suptech events and 11 Spin-off events. These events successfully attracted more than 3000 participants from more than 28 countries in Europe and International, with background of FinTech consortium partner, FinTech/Bank/Insurance company, national supervisor, international advisor/regulator and others. In addition, the project posted over 13 podcasts and 320 LinkedIn posts which attracted more than 1000 followers.

These events were consistent to the objectives such as monitoring the activity of the project, opening the activity of the project to international stakeholders and providing a discussion platform for the latest research and training activity conducted by the project partners. Simultaneously these



events attracted international attention on the fast development of FinTech risk management in EU.

These activities were very well organized and I enjoyed the insightful discussions and communications in the events I personally attended. Overall, the project was successful and reached to KPIs of e.g. dissemination to the academic community, through publications, workshops and via the website, and provided contributions to the scholarly community and professionals through the sup tech and spin-off events. I congratulate the project for its achievements.

ABM:

Overall, I find that the project team did a good job in maintaining a social media presence and a digital footprint. I observed several interesting posts by the project team, and also found the videos posted by the team to be very useful and informative. I only attended a few of the project events, but the research related events I did attend were well organized and provided a good mix of industry, academic, and regulator representatives. The events provided the opportunity for a meaningful dialogue across the three stakeholder groups to discuss the issues and potential solutions. The in person events were very successful, and the online events that were a result of the pandemic, were able to provide a decent compromise given the situation, and I applaud the project team efforts in making such a transition in a quick and relatively seamless way.

ABM:

Nothing to add regarding the events, website and the social media presence of the project.

ABM:

The project has a dedicated website that is user friendly; the contents are classified into main categories in a manner that is easy to follow and reach out, the videos are of good quality, the social media covered the events in a clear manner through main platforms such as LinkedIn and Twitter, the project repository on GitHub includes all the project documents, events, use cases, and dissemination files.

The stakeholders are provided an open platform for the project, and the workshops were conducted with the participation of a variety of interested stakeholders, including university participants, Fintechs and banks, international and national supervisors.

To achieve the planned goal of 87 SupTech events within the project to national supervisors of 29 EU countries, despite the interference of the COVI-19 pandemic, is impressive. Both the number and the scope of the organized SupTech events are valuable in terms of supporting the EU supervisory boards risk management practices. This achievement certainly reduced the gap across EU between FinTech technicalities and FinTech supervision by increasing the effectiveness of main SupTech supervision activities over data collection and data analytics. The training conducted for the supervisors is based on the USE-CASES developed by the project for BDA, AI and BC applications.

The availability of practical training sessions to both FinTechs and to banking institutions helped in validating the innovative technological models through the coding sessions from a RegTech perspective within BDA, AI and BC. The project reduced the mismatch at an international level between the speed of advancement in FinTech compared to RegTech advancement. Yet, this mismatch is not eliminated and is still obvious due to the disruptive nature of FinTech innovations and their models' validation impediments in comparison with the processes of the conventional

financial institutions. The validation training is based on the replication of the USE-CASES developed by the project for BDA, AI and BC applications.

The project goals included achieving 6 research workshops, out of which three were horizontal workshops with the purpose of developing use cases that satisfy the regulators priorities, and another three vertical workshops with the purpose validating the developed use cases. The research workshops were conducted by several EU participants.

ABM:

The project has built a user friendly website whose contents are classified into main categories in a manner that is easy to follow and reach out. The videos of this project are of good quality. The events of this project have been promoted in a clear manner through the main social media such as LinkedIn and Twitter. The project repository on GitHub includes all the project documents, events, use cases, and dissemination files.

The project has collaborated with several institutes, including Concordia, BDVA, SPARTA and Cybersecurity for Europe.

The stakeholders are provided an open platform for the project, and the workshops were organized with the participation of a variety of interested stakeholders, including university participants, Fintechs and banks, international and national supervisors.

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The practical trainings for both FinTech companies and banking institutions helped validating the innovative technological models through the coding sessions from the RegTech perspective within BDA, AI and BC. The project reduced the mismatch at an international level between the speed of advancement in FinTech compared to RegTech advancement. Yet, this mismatch is not eliminated and is still obvious due to the disruptive nature of FinTech innovations and their models' validation impediments in comparison with the processes of the conventional financial institutions. The validation training is based on the replication of the USE-CASES developed by the project for BDA, AI and BC applications.

The project goals included organizing 6 research workshops, out of which three were horizontal workshops with the purpose of developing use cases that satisfy the regulators priorities, and another three vertical workshops with the purpose of validating the developed use cases. The research workshops were conducted by several EU participants.

Key aspects

Wide variety of events mixing all important stakeholders.

Good social media presence.

Videos provide useful information in a very accessible manner.