

GENERAL IMPLEMENTATION PROCESSES OF ARTIFICIAL INTELLIGENCE AND ITS ECONOMIC EFFECTS IN HUNGARY

Ilkin Seyidzade¹ and Dr. Rudnak Ildiko²

¹Ph.D. student at Szent Istvan University, Godollo, Hungary,

E-mail: ilkin.seyidzade@gmail.com

²Dr. Associate professor at Szent Istvan University, Institute of Social Sciences,

Godollo, Hungary, E-mail: rudnak.ildiko@gtk.szie.hu

Received 10 January 2019; accepted 20 May 2020; published online 10 July 2020

ABSTRACT:

In the modern scientific world, Artificial Intelligence (AI) and its widespread use are being broadly investigated. However, while some countries have already excelled in implementing AI in the business environment, others are in the stage of developing and learning the process. Hungary is one of the countries where AI is expected to have a bright future has also joined this process. The main goal of this research is to investigate the steps that are crucial in the implementation of AI-based models in the business. Furthermore, the Hungarian approach has been researched as a case study to give a better image of the governmental approach towards the new technology. The authors investigate the primary requirements of AI implementation in general, in line with the steps that take to the successful implementation. Moreover, the difficulties and criticism of the new technologies have been researched to see their relevance in the Hungarian case. The author has also learned about the economic effects of AI in Hungary, and the industries in the country that have already applied to use it. Furthermore, government incentives and efforts, together with current trends in the country have been presented to the reader.

Keywords: Artificial intelligence; computer; future perspectives; new technologies; Hungary

JEL Classification: O30, O31, O38, O52

INTRODUCTION

Nowadays, Artificial Intelligence (AI) is present in almost every aspect of life and has a significant impact not only on our lives and work but also in providing the foundations for a new, innovative business model, a new technological milestone. New goods are being implanted as virtual assistants, whereas chatbots are replying client inquiries on everything, the use of automatic and robotic tools is characteristic of almost every field of manufacturing and production.

While emerging and developing technology may not be fully understood, but of increasing importance, it is almost a basic requirement in business as it intensifies competition in various industries. Those who do not have the appropriate technological capabilities will be left behind, eliminated from the competition, so every company needs to keep up the pace. Of course, there are both advantages and disadvantages of the new technology options, which should always be assessed, the same way as the resources and tools available, and the difficulties of the implementation. AI is globally present, not only within a country's borders but also internationally. The purpose of this study is to analyze the technological situation of a country, Hungary and the areas of the AI used. The dissertation tries to explore which industries use AI, what the benefits are, what difficulties do Hungarian companies face in implementation and integration of AI, and what possibilities and opportunities AI brings and holds for the future.

Requirements of AI implementation

Although AI is gaining popularity, many companies have not heard of it or do not know exactly how it works, what it is good for and how to use it. For the companies to get to know if they need this technology, they need to identify the problem. AI is not just about data; it is about understanding the relationship between data acquired and the problem to be solved. There are 3 main aspects to consider: consistency, completeness, and compactness. Consistency mentions the significance of standardization to avoid analytical problems. Equally important is the availability and readiness of a complete data set. And compactness involves the concision and singularity of data and information. If these three components are not available, likely, the AI-based model will not work properly. However, implementing AI is not such a simple process, companies should always try to build from the bottom up after defining the concrete goals. A proper and extensive IT system and structure within the company is also essential, which includes servers, proper data storage capabilities, and the right methods to run code and algorithms (Shuja, 2017).

Also, there are a few other requirements that must be met to properly implement an AI system, mainly by evaluating existing system requirements and data. By analyzing data sets, the following checks are required before starting the implementation. In fact, what data is needed to be successfully executed and which of these data is available internally and externally. Besides, it is necessary to examine how up-to-date these data sets are and how often existing data is updated. Comparing and combining all data sets takes approx. how long it takes to get a full picture of them. It also helps you determine how often your business model will need to be updated. By creating data models, the company makes a major

contribution to unlocking its hidden resources, as well as providing significant help in controlling data flow. Designing and executing AI models thus not only provide insight into useful information for the company but also help leverage effective business information and get the best quality data. Because AI can handle many different types of data (data with different wording, style, content, and length), the tagging process makes it easy to distinguish between these data sources. Once the records from multiple data sources have been merged, the unification mechanisms will then be able to update the data in time. Last but not least, there is a need for a validation process consisting of validating the model and the indicators. Regardless of the industry in which AI is wanted to be implemented and integrated, meeting these requirements is an important part of the preparation phase and proves useful in the practical implementation. (Kessler and Gwozdz, 2018).

However, it must not be forgotten that, in addition to assessing needs, problems, and objectives, infrastructure requirements must also be met. On the one hand, the transition to AI and integration will involve a significant financial investment, as it will be able to change the overall corporate structure and workflows to date. As technology becomes more complex, the cost of resources increases. Nowadays, cloud solutions and cloud technologies are the foundation of AI, so when choosing the right platform, the following should be evaluated.

- High computing capacity, which means proper performance computing, including CPUs and GPUs that are suitable for AI integration.
- Storage capacity is also important due to the increase in data volume, but in some cases, a company needs to consider whether it prefers a system with more capacity but slower, or a system with less capacity but faster. For the most part, AI solutions can work effectively when as much data and applications as possible are available.
- Network infrastructure, i.e. communication within the network, scalability, bandwidth, and uniformity.
- The security issue, i.e. the confidentiality of sensitive data such as e.g. in health care, the patient register, in the case of a financial institution, personal data, and financial information. Poor integration of AI can cause system vulnerabilities, but AI cannot work effectively.
- Cost-effective solutions. Nowadays, the more complex and advanced a system is, the more expensive it is. For the infrastructural performance to bring out the best possible and maximize, the company or unit performing the implementation must also take into account the continuous increase in costs. But also, after a thorough decision, it can be expected that the performance of the company will increase, which will even result in cost reduction if the AI is applied effectively (Hofstee, 2019).

AI implementation steps

For companies to keep up with their competitors and gain a market advantage, innovative technology must be integrated into the existing system. This can be a part of a given activity task or sub-process, or it can be the automation of an entire company and its activities. However, the implementation steps are worth going through, whether it is only a small project or a larger project (Kessler and Gwozdz, 2018). According to Gassman et al (2017), developing an AI-based business model is a series and set of interdependent activities aimed at creating enterprise value by defining specific goals and improving performance.

Firstly, it is worth getting to know what AI and what type of AI is requested by the company that wants to integrate the technology into the processes. What technology is needed, what resources, and what the purpose of implementing AI is? Almost all the information and online resources available today are at our disposal. It is necessary to recognize and identify the problems that the enterprise is facing and to identify the AI solutions that can be associated with the company's activities. Financial and business values must be distinguished and these particular values must be prioritized. In some cases, matrixes of potential and feasibility need to be ranked, and the goals and priorities recognized by the management of the company should be emphasized. Of course, there is a difference between what a company wants to achieve with AI implementation and what it can achieve based on its capabilities and resources. Identifying and organizing AI processes is the next step to eliminate capability gaps and needs to be further developed internally. In case the company is not familiar with the artificial technology used, it is worth considering to involve an external expert (Marvin and Horowitz, 2018). Before the implementation process begins, the definition of some milestones and metrics are needed. At this point, it has to be determined at what points the company wants to improve and what measures to improve. Defining indicators and forecasts will make the back-testing process much easier later (Kessler and Gwozdz, 2018).

Many people may think that there is a standard business model for AI implementation that is always applicable. In reality, however, much depends on what activities and when the company wants AI-based technology. Depending on the nature of the AI solution, it is based on huge amounts of data and algorithms. Besides, the implementation of the AI business model can be divided into two parts:

- Infrastructure: providing IT services to others.
- Application: companies develop application services for clients based on individual needs (Gonfalonieri, 2019).

3 AI solutions can be used, as shown in Table 1.

Table 1: Three categories of AI

Startups whose product simply could not function without AI at its core, whether they serve consumers or enterprises.	Startups providing AI tools and infrastructure (software and hardware) to all companies	Startups that use AI as part of a broader product or technology stack.
---	---	--

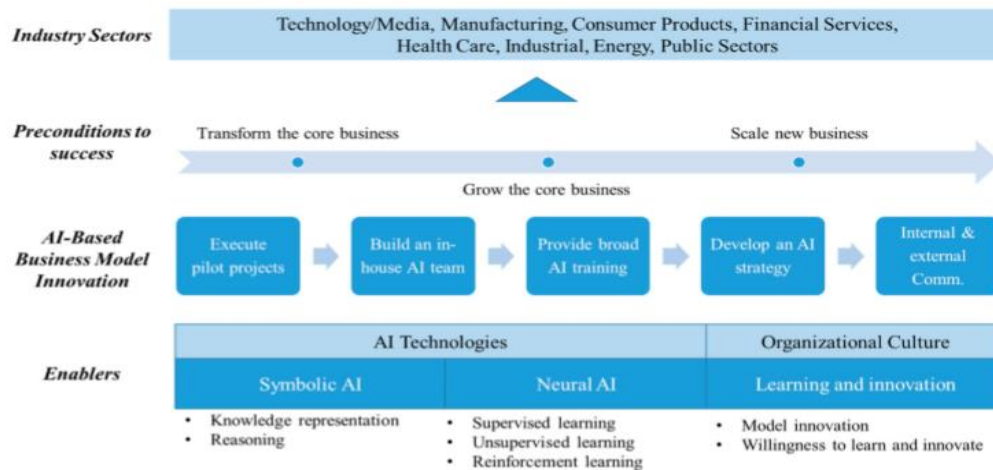
Source: Gonfalonieri, 2019

In the first case, the AI solution focuses on improving and optimizing current processes. These usually involve significant development and operational costs. In the second case, which is similar to SaaS, we are talking about interacting with other systems, such as CRM or ERP systems associating AI. The third case is the expansion of existing AI tools within the company. In every case, the existence of data is very important, but the companies do not need all the data, as they only have to count on the ones that answer the question to the problems that exist. On the cost side, when choosing an AI model, the costs must already be integrated into the business model (Gonfalonieri, 2019).

Once the work teams have been set up, AI integration should begin in small steps, be gradually rolled out to verify that the AI represents the expected value, and then, after verification and feedback, be continually extended to AI technology across the enterprise. It must be ensured that the new technology created does not replace the daily routine, but complements it. Keep in mind that employees may think AI is taking their jobs. Therefore, it is necessary to ensure that their scope and activities are expanded so that the AI complements and facilitates the execution of the tasks (Marvin and Horowitz, 2018).

According to Andrew Ng (2018), who is the chairman of Landing AI, for a successful implementation, a pilot project must first be implemented within an easy-to-implement project. Planning and merging teams is the second step, namely, the collection of an expert team but with the help of external experts, of course. The third step is to organize a comprehensive and detailed AI training for those affected. As data collection and appropriate structure design are essential, the development of an AI strategy is the next phase. Developing both internal and external communication is essential for implementing a business model and strategy and for proper interactions and cooperation.

Figure 1: Developing an AI-based business model



Source: Andrew Ng, 2018

Difficulties and criticism of AI technology adoption

Even though AI is appearing in more and more places and more and more people want to experience its benefits, it is gaining in popularity, yet there are still many challenges to be faced today. In addition to the benefits of AI implementation, Polachowska (2019) has also collected difficulties and problems from a business perspective, and her analysis includes the following.

Figure 2: The main obstacles holding back further AI adoption



Source: Polachowska, 2019

Based on the assessment of the author, the main adoption and implementation problems of AI is: The company culture does not recognize needs for AI in 23%; Lack of data or data quality issues in 19%; Lack of skilled people or hiring problems in 18%; Difficulties in identifying appropriate business use cases in 17%. Fewer hurdles with values below 10%: Technical infrastructure challenges; Legal concerns, risks or compliance issues; Efficient tuning of hyperparameters; Workflow reproducibility.

Based on these, the problems can be categorized as they are data, people, or business issues. However, all companies are diverse and work in different ways, so they see the occurrence of these problems otherwise and treat them differently. But in general, the following can be said about these problems.

In the case of data problems, this may include difficulties with the quality and quantity of the data. An AI system can work well if the data provided by the company are adequate, as the company itself is responsible for providing the data. For the AI to work, it is also needed to choose the right model for the system to work. It should be taken into account that not all data is available even to the company. In the case of hard-to-reach data, we can also talk about synthetic data, which, based on existing information, means artificially generated data, in which AI can also help. Another problem could be untagged data. Labeling is also possible within the company, but a company can choose to outsource the work in the form of data programming or use an existing data set. Another obstacle may be the explainability of the data. If the system provides a result that is not clear to the user or has not reached the same decision regarding the process, then AI technology may not meet expectations. Therefore, the company should choose a model that it knows for sure is transparent and also justifies the results generated by AI. In terms of bias, it is sure that the AI is not biased and has no opinion. However, if only data is available that man provides to the system out of bias, in his judgment, we already get a biased result. However, this is not the failure of AI, but human judgment. Because the system receives the wrong data in the event of bias, the results can also be erroneous, which is sometimes diagnosed as a system error. The more advanced the AI system, the more complex it is and so it can be difficult to determine and identify in retrospect where the error slipped.

In terms of people issues, two possible problems are worth highlighting here. One is that a lack of understanding of AI can hinder its proper functioning in many areas. If people who use the application do not accept the technology or do not understand how it works, it is impossible to achieve efficiency. The other hurdle is the lack of a professional in the field, those, who know how to apply the technology and can react

immediately in the event of a problem. In both cases, continuous education and training is required, or outsourcing a given task can also lead to results.

And last but not least, business issues should be mentioned. The lack of business alignment can even be linked to the people issue, as it means that the adoption of technology could not be incorporated into the corporate culture itself. Not only employees but also managers need to be required to understand AI so that it can be incorporated into corporate goals and strategy. The absence of AI knowledge may hamper implementation in several organizations. Choosing the right service provider is at least as important from a business standpoint, as the system can only be effective if it is used for actual business tasks and has the support. Before implementing AI development, it is advisable to examine what AI solutions providers can propose to the company and then evaluate and select based on that. And to overcome the integration challenges, it is worthwhile to go step by step during the implementation, because if the integration takes place at all levels of the company at the same time, it can even be detrimental. And finally, legal issues can be mentioned here. It is also worth clarifying from a legal point of view before implementation that e.g. what damage can the AI cause, whose liability is it? How to collect data? How to manage data? How to protect data? As there are no clearly adopted or enacted rules on them yet, it is necessary to clarify the legal aspects and fix them in a contract or agreement (Polachowska, 2019).

Concerning international security and international law, AI is currently an immature field that is now critical to nations, too. Since there are no limits to algorithms and there is no standard and universal control at the moment, there is no clear boundary between ownership and the origin of the data. Thus, for the time being, there is no consensus on all business models and their applications (Pandya, 2019).

According to Doucette (2019), according to a Gartner survey, around 85% of AI projects up to 2022 will produce flawed results due to rudimentary data management and algorithms. Some critics believe that AI will not deliver the hopes it brings and the expected values. On the one hand, initial models are not scalable or too experimental for use by any customer. Normal development processes receive insufficient emphasis, and transition and transition times are not suitable for finalization. Although some companies follow the project transfer steps closely, there is no proper workgroup and production support workflow. On the other hand, the transfer process may be inadequate, that is, innovation teams that are sharply separated from, and not accepted by, non-digital teammates. While an AI solution can meet the company's goals, the challenge is to use it within the company.

It is certainly worth noting and keeping in mind that the AI is not even advanced enough to be able to learn independently but rather is given the command to act. AI is not capable of transmitting emotions, and it scares humanity significantly. It is unable to perform functions and tasks that include any emotion (Martinez and Fernandez-Rodriguez, 2015). Lack of emotion can even be destructive and lead to a damaging situation. Also, it is typical that the AI employed can take risks and is unable to recognize the difference between positives and negatives. They also lack design ability because they lack consciousness and creativity. Although in some cases an AI solution may be creative, it is minimal, as creativity is less predictable and expectable and cannot be achieved by using and studying previous data. In the absence of past data, the AI is unable to get started or make a good decision because it is not trained in advance. AI is also incapable of transferring knowledge and, in novel cases, is unable to apply and use logic and ingenuity (Turan et al., 2018). AI systems can be disrupted even by a situation they have never encountered before. Because not all AI systems understand causation, they are not always able to connect events either. Sometimes it is necessary to re-teach how to do a task because a variable has changed. At this point, the AI may lose its existing expertise that was associated with the original task (Bergstein, 2020).

Singh (2017) estimates that one of the biggest problems is that the concept of AI is often confused with simulating a person with software that is equivalent to intelligence. The AI application is specific and does not necessarily correspond to the concept of simulation. Years ago, with the advent of 'big data', people were sadly unaware of the concept of real space. The effect of this extends to AI. The problem is that most of the data is unlabeled, so it does not mean quality, undistorted data. Unlabeled data is ubiquitous and will continue to be a major challenge. There are not so many scientific researchers, professionals, data scientists who can keep up with the spread of AI. In conclusion, there are no previous research results that could be effectively used for improvements. The models so far have only limited capabilities, so the capabilities of the appropriate AI implementations are not fully developed. It is still an untapped area because it requires a lot of additional research work. There is a broad context in the area of AI, and to be successful, all components and elements must be well defined and specified. This is still incomplete today.

Economic effects of AI in Hungary

Automation contributes to GDP growth in Hungary, as it increases productivity levels and also addresses labor shortages in certain areas (PWC, 2019). While GDP in Hungary declined after 1989 due to the transition, there was an increase between 1995 and 2009 as a result of improved capital investment and productivity. After the

transition, there has been a decline in GDP of about 20% and more than 1 million people have become unemployed. A large proportion of these people could not even get a job any time soon, and only capital inflows from abroad and government measures made it possible to reverse the economic downturn. The average GDP growth was 3.1% till 2008, and the number of the employed workforce was 3.85 million at that time. Following the economic crisis, despite the integration of automation processes, GDP growth has fallen to an average of 2%.

Between 2008 and 2010, the economy shifted from the public sector to a more productive service sector. This was followed by an increase in the number of employees, which contributed to GDP growth. In 2016, the number of employees was already 4.4 million, however, automation and AI technologies play a major role in this. AI provides an opportunity for employment to be achieved at a higher level if the issue of productivity is addressed in the right way and at the right time (Fine et al., 2018).

According to the PWC (2019) report, it is worth considering, from an economic point of view, the potential but also the threat of using AI. It is also worth examining whether the rate of return on technological innovation, which requires huge investments, will multiply. AI has long-term effects on the Hungarian economy, and it is estimated that by the year 2030, a quarter of jobs will be dominated by AI. In terms of value-added to the global economy, Hungary is a good place to conduct operations. AI technology helps the country deliver quality activities and values at a low operating cost. This can also provide the country with a competitive advantage and low-cost opportunities for higher wages. But this requires training in AI technology, defining the educational framework. It must be present not only in primary, secondary, and higher education but also in adult education. However, defining it in a business environment is just as important, in which the relationship between human effort and technology is supported by their (human-AI) collaboration.

Of course, automation has an impact not only on the economy but also on society. According to a 2017 annual survey, 38% of Hungarians have a negative view of the presence of automation, and social skepticism is more pronounced. Although Hungarians are one of the most negative nations on the topic of AI compared to the EU average, they can be reassured that automation will not appear immediately everywhere and the integration of AI into a business will only be moderate. On the other hand, it should be considered positive that AI does not take a job, but changes the structure of labor market or provides entirely new occupations and jobs, which can increase the added value and the income it earns (Fine et al., 2018).

Hungarian industries with AI

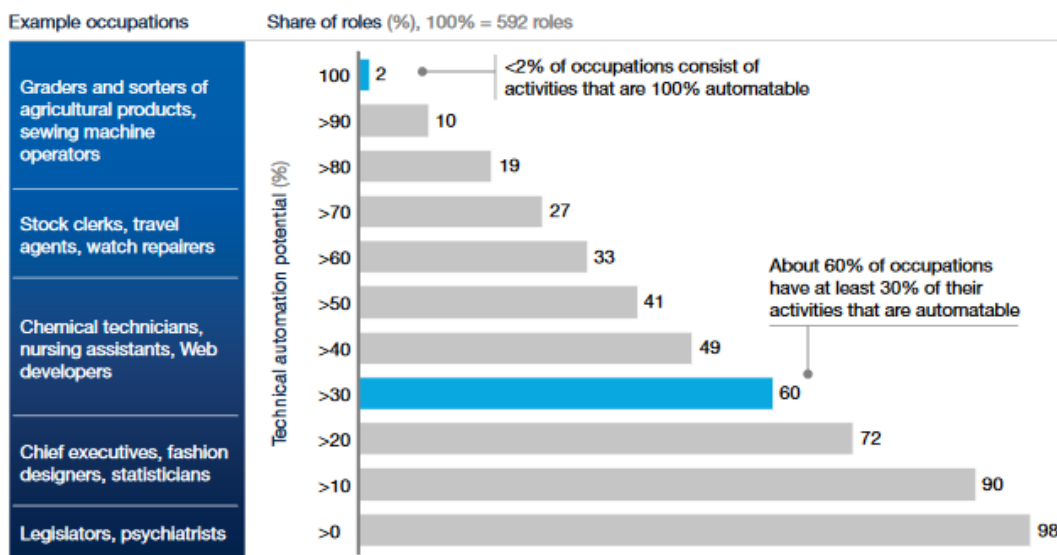
Hungary has achieved significant economic results by 2010 through the introduction of free trade, capitalism, and EU accession in 2004. It is a country blessed with a geographic location that provides suitable logistics and production locations for both Hungarian and foreign companies. Over the past 20 years, the structure of the economy has been completely transformed, with an average growth rate of 3.1%. Hungary is an industrial country meaning that the transportation, manufacturing, and production and construction industries have a great role in the economy of the country. These three sectors account for two-thirds of Hungary's workplaces. Due to the industrialized country, it is less characterized by over-automation, typically manual or routine work plays a major role, and its exposure to automation is currently quite low. However, as in all countries, it is already typical that in some sectors, for example, finance, insurance, IT, education, communications, professional services, automation tools have already appeared. These industries currently account for 7% of the Hungarian economy and account for approx. only 3% of automation is present (PWC, 2019).

In terms of sectors, the financial sector can be highlighted in Hungary in the field of automation. The goal of the financial sector is to provide high-quality customer service on the one hand and to increase the efficiency of internal operations on the other. Therefore, the automation of the robot process is already typical in financial institutions in Hungary as well, which helps e.g. closing accounts, contract amendments, automatic data updates, reconciling payments. Thanks to automation processes, the Hungarian financial sector can mean a reduction in a lead time of about 70%, mobilizing fewer human resources, and at the same time increasing customer satisfaction. Digital management of banks and checking accounts also enhances the customer experience, as they do not have to spend a lot of time completing a single transaction and they can be done conveniently from home. Financial institutions have also made a platform available to SMEs to provide custom settings. SMEs also have the opportunity to open an online bank account or apply for a loan with the help of technological solutions. Digitization has also reduced costs, used paper, reallocated resources, and eliminated human error.

An example of robot technology in the automotive industry is the Daimler Kecskemét plant, where robots carry out material transport processes, the part is transported from one place to another, thus optimizing the logistics processes. Since 2010, the chemical industry has also doubled productivity growth, mainly due to innovative technology investments. In the agricultural sector, automation has become more and more important in processing processes, physical work has been replaced by robotics, but in logistics processes, automated processes are also typical,

such as. ordering, stock monitoring, etc. Of course, there are differences in the extent to which some industries have integrated AI into their processes. Compared to the EU average, which is 25%, the degree of industrial automation in Hungary is 31-39%. Jobs currently have nearly 30% automation potential, but full automation is available in 2% of occupations (Figure 3).

Figure 3: Share of tasks technically automatable within occupations



Source: Fine et al., 2018

One of the benefits of new technologies is that they can be continuously improved while analyzing additional data. This may also be necessary for industries in Hungary where data collection is already automated and manual analysis of large amounts of data is essentially impossible. Drones can be used to assess the condition of forests, effectively model fire propagation or analyze agricultural areas in detail (vegetation index, soil moisture, ragweed spread), but drones can also help with air traffic control, accident detection or even motion anomalies (traffic chaos, mass panic). However, automated data collection is not enough, automated data analysis will also be needed. OTT-ONE Plc., listed on the Budapest Stock Exchange, responds to this challenge with its AI-based solutions, which are not only efficient but also customizable, secure, and transparent.

It also uses an AI solution and AI application area such as vegetation monitoring, plant identification. Currently, the detection of allergen ragweed is a serious problem in Hungary as well, as weeds often grow in hard-to-reach or uncultivated areas. With drones, however, these areas can be easily explored. With various sensors that can be mounted on drones, the same AI-based analysis system is also suitable for

examining the condition of industrial facilities, pipelines, tanks, roof structures, fences, dams, embankments.

Considering the health situation, nearly 8 percent of the adult society in Hungary suffers from diabetes, and 8 percent is presumably close to becoming diabetic. One of the symptoms of diabetes is vascular damage, which can be observed, among other things, in the blood vessels of the fundus. Although AI-based diagnostic solutions are performing better on smaller samples, OTT-ONE Plc. wants to develop an efficient pre-screening system as a first step, which could then be used nationwide. With the help of the large amount of data obtained during the pre-screening, it will be possible to develop a high-precision diagnostic system in the future (Veres, 2019).

Taking into consideration the composition of the Hungarian economy and the activities of the sectors, where it can be expected and there is the possibility of further automation processes are: agriculture, transportation, processing industry, warehousing sectors. Whereas social services, health, and education require significant interaction and human expertise, although there is still scope for the introduction of additional AI technology, it is one of the least automated processes in Hungary today (Fine et al., 2018).

Efforts and activities for AI in Hungary

In April 2018, the 24 member states of the European Union, including Hungary as well, signed a declaration expressing their intention to cooperate in the field of Artificial Intelligence Research and Development and to jointly develop ethical rules for the use of AI. Confirming the content of the statement, the European Commission announced a European artificial intelligence strategy back in April. In parallel, the Commission, together with the Member States, is developing a common KPI and monitoring system on the Union's AI Watch knowledge-sharing portal, which will allow the Member States to monitor the progress of announced programs.

Pillars of the Coordinated Plan: encouraging investment, ensuring access to data necessary for development, encouraging research, supporting talent, and increase user confidence.

- Increasing investments aimed at the development of artificial intelligence applications: The Commission aims to achieve at least € 20 billion in innovation and investment programs by 2020, using a combination of private and public resources. The Commission also expects projects for startups, innovative SMEs to receive significantly more funding than before. Therefore, the Commission will set up a dedicated fund to support start-ups and growth companies in the field of artificial intelligence and blockchain. By setting up Artificial Intelligence Centers of Excellence, the Commission would strengthen Member States' R&D

capacities and encourage international cooperation by networking these centers. It would ensure the wide range of testability of artificial intelligence solutions by creating user test fields and reference areas. By 2020, the Commission has earmarked around € 1.5 billion to test applications developed around the Centers of Excellence.

- Creating European data spaces to create unified data access: The development of AI is impossible without simple, automatic, fast access to data. The Regulation of the European Parliament and of the Council of 14 November 2018 on a framework for the free movement of non-personal data in the European Union is therefore of particular importance. In addition to delimiting the requirements for data localization, the regulation lays down rules on data transmission and calls for the development of an EU code of conduct based on self-regulation. allows cross-border access to machine-generated data. To ensure uniform access to data management, the Commission will create European data spaces, in particular for access to administrative and energy data, and will set up a data-sharing support center to build knowledge, practice, and trust.
- Scholarship program: The Commission will support talent through targeted scholarship programs and ensure that the introduction of artificial intelligence to students is included in the curricula of disciplines other than engineering and health (e.g. law).
- Development of ethical and reliable Artificial Intelligence: The use of services and applications based on artificial intelligence and thus the integration of AI into our everyday lives is fundamentally influenced by trust and the social acceptance of AI. To build trust, it is essential to settle the ethical issues of AI and to create the appropriate regulatory framework.

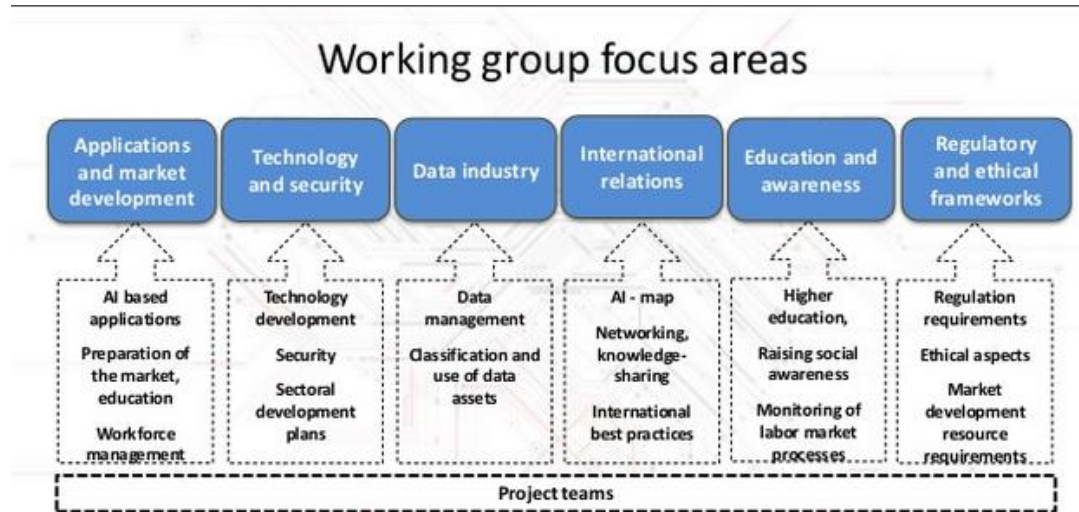
The Commission has therefore set up an international special expert group of 52 professionals from different industries to consult on ethical guidelines for the development and use of artificial intelligence through the European Artificial Intelligence Association later (EC, 2018).

In Hungary, under the leadership of SZTAKI, the Artificial Intelligence Center of Excellence will be established in 2020, its members will be research institutes of Eötvös Loránd Research Network (ELKH) and higher education institutions. The Artificial Intelligence Center of Excellence (AI National Lab) will be responsible for organizing and coordinating basic and applied research on Artificial Intelligence and for participating in the work of European AI Excellence Centers. The center is involved in international AI research collaborations and is involved in AI education and AI development. The main aim of the Action Plan is to make a breakthrough in

the social awareness of artificial intelligence. The AI Coalition is, therefore, launching the AI Challenge, a Scandinavian model, which aims to have at least one hundred thousand Hungarian citizens complete a groundbreaking AI course by the end of 2020. In addition to online training, there will be a permanent exhibition on the subject at the Palace of Wonders.

The main areas defined and executed by the AI Coalition are presented in Figure 3. According to the regulation of the Coalition, it has regular meetings, at least 3-4 times a year, and they are responsible to prepare professional reports. The projects usually cover 2-4 month long projects, their executions have to be met with the guidelines of the strategies of the Council.

Figure 4: Working groups of AI Coalition in Hungary



Source: AIC, 2019

The Coalition also aims to address at least 1 million Hungarians with the message that Artificial Intelligence is not to be feared, as it is a technology present in our daily lives that must and can be turned to our own advantage through joint economic and social efforts.

There are data markets coming in, along the way of data wealth regulation. A key element of the package is the definition of the AI ecosystem organization system, which is based on the SZTAKI-led AI Center of Excellence and the AI Coalition. The Center of Excellence primarily coordinates applied and basic research related to artificial intelligence, while the AI Coalition provides, besides market organization and general information, brokerage ecosystem construction and management, and AI training organization. A National Data Asset Agency is created to create the

conditions for use, identify stakeholders, and support the development and operation of the data market (Origo, 2019).

Trends

According to the latest study by PwC Hungary (PWC, 2019), today's most disruptive technology solutions - automation, machine learning, and artificial intelligence - will have a significant impact on Hungarian workers in the coming years. According to the OECD, Hungary is basically an industrial-focused economy, so the effects of technological changes will mainly affect the domestic labor market from the 2030s. It is estimated that over 900,000 jobs will be affected by AI in the next 15 years. Based on the economic structure of the country, it can be concluded that the automation of manual tasks that require precision or monotonous tasks in Hungary can cause the greatest changes in the labor market. However, according to PwC Hungary, this can only be expected from the 2030s, the third wave of AI, with the automation of manual and manual precision tasks. On this basis, the Hungarian manufacturing, shipping, and construction industries will be dramatically affected by the rise of artificial intelligence. In terms of numbers, approx. 380,000 jobs will be affected by AI in the manufacturing industry, 108,000 in the transportation industry, and 107,000 in the construction industry. Jobs are also likely to change in the 2030s.

Table 2 shows the expected results of the automatization process in the Hungarian economy from the 2020s to the 2030s. In the first wave, AI will be able to perform simple computational tasks and analysis of structured data sets in the first half of the 2020s, which could affect sectors specifically based on data processing (e.g. financial and info-communication sectors). From the mid-2020s (second wave), AI's influence will be enhanced by being able to perform business support functions as well as simple decision-making functions (e.g., general data retrieval and reconciliation / HR/accounting functions). In addition, AI is expected to move objects independently in well-controlled environments, such as warehouses. From the 2030s (third wave), AI is expected to appear in the automation of manual and precision work (e.g. assembly, shipping) (PWC, 2019).

By 2030, economic growth will result in the productivity of between 0.8 and 1.4%, depending on the degree of AI integration. It is not only in the workplace that the impact of automation can be observed, as the demand for automated processes, including education, healthcare, hotel, and financial services, will increase as demand increases. In principle, due to automation and development, wages will also have to increase, but some estimates are likely to generate more significant wage differences between the strata of those with different incomes. If AI becomes accepted by the people in Hungary as well, economic competitiveness can be

preserved, and foreign investments can also be attracted to the country (Fine et al., 2018).

Table 2: The Hungarian labor market from 2020 to 2030 – expected results

Hungarian labour market	(Chapter 2) Industry analysis	(Chapter 3) Occupation analysis	(Chapter 4) Type of worker analysis
 Algorithm wave (2020s)	• Financial • Human health and social work • Accommodation and food service • Agriculture	• Professionals • Technicians	• Young generation (15-24) • Female workers with high education level
 Augmentation wave (2025)	• Education • Wholesale and retail trade • Public administration and defence • Administrative and support service	• Professionals • Technicians • Service and sales workers	• Young (15-24) and middle aged (25-54) employees • Female workers with high education level
 Autonomy wave (2030s)	• Manufacturing • Transportation and storage • Construction	• Craft workers • Machine operators	• Middle (25-54) and older (54-65) generation of employees • Male workers with low and medium education level

Source: PWC, 2019

Of course, technological innovations need to be educated, on the one hand, because a skilled workforce is crucial for the competitiveness of businesses, and on the other hand, the workforce needs to adapt to these innovations. In addition to the fact that the acquisition of the basics of technology must be included in the curricula of primary and secondary schools, adult education is also essential, which must take the form of on-the-job training. The transition to automation needs to be taught, then measured and monitored. Regarding the private sector, policymakers will also offer incentives, e.g. innovation grants, which will target technology transitions (Fine et al., 2018).

CONCLUSION

As mentioned at the beginning of the article, there are plenty of companies that are unaware of the way AI functions. To apply to AI-based models, those companies should consider the main aspects, and make sure that a) standardization has been implemented, b) complete data set is available and ready, c) the given data, and information is concise and singular. Furthermore, some other requirements should be met, such as, checking which data is needed to be and how reliable and up-to-date that data is. The validation process is also important to pay attention to.

Furthermore, maintaining a proper infrastructure by choosing the right platforms for AI models is also important. In general terms, the company should integrate the new technology into the existing system. For achieving this, first of all, the company

should decide what kind of AI it needs to implement. Then the AI processes should be identified and organized. It is worth realizing that there is not any standard business model for AI implementation, in fact, much depends on what activities and when the company wants AI-based technology.

Furthermore, the paper reveals that the AI solutions can be used in 3 categories: 1. startups for which AI is the core technology; 2. startups that provide AI to companies; 3. startups that use AI as a part of the broader product.

Summarizing, the steps for developing an AI-based business model are to launch a pilot project, collecting and merging a team, organizing an AI training to the affected individuals, and development of an AI strategy.

The article also discusses the difficulties and criticism of AI. The main obstacles in this term are considered to be lack of need in AI in the company culture, quality issues, lack of data, limited number of skilled professionals, and difficulties in identifying appropriