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FINANCE AND ARTIFICIAL INTELLIGENCE: THE FIFTH INDUSTRIAL REVOLUTION AND ITS IMPACT ON THE FINANCIAL SECTOR

ФИНАНСИЈЕ И ВЈЕШТАЧКА ИНТЕЛИГЕНЦИЈА: ПЕТА ИНДУСТРИЈСКА РЕВОЛУЦИЈА И ЊЕН УТИЦАЈ НА ФИНАНСИЈСКИ СЕКТОР

Summary: *A true artificial intelligence (AI) system is something that "learns" from the data it stores, in order to perform tasks and solve problems that typically require human intelligence - either with the help of a human expert or independently. The area of AI is an interdisciplinary field, which has been designated as a strategic area in the European Union (EU) approach and a key driver of economic development that can bring solutions to many social challenges and problems. Due to its nature and its tendency to be digitally advanced and smarter with analytics, the financial sector is one of the early adopters of AI and expects multiple benefits from its application, that is, the ability to provide better service in the shortest time possible and at a lower cost. AI in the financial sector is based on an understanding of the business needs of financial organizations, institutions and markets and the ability to connect with technological capabilities. They are powerful tools that completely transform this sector. The basic idea of this paper is to consider where the real value of AI in the financial sector is, i.e. what are the practical aspects and business implications of AI in the financial sector globally. It is common knowledge that evolving technologies have always had a strong impact on the sectors in which they are applied because they give them the opportunity to improve existing manufacturing processes, services, customer experiences, operate more efficiently, achieve cost savings, etc. The aim of this paper is to identify areas of application of AI in the financial sector, and to explore leading AI applications that are changing the financial ecosystem, transforming the financial sector and that have the potential to significantly improve many of its functions. The paper further highlights other implications of AI implementation in the financial sector such as employment - job creation and termination of existing AI-influenced employment, the scope and potential of application in developing countries, the problem of regulation and use in the best interests of man, and the importance of properly managing specific AI risks.*

Keywords: *financial sector transformation, personalization of financial products and services, Chatbots, Cobots, Robo-traders, Robo-consultants, machine learning, specific risks of artificial intelligence*

JEL classification: *G00, G39, G29, G21*

Резиме: *Прави систем вјештачке интелигенције (АИ) је нешто што „учи" од података којима се храни, како би обављао задатке и рјешавао проблеме који обично захтјевају људску интелигенцију – било уз помоћ људског стручњака или самостално. Подручје АИ је интердисциплинарно подручје које је у европском приступу (приступу Европске Уније) означено као подручје од стратешког значаја и кључни покретач економског развоја који може донијети рјешења за многе друштвене изазове и проблеме. Финансијски сектор, због своје природе и тенденције да буде дигитално напредан и паметнији са аналитиком, спада у секторе ране прихватиоце АИ и од њене примјене очекује вишеструке користи, односно могућност да пружи квалитетнију услугу за што краће вријеме и уз ниже трошкове. АИ у финансијском сектору се заснива на разумијевању пословних потреба финансијских организација, институција и тржишта и способности да се повежу са технолошким могућностима, ријеч је о моћним алатима који потпуно трансформишу овај сектор. Основна идеја овога рада је била да се размотри гдје је стварна вриједност примјене АИ у финансијском сектору, односно који су практични аспекти и пословне импликације примјене АИ у финансијском сектору глобално посматрано. Општепознато је да су еволуирајуће технологије одувијек имале јак утицај на секторе у којима се примјењују због тога што им доносе могућност да побољшају постојеће производне процесе, услуге, корисничка искуства, ефикасније послују, остваре уштеде у трошковима, итд. Циљ овога рада је да укаже на области примјене АИ у финансијском сектору, те истражи водеће АИ апликације које мијењају финансијски екосистем, трансформишу финансијски сектор и које имају потенцијал битног побољшања многих функција у овом сектору. Рад додатно указује на остале импликације примјене АИ у финансијском сектору као што су запошљавање – креирање нових радних мјеста и укидање постојећих под утицајем АИ, обим и могућности примјене у земљама у развоју, проблем регулације и коришћења у најбољем човјековом интересу, те значај правилног управљања специфичним ризицима АИ.*

Кључне ријечи: *трансформација финансијског сектора, персонализација финансијских производа и услуга, Chatbots, Cobots, Robo-traders, Robo-consultants, машинско учење, специфични ризици вјештачке интелигенције*

ЈЕЛ класификација: *G00, G39, G29, G21*

1. INTRODUCTION

Customer or consumer satisfaction is one of the major drivers and factors of the fifth industrial - AI revolution. This satisfaction is achieved through a higher level of personalization of products and services and improved customer experiences, and AI is a powerful tool that enables this. The financial sector, as one of the sectors of early adopters of AI, expects great benefits from its implementation.

AI is expected to completely change the way clients interact with banks and conduct financial transactions, leading to the emergence of a range of new products and services, new jobs (as we do not know today) in the financial sector, assisting with transaction security, protecting data, preventing financial fraud and abuse and finally with the help of machine learning - ML (one of the AI spectra) it will be able to detect market anomalies to anticipate and prevent financial crises like the one in 2008.

Using the AI, the financial sector will be able to offer cheaper products and services, provide enriched and enhanced experiences to its customers, reduce losses, achieve cost savings, trade smarter, and replace people in certain positions with cobots, chatbots, robo-traders that will provide faster and much more efficient solutions in entrusted jobs and thus save money by reducing employment and avoiding human error in the process.

Considering all of the above, it is indisputable that the fifth industrial - AI revolution will have a major impact on the serious transformation of the financial sector, and it is impossible to predict where this transformation will lead us and what the financial sector and finance will look like. The aim of this paper is to highlight areas of application of AI in the financial sector and to point out to the leading applications of AI that are transforming the financial sector and which have the potential to significantly improve manof its functions.

In short, the paper aims to show many benefits of using AI in the financial sector such as customer or client involvement, personalization (customized content and user experience), proposing solutions to defined problems, modifying products and services, etc. which could be of use to the wider academic and socio-political community (regulators), and to service users or clients in order to welcome, understand and accept these changes as willingly as possible. That is why the paper is structured as follows. Chapter 2 gives a brief history of the industrial revolutions and changes that they have brought with them. In Chapter 3, we give a theoretical discussion of the Fifth Industrial - Artificial Intelligence (AI) revolution, its drivers, and what it brings to society and the economy as a whole. In addition, this chapter presents the views and recommendations of the European Union (EU) on AI, and outlines AI various spectra. The growing impact of AI on the financial sector is described in Chapter 4, which elaborates on AI in the financial sector today, and provides an overview of key AI applications that are transforming the financial sector and have the potential to radically improve a number of functions in this sector. Discussion and concluding considerations are given in point 5, which is also the last part of this paper.

2. BRIEF HISTORY OF INDUSTRIAL REVOLUTIONS - FROM INDUSTRY 1.0 TO INDUSTRY 5.0

In the period before the First Industrial Revolution, more than 80% of the world population was engaged in agriculture, i.e. cultivating the land and producing food for themselves and the rest of the world's population (Muir 2018).

The First Industrial Revolution began in the UK and lasted from 1760 to 1870 and meant the transition to new production processes using steam. Fuel sources such as steam and coal have made the use of machines more feasible, and the idea of manufacturing with machines has expanded rapidly. The industry, first of all, transformed the transportation as well as the textile industry, which at that time was dominant in terms of employment, product

value and invested capital, and which was the first to adopt modern production methods. The use of machines makes it possible to produce a greater variety of goods faster and easier, and thus to create a better standard of living (Jenis 2019; Muir 2018).

The First Industrial Revolution was at the same time a direct cause of increased urbanization due to the increasing number of people moving to cities in order to work in factories. Thus, for example, by 1800, as many as 10% of Britons had moved to London for work (Muir 2018).

The Second Industrial Revolution took place mainly in Great Britain, America and Germany and lasted from 1870 to 1914. This industrial revolution, often referred to by historians as the "technological revolution", has caused electricity, oil and steel to change the world's socio-economic situation. Steel replaced iron, and the massive production of steel made it possible to build railways, which in turn improved the connection and transportation conditions of people and goods. Electricity and light bulbs replaced candles, and electric generators steamed the machines. Alexander Graham Bell found the phone in 1876, ten years later (1886) Karl Benz patented the world's first car, and ten years later (1896) Henry Ford made his first car with many invested efforts. To address this challenge, Ford redesigned the plant by creating workstations, in which cars were assembled in stages, i.e. from station to station. The parts for the stations were delivered by conveyor belts and were at the same time the first assembly lines (production lines). Along with increasing automation in factories, the world was faced with massive employment.

The Third Industrial Revolution was triggered by the invention of a microprocessor that was developed in 1969 by Intel. Further, the microprocessor led to the invention of the personal computer. These first computers were usually very simple, cumbersome, and incredibly large compared to the computing power they could provide, but they laid the groundwork for today's world that is hard to imagine without computer technology. Personal computers (PCs) monitored and revolutionized the workplace, and from that point on, complex and repetitive tasks were performed by programs that provided process orientation and automation both in the office and in the production line (Muir 2018). Industry 3.0 has introduced multiple automated systems on the assembly line to perform human tasks, i.e. using programmable logic controllers (PLCs). Although automated systems existed, they still relied on human input and intervention (Jenis 2019).

Material Requirements Planning (MRP), Customer Relationship Management (CRM), Supply Chain Management (SCM), Business Intelligence (BI) are just some of the terms that have become familiar and became the ways of collecting and understanding information while allowing businesses to be more efficient. The Internet was used as a platform for transmitting this information, leading to the emergence of cloud computing and e-commerce (Muir 2018).

Cyber Physical or connecting technology to humans is known as the Fourth Industrial Revolution, and the daily need to use a mobile phone, tablet or life management device is its beginning. This revolution is the age of smart machines, storage systems, and manufacturing facilities that can autonomously exchange information, initiate actions, and control one another without human intervention. Information sharing is enabled by the Industrial Internet of Things (IIoT). According to Jenis (2019), key elements of Industry 4.0 include the following: Cyber-physical system, The Internet of Things (IoT), Cloud computing and Cognitive computing. Muir (2018) states that the Fourth Industrial Revolution is not only a technology platform, but it also meant advances in communication and connectivity, such as 3G to 4G to 5G. It is also stated that changes in production, such as 3D printing, will stop us from transporting finished products worldwide, but instead we will transport raw materials to be then printed and assembled locally.

Industry 4.0 is surely leading to Industry 5.0 when you start allowing users to customize or personalize what they want, which has already happened and is happening to us (Figure 1), meaning that the Fifth Industrial –AI revolution has already begun.

Figure 1: The Industrial Revolutions - 1.0 to 5.0
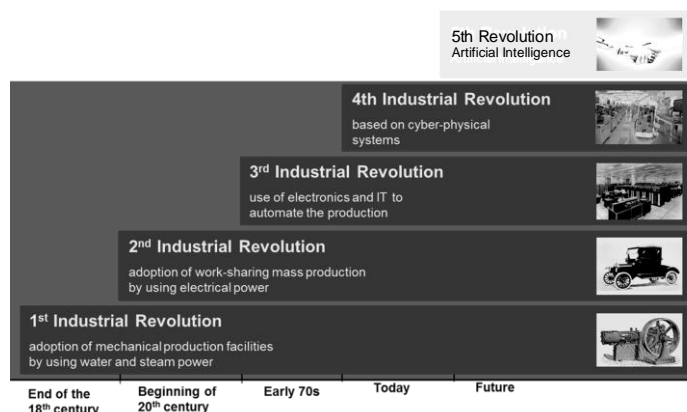
Source: Vollmer 2018

The Fifth Industrial Revolution focuses on the return of human minds and hands within the industrial framework. Thus, Industry 5.0 is a revolution in which man and machine are reconciling and finding ways to work together producing perfect products at an unprecedented speed (Jenis 2019, Lewis 2017). Why? The answer is very simple: we live in a time when consumers want more, mass production is no longer sufficient, mass customization is sought, which can only be obtained when human touch returns to production, and this is the essence of Industry 5.0 (Østergaard 2019). In his paper, Østergaard (2019) states that the products of Industry 5.0 empower people to realize the basic human urge to express themselves (even if they have to pay a premium price to do so). Making these and such personalized products requires what we call the human touch. Of course, greater product personalization is not inherent in some industries, but the human role in the business case of digitization and automation is the moment we live in (Olsevska 2019).

At the same time, Industry 5.0 may be more environmentally friendly as companies develop systems that work on renewable energy and eliminate waste (Jenis 2019; Lewis 2017).

3. THE WAY TO THE (UN) KNOWN: WHAT IS THE FIFTH INDUSTRIAL - ARTIFICIAL INTELLIGENCE (AI) REVOLUTION?

Like it or not, we are at the beginning of the next wave of the industrial revolution, because the Fifth Industrial - AI Revolution has already begun. Back in 2017, Andrew Ng, Stanford Adjunct Professor, said: *"Just as electricity transformed almost everything 100 years ago, today I actually have a hard time thinking of an industry that I don't think AI will transform in the next several years."* (Lynch 2017), that is, he told us: *"Artificial Intelligence is the New Electricity"* (Synced 2017).

Although this is an extremely important issue for all of us, the society as a whole, the economy, it seems that the academic community is slow to react, because the scientific and research work in this area is still in its infancy. However, lately, this topic has been increasingly written and talked about inside and outside the traditional academic debate, so many of the debates about AI - Industry 5.0 will come across Blogs, Web portals, social networks, popular books, newspaper articles, and somewhat less frequently in scientific and professional papers and journals.

That is why this part of the paper presents a theoretical discussion of AI, then Industry 5.0, its drivers and what it brings to us. The first subsection deals with the EU's views and recommendations on AI, and the spectra of AI, while the second one provides discussions of scholars and practitioners on the substance of Industry 5.0.

3.1. European Union and Artificial Intelligence: A European Approach and Definition of AI

The European Economic and Social Committee (EESC), an EU consultative body, acknowledged that Europe is lagging behind the USA and China in the field of AI, and called for speeding up the development of AI and robotics in the region. In order to overcome this problem, a unique European approach to AI has been created, which will be discussed further in this paper. According to the EESC, *"The EU should embrace the era of digitalization wholeheartedly for the sake of consumers, manufacturers and employees alike"* (EESC 2018).

Europe's AI approach aims to increase EU competitiveness while ensuring confidence based on European values. The European Commission (EC) has already made significant efforts and resources to bring benefits to European society and the economy (EC 2019a).

In its Communication "Artificial Intelligence for Europe" issued in April 2018, the Commission outlined its approach to AI, which is based on the following three pillars (EC 2018a):

The first pillar entails strengthening the EU's technological and industrial capacity and embracing AI in the economy, both by the private and public sectors;

The second pillar represents the preparation for socio-economic changes brought by AI;

The third pillar refers to ensuring an appropriate ethical and legal framework, based on the Union's values and in line with the Charter of Fundamental Rights of the European Union.

EC's opinion is that AI has become a strategic area and a key driver of economic development that can bring solutions to many social challenges from treating diseases to reducing the environmental impact of agriculture, with its socio-economic, legal and ethical impacts having to be considered in detail. For this reason, it is necessary to work with the combined forces in the EU to stay at the forefront of this technological revolution, and to ensure competitiveness and create conditions for its development and use, with a mandatory respect for European values (EC 2019a).

Therefore, on 10 April 2018, 25 European countries signed the Declaration of Cooperation in AI (EC 2018b), which was further upgraded to the achievements and investments of the European AI research and business community. Then, working together, the EC and Member States published a Coordinated Action Plan on AI Development in the EU on December 7, 2018, with the aim of promoting AI development in Europe (EC 2018c).

Under this Action Plan, it is necessary to develop citizens' trust in AI, and in order to gain this trust AI will need to respect ethical standards that reflect European values. It is suggested that decision-making must be understandable and human-centered, which in the coming period requires a broad, open and inclusive discussion on how to use and develop AI both successfully and ethically sound.

On 18 February 2019, the Council of the European Union (EUCO) adopted conclusions on the Coordinated Plan on the Development and Use of AI Made in Europe, emphasizing the key importance of encouraging the development and use of AI in Europe, by: increasing investment, strengthening excellence in AI technologies and applications, as well as enhancing collaboration between industry and academia in this area and in the field of research and innovation (EUCO 2019).

To define AI, the EC proposes to use a new updated definition created for its needs by the Independent High-Level Expert Group on AI (AI HLEG) established by the EC in June 2018, which reads (EC 2019b, 6):

„Artificial intelligence (AI) systems are software (and possibly also hardware) systems designed by humans that, given a complex goal, act in the physical or digital dimension by perceiving their environment through data acquisition, interpreting the collected structured or unstructured data, reasoning on the knowledge, or processing the information, derived from this data and deciding the best action(s) to take to achieve the

given goal. AI systems can either use symbolic rules or learn a numeric model, and they can also adapt their behaviour by analyzing how the environment is affected by their previous actions.

As a scientific discipline, AI includes several approaches and techniques, such as machine learning (of which deep learning and reinforcement learning are specific examples), machine reasoning (which includes planning, scheduling, knowledge representation and reasoning, search, and optimization), and robotics (which includes control, perception, sensors and actuators, as well as the integration of all other techniques into cyber-physical systems)." (EC 2019b, 6).

Finally, given that the EC has already modified and updated the definition of AI, we conclude that defining AI is obviously tricky (FIBR 2018), and dare we say it is almost impossible, since it is an ever-evolving area moving forward. Defining AI means knowing what lies ahead for us, and none of us have such privilege and power. Therefore, any attempt to define AI seems to be an attempt to capture the elusive. Since, in our view, the definition of AI is currently elusive, we appreciate that for the sake of a better understanding of AI and the considerations that will follow in this paper, it is useful to list AI spectra, which according to FIBR (2018, 8-9) are as follows:

First spectrum AI is automation i.e. manually crafted automation, such as macros (programs do not "think" or make decisions beyond pre-programmed rules); second spectrum is classical statistical and traditional programming (techniques or programs to draw inferences based on quantifiable probability of a relationship); third spectrum is ML and Robotic Process Automation (RPA) - systems that allow computers to improve with additional time and data; and the fourth spectrum is Artificial General Intelligence (AGI) - machine intelligence that can perform the same intellectual tasks as humans.

Finally, there are opinions, which we also fundamentally agree with, suggesting that the AI and ML (the current application of AI, which is based on the idea that we need to give machines access to data to extract patterns from them, that is, learn on their own)) are two sides of the same coin that is often used interchangeably (Njegovanović 2018, 59).

3.2. What is Industry 5.0 and what does it bring us?

And while the scientific circles debate whether Industry 4.0 has just finished, is ending, whether Industry 5.0 has started, or whether it will start in 2020, whether it is a continuation or just a shade of Industry 4.0, Japan has gone the furthest, which in 2016 instead of the term Industry 5.0 introduced the term "Super Smart Society" (Society 5.0), offered by Keidanren, the most important Japanese business federation (Keidanren 2016), thus extending the digital transformation from industry to "Super Smart Society" being strongly promoted by the Council for Science, Technology and Innovation; Cabinet Office, Government of Japan (Nirmala 2016).

Skobelev and Borovik (2017, 307) argue in their paper that the convergence of modern technologies - from IoT to AI has enabled the transformation from Industry 4.0 to Industry 5.0, which they see as the penetration of AI into human life, and their "collaboration" in order to increase man's capacity to return to the "Center of the Universe".

In order to understand Industry 5.0, it is necessary to clarify three key things, which Fazzi (2018) states in her paper, which, according to her, are:

First, Industry 5.0 is about humans, not robots, because they are designed to help and improve people's lives. For this reason, the term "cobots" is used for universal term robots, which is an abbreviation of collaborative robots, to emphasize the importance of humans and their primacy over robotic technology. Further, the production process can be simplified through automation and cobots, which will allow humans to create something special and

unique - personalized, meaning that the use of robots will actually restore the human factor to production.

Second, Industry 5.0 is designed to optimize human efficiency and productivity. The interconnection of machines and systems for optimal performance is characteristic of Industry 4.0, while such efficiency and productivity is further enhanced by refining human-machine interaction in Industry 5.0. Industry 5.0 identifies the need for human-machine connectivity to meet the complexity of manufacturing in the future, and addresses this by increasing adaptability through an optimized robotic manufacturing process. However, this combined human and robotic workforce will seek a new executive role, i.e. someone who will be responsible for planning and managing all activities related to robotics and intelligent operating systems - chief robotics officer (CRO).

Third, Industry 5.0 is inevitable because when it comes to technology, there is no turning back. However, the author suggests that there are basic issues that policy makers need to address in the near future, which she sees as the impact of "extreme automation", systemic risks such as complete network collapse, risks of creating a new social and political structure as a consequence of extreme connectedness and many others, to which Özdemir and Hekim (2018) also point out in more detail in their paper.

A very succinct, yet crystal clear explanation of the cause and substance of Industry 5.0 is found in Olevska's paper (2019), which states that our current market trends towards a higher degree of individualization have already led us to a mass adaptation of products and services. However, human creativity is impossible to standardize according to predefined rules and characteristics. Customers have become increasingly demanding and sophisticated because they are still looking for something "unique", so this very opportunity to create and offer something special for many companies is a key value. According to the author, this is where the human factor enters our systems of the future, creating mass personalization - individualized interiors of cars, pieces of furniture, jewelry, shoes or clothing. Which again means that machines will require guidance and, in some industries, the return of the right craftsmanship to allow personalization of each product. On the other hand, this means an increase in the number of cobbots working in harmony with humans and this would be Industry 5.0's second projection. Cobots serve as multi-tools and take on all the monotonous and difficult tasks, leaving room for human skill and flexibility. The AI system that comes with the robots may at some point make decisions at the speed of light, it will be entrusted with operational problems, but the machines will still serve humans, and that's the essence of Industry 5.0 (Olevska 2019).

Finally, one of the world's leading experts in robotics today, Esben Østergaard, who at the beginning of his career worked as a research scientist at USC Robotics Labs in Southern California and at AIST in Tokyo as a visiting researcher, and then was one of the founders and inventors of Universal Robots, which is the market leader within cobots, who is also a key note speaker about robotics in our opinion provides the most comprehensive explanation of the drivers of Industry 5.0 and its essence (Østergaard 2019). According to Østergaard (2019), the psychological and cultural driver of the Industry 5.0 is personalization of products and services. He thinks that Industry 5.0 is in fact an industry where man's/human psychology transcends technology and puts it into its own use. Why and how? People want to be seen as unique, to stand out, differentiate and express themselves through their choices - including their shopping choices. Now, for the first time since the beginning of the industrial age, this is possible, as technologies are available that allow people to express themselves as individuals through personalized products. In addition, it is not just low-tech products, it can be any product that can send the right signals, and it is not only products that can be afforded only by the super-rich, but also any product available even for people with more modest income. In other words, making products for Industry 5.0 - personalized products takes what we call human touch, and these products empower people to understand the basic human need to express themselves - even if they have to pay a higher price for it. Of course, mass

personalization trends and related trends do not apply to all types of products, because there is a huge number of product types that no one wants to personalize when these products can be produced at minimal cost in the traditional way (Østergaard 2019).

The personalized products that consumers will most demand and pay the most for are the products that carry the distinctive mark of human care and craft (fine watches, craft beers, designer items of all kinds). New consumers are not bothered by the fact that automation is part of the production process, on the contrary, they embrace technology, but they also seek personal footprint, the stamp of human design and craft skills, and the effort to produce something new and special. They are looking for personalization, a sense of luxury, and that's what Industry 5.0 provides them with. However, the logical question that arises is how designers and craftsmen produce the products that today's consumers are looking for and want to buy and that meet their high standards, and what is the price they are willing to pay to afford such products. According to Østergaard (2019), a good part of the answer to this question lies in AI i.e. cobots. He argues that cobots are exactly the tools that companies need to make personalized products of the kind consumers want today. Cobots are essentially power tools that enhance human skill with the necessary precision and speed to create modern products with human touch and thus make Industry 5.0 give consumers the products they want today.

4. THE GROWING IMPACT OF AI IN THE FINANCIAL SECTOR

AI, as a symbol of the present and future of the financial sector, affects all areas it covers, in which the speed and accuracy of digital computing are becoming widespread (Njegovanović 2018, 59). Modern financial operations would be impossible without digital technology and algorithms capable of processing and analyzing the vast amount of data that come from the existence and day-to-day operations of financial institutions and markets. For this reason, and for many other reasons, the financial sector, besides the High tech and telecommunications sector, Automotive and assembly is one of the early adopters of AI (Bughin et al. 2017).

In addition, the Microsoft Report, based on surveys and/or interviews by AI leaders in 277 companies, in 7 sectors, including the financial services sector, in 15 European countries, made by Ernst & Young (EY) says that the companies currently leading in terms of AI maturity among other is Financial Services (Microsoft 2018, Kiebdoj 2018). Of all the 7 sectors surveyed in this survey, the Financial Services sector has shown that it expects the largest percentage of business benefits from using AI in its business in the future, mainly in all areas considered. More specifically, in the part of the Report that looks at the benefits of using AI in the Financial Services sector, the answers to the question of what business benefits companies in this sector expect to generate via AI, were that the following percentage benefits are expected in these areas: attracting clients/customers - 78%, business optimization - 84%, employee empowerment - 67%, and product and service transformation - 73% (Microsof 2018, 48-49).

The fact is that we live in a time of driverless cars, virtual agents, smart homes, face recognition and speech and whatnot. We are currently experiencing the beginning of a new industrial revolution (all in their own way), in which AI and ML are at the forefront seriously transforming society and the economy. Therefore, a logical question arises, which also coincides with our research question, that is: how is AI transforming the financial sector?

In order to have a fuller understanding of the impact of AI on the financial sector and to respond as fully and successfully as possible to the defined research question, this paper will first consider where AI is used in the financial sector today, and what are the leading AI applications that are transforming and enhancing the financial sector.
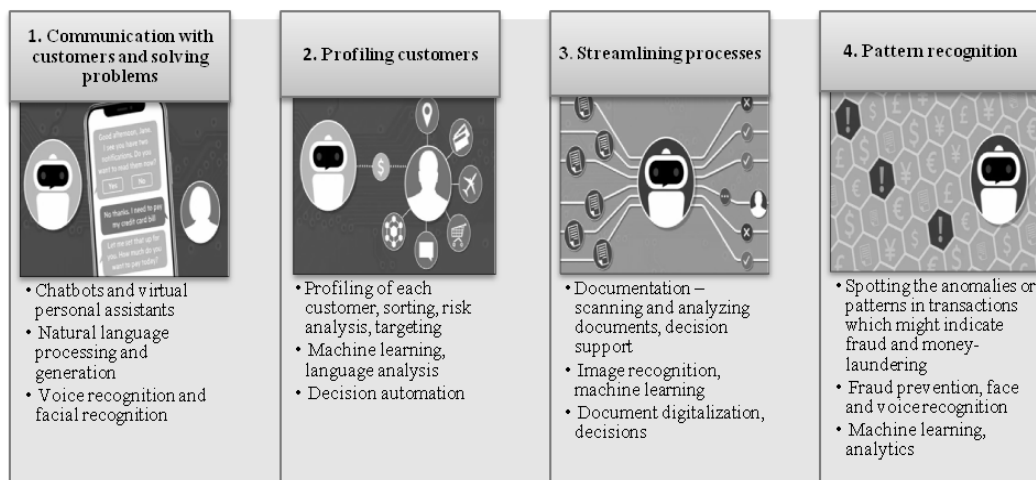
4.1. AI in the financial sector today

Recently, the financial sector is experiencing a revolution in its day-to-day AI-driven business that is successfully used most commonly for customer interaction, analytics and decision support, and observing and recognizing behavior patterns to detect fraud and prevent money laundering (Georgiev 2018). Leading banks such as Bank of America, UBS, CitiBank, Morgan Stanley, HSBC, JPMorgan Chase, and Wells Fargo, have embraced AI to deliver a rich customer experience (Sharma 2019, Noonan 2018).

Bank of America introduced their own "JARVIS" (Iron Man). Being one of the oldest banks to provide mobile banking services, the firm has launched a new and unique enhancement called "Erica" - a virtual assistant helping customers 24/7 to address their one of a kind banking requirements. "Erica" is also supporting bank employees to address their complex customer needs (Sharma 2019). UBS has Amazon's digital assistant "Alexa" on customer service duty (Noonan 2018). CitiBank being a part of a huge corporation - CitiGroup is constantly investing in various startups and tech companies. To prevent various fraudulent activities in online and personal banking, they invested in Feedzai (Leveraging a unique ML algorithm to prevent fraud), which is a leading data science enterprise (Sharma 2019). Morgan Stanley has an AI fraud detection team, HSBC said it would follow suit by using AI to detect money laundering, fraud and terrorist funding (Noonan 2018). JPMorgan Chase is using robots (the invisible kind) to execute trades and an ML algorithm that will extract crucial information from thousands of legal documents and create valuable points for reviewers. It will help the company reduce 360,000 man hours. Finally, Wells Fargo is using AI-based Chatbots to meet their customers' needs faster and to improve client experience (Sharma 2019, Noonan 2018).

For the purposes of the 2018 survey, the Financial Times surveyed the world's 30 largest banks regarding their access to AI. Eighteen provided detailed answers to at least five of the 14 questions asked, five more gave descriptive answers about their AI-related activities, while others refused to participate (Noonan 2018). The obtained results show in which areas these banks use AI and they are presented in Figure 2.

Figure 2: Use of AI in the financial sector

1. Communication with customers and solving problems
- Chatbots and virtual personal assistants
- Natural language processing and generation
- Voice recognition and facial recognition

2. Profiling customers
- Profiling of each customer, sorting, risk analysis, targeting
- Machine learning, language analysis
- Decision automation

3. Streamlining processes
- Documentation – scanning and analyzing documents, decision support
- Image recognition, machine learning
- Document digitalization, decisions

4. Pattern recognition
- Spotting the anomalies or patterns in transactions which might indicate fraud and money-laundering
- Fraud prevention, face and voice recognition
- Machine learning, analytics

Source: Author's adaptation according to Noonan 2018 and Georgiev 2018

A somewhat different identification of the use of AI in the financial sector is found in Schroer (2019), which also lists the top 15 AI companies in the world that offer solutions in these areas. According to the statements made in this paper, AI is used in the financial sector in the following areas (Schroer 2019):

1. Personalized banking. Chatbots - AI assistants, use AI to generate personalized financial advice and natural language processing to provide instant, self-help customer service.
2. Credit decisions. AI solutions are helping banks and credit lenders make smarter underwriting decisions by utilizing a variety of factors that more accurately assess traditionally underserved borrowers in the credit decision making process.
3. Quantitative trading. AI is especially useful in this type of trading because AI-powered computers can analyze large, complex data sets faster and more efficiently than humans. The resulting algorithmic trading processes automate trades and save valuable time.
4. Managing risk. Financial markets are turning more and more to AI, or ML, to create more exacting, nimble models and it is these predictions that help financial experts utilize existing data to pinpoint trends, identify risks, conserve manpower and ensure better information for future planning.
5. Fraud detection and Cybersecurity. The need to ramp up cybersecurity and fraud detection efforts is now a necessity for any bank or financial institution, because every day, huge quantities of digital transactions are carried out via online accounts and smart phone applications, and AI is playing a key role in improving the security of online finance.

To date, in Europe, more than a dozen banks have replaced older statistical modeling approaches with AI/MI techniques and, in some cases, experienced 20 percent increases in cash collections, 20 percent savings in capital expenditures, 20 percent declines in churn and 10 percent increases in sales of new products. The banks have achieved these gains by devising new recommendation engines for small and medium-sized companies and clients in retailing, they have also built microtargeted models that more accurately forecast who will cancel service or default on their loans, and how best to intervene (Pyle and San José 2015).

In view of the foregoing considerations, we can conclude that the cases of AI use in the financial sector today are as follows (Njegovanović 2018, 59):

Institutions have optimized capital deficiencies with AI and ML techniques such as back-ward testing models and large-market trading impact analysis.

Suppliers and financial institutions who use the learning method and methods of learning machines to evaluate credit quality, pricing and market contracts and automate client interaction.

Public and private sector institutions can use these technologies to regulate compliance, monitoring, evaluation of data quality and detection of fraud.

Broker traders, hedge funds, and other companies using AI and ML to find signals for larger (and non-corrected) returns and optimization of trading execution.

With the implementation of AI/ML, the financial sector now has the ability to meet the demands of digitally aware and enlightened clients who want more affordable, smarter, safer ways to save, spend and invest their money (Schroer 2019). A number of AI applications used in the financial sector play a key role in realizing these opportunities, transforming it day by day, and so in the continuation of this paper we shall provide an overview of the leading ones.

4.2. AI-influenced financial sector transformation

The financial sector is one of several sectors that has long been adopting and adapting AI applications in accordance with its needs. Namely, most of the applications of AI already exist and are fueled by technological advances, financial sector infrastructure, data availability, and demand factors such as competition with other companies, the need for profitability, and financial regulation requirements (Njegovanović 2018, 59). However, the

leading applications of AI that are transforming the financial sector and have the potential to radically improve a number of functions in the financial sector are as follows:

In-app Banking Experience. Today, most banks have at least one mobile application for occasional banking operations such as transactions, checking balances, printing statements, ordering new cards and the like. However, a small number of banks use AI in their applications to provide a rich user experience, AI chatbots can help banks provide personal assistance to their customers. It is the chatbots that help clients automate simple tasks such as opening a new account, paying bills, transferring cash between accounts (transfer orders), and processing various applications (Sharma 2019).

Smart Loans. AI finance technology has been uniquely designed to tackle the problems facing the lending market and is disrupting the loan-underwriting process and hence the lending industry as we know it (Amery 2018). Banks provide loans to their customers based on a credit-scoring system (Sharma 2019). AI finance technology has the ability to capture complex patterns in customer's data analyzing many aspects (such as business and personal finance, credit score, revenue, etc.) to find borrowers that are more likely to default (Amery 2018). In short, the new AI-based credit scoring system will collect wealth data from smartphones of underbanked customers to identify their creditworthiness and these alternative data points will provide new means for such customers to access credit from financial institutions (Sharma 2019).

Smart Sales Processes. Intelligent systems such as chatbots can act as a virtual salesperson. While sales executives have a number of limitations such as industry knowledge and working hours, etc. chatbots have no such limitations and can answer all customer questions 24/7 as long as the information is available in the database, based on a unique algorithm that will help you negotiate with your customers seamlessly without human intervention (Sharma 2019) .

Algorithmic trading (Automated Trading Systems). Involves the use of complex AI systems to make extremely fast trading decisions (Njegovanović 2018, 60). In order to determine the future of stocks, institutional investors and investment companies today no longer rely on market experts but on data scientists who create complex ML algorithms that are capable of finding future patterns in the market by observing the patterns in historical data. These algorithms can be taught to identify triggers for anomalies happening in the market. Sharma (2019) states that in addition to institutional investors, individual investors can also use AI in deciding when and what stocks to buy, sell or hold.

Algorithmic systems. Algorithmic systems often create thousands or millions of trades in one day. However, it takes months to identify malpractices such as market manipulation, money laundering, foreign regulatory compliance, etc. despite each financial institution facing a high degree of scrutiny. Most financial institutions and hedge funds uncover their AI approach to trading but it is believed that ML play an increasingly important role in calibrating real-time trading decisions (Njegovanović 2018, 60).

Risk Evaluation. AI is rapidly taking over banks' financial risk functions as the tasks are relatively straightforward, and data to train on is ample (Danielsson, Macrae and Uthemann 2019, 3). In addition, AI will improve risk assessment and so will contribute to this source of homogeneity of risk management techniques (Danielsson, Macrae, and Uthemann 2019, 16).

Transaction Data Enrichment (TDE). According to Sharma (2019) TDE transforms difficult-to-understand transaction information into easy-to-understand and helps customers monitor things like budgeting, credit scoring, spending habits, analyzing and predicting spending and earnings of the future.

Portfolio Management. Robo-consultants or robo-advisors are algorithms built to calibrate the financial portfolio's goals and tolerance at user's risk (Njegovanović 2018, 60). That is, the AI algorithm predicts what the customer's financial condition will be if it

continues to spend and invest money like the way it is doing, and can also act as a personal financial advisor to the customer by providing them advice as to how it can improve his financial condition (Sharma 2019).

Personalized Wealth Management. It means introducing an in-app personalized wealth management system by the financial sector. According to Sharma (2019) these are AI-powered advisors who continuously learn from our financial activities and provide the best advice to customers, similar to what a relationship manager would do.

Fraud detection. Everyday business in the financial sector today cannot be imagined without the Internet. And this means that the financial sector is making more and more global transactions through the network, then storing valuable data online, which leaves room for risk of data security and financial fraud over the Internet (Njegovanović 2018, Sharma 2019). Unlike traditional online fraud detecting algorithm, AI-based algorithms consider much more data points to identify fraud (Sharma 2019). This is why AI can proactively detect whether fraud is going to take place in a financial system or not and makes it a point to keep all things secure and take steps towards safety before any chances of fraud can occur (Parakh 2018). As stated in Sharma (2019) AI-based algorithm helped payments of giant MasterCard to reduce fraudulent activities by 50%.

5. DISCUSSION AND CONCLUSION

Evolving technologies have always had a great impact on the different sectors in which they are being applied because of their ability to improve existing manufacturing processes, services, customer experiences, and the like. Following tremendous success in sectors such as manufacturing and retail (Sharma 2019), AI is now revolutionizing the rapidly changing financial sector with the expectation that these changes will increase efficiency and reduce costs (Danielsson, Macrae and Uthemann 2019, 3). Few sectors beyond the financial sector are struggling to adopt AI because they face many challenges such as cyber risks on the rise, customers getting more demanding, increasing competition and regulations getting more stringent (Vashisht n.d-), and AI with its own techniques enables them to make improvements and advancements in all fields that will be of great benefit to clients/customers and the entire financial sector (Parakh 2018). AI offers the financial sector a new way of dealing with financial fraud, building confidence and creating a secure financial atmosphere. New forms of AI are constantly being introduced so that fraudsters are quickly and effectively blamed and caught, and thanks to these new technologies, AI can identify anomalies or patterns in transactions that may indicate money laundering, fraud, and/or terrorist financing (Wall Street 2019). Other potential future applications of AI in the financial sector lie in the area of customer service and financial product sales. In addition to the role of AI in improving customer experiences, it is expected to play a significant role in the sale and recommendation of financial products, because as a robo-advisor it will be able to recommend portfolio changes (Wall Street 2019), and it is also expected that the use of AI could become commonplace in the future to select the right policy life insurance (Pickford and Warwick-Ching 2019). In terms of personal finance, it is anticipated that people will be able to manage their personal finances through a financial "dashboard" that allows them to view all their key financial data in real time (Pickford and Warwick-Ching 2019).

In addition, AI and its technologies are very likely to have a major impact in the future on employment and the creation of new professions in the financial sector (Stanford University 2016, 38). However, it is currently impossible to accurately assess these impacts, whether positive or negative. Noonan (2018) states that former Citigroup chief Vikram Pandit predicted 30% of banking jobs could be wiped out by AI in five years, which is similar to KPMG predictions that up to 75% of jobs in the financial services sector are very likely to be performed by robots in the next 15 years (Amery 2018). Then, Mizuho Financial Group in

Japan says it will use AI to replace about a third of its workforce (19,000 people) by 2027 (Noonan 2018). It is clear that under the influence of AI, the entire financial sector is completely changing in all segments, including in the jobs and employment segment, and understanding these changes should give us insight into how AI will affect future labor demand, including changing demands for skills (Stanford University 2016, 38). A Stanford University report (2016, 38) states that AI is more likely to replace people in certain tasks rather than jobs in the short term, and will create new types of jobs that are harder to imagine than existing jobs that are likely to be lost. And global leader in consulting, technology services and digital transformation Capgemini found that 80% of organizations using AI went so far as to actually create even more jobs (Amery, 2018). It is expected that something similar will happen in the financial sector, i-e. that AI will also create jobs, especially in certain segments of the sector, making certain tasks more important and creating new categories of employment by enabling new ways of interacting (Stanford University 2016, 38).

Furthermore, AI use cases in which financial experts see value vary depending on the size, location, and type of financial institution (Maskey 2018), and due to the high cost of technology, the latest AI techniques are unlikely to be adopted equally and evenly across the financial sector across the world. Smaller financial institutions and organizations will not only have smaller budgets, they will also be at a disadvantage and more disadvantaged due to the lack of data (Pickford and Warwick-Ching 2019). The volume of day-to-day interactions of a large financial institution with clients will create a much more powerful data set, which is the raw material of AI applications than a small financial institution located in a developing country, which provides the former with multiple benefits for the application of AI. For example, large banks are constantly under pressure to attract new and retain existing customers, so they logically look at the continuous improvement of their products and the automation of customer service by chatbots; insurance companies improve AI risk models; hedge funds are chasing alpha coefficient with AI on top of new layers of data sources (Maskey, 2018). Many financial institutions and organizations in developing countries are still stuck in deploying data infrastructures in a way that enables them to use AI (Maskey, 2018), indicating the fact that AI is unevenly applied in the financial sector globally.

The Financial Stability Board (FSB) considers the impact of AI on the financial sector and financing practices to be largely positive (FSB 2017, 2) and we fundamentally agree. However, in addition to the myriad opportunities and benefits provided by AI, some AI innovations can counter the other issue - data privacy, then can lead to potential threats to the financial sector and destabilize the market in just a few milliseconds (Pickford and Warwick-Ching 2019, Njegovanović 2018, 59). This is why AI sophistication requires strong regulatory mechanisms for data security and market integrity, and adequate regulations and policies that will prevent algorithmic failures without affecting the possibility of further development of innovation (Njegovanović 2018, 59). On the other hand, the European approach to AI emphasizes that AI has become a strategic area and a key driver of economic development that can bring solutions to many social problems and challenges, and points to the importance of stimulating the development and use of AI in Europe while ensuring an appropriate ethical and legal framework, based on Union values and in line with the Charter of Fundamental Rights of the European Union. Finally, we can conclude that AI brings many good and useful things to the financial sector, but only if the specific risks of AI are specifically managed (FSB 2017, 2).

As the issue of AI and its application in the financial sector is a hot and current topic, and it is well known that academia with scientific papers on these topics is usually a little late because of the publication procedures, what can seemingly be a limitation of this research (lack of scientific papers from this area) has been replaced by the blogosphere - expert opinions and comments, Financial Times, Forbes, Microsoft, conference presentations, reports from organizations and institutions, AI sector insiders, owners and founders of AI

companies, etc. literature available online. This means that technology is not late and with technology we are repairing other defects and repairing things/users

experiences, similar to finance and AI. By trying to avoid a "sensationalist approach" (WEF 2018, 2), we can conclude that the long-term impacts of AI on the financial sector and finance in general can be even more radical and transformative than it seems at the moment and as it has been presented in this paper. The new era in AI-influenced finance has just begun.

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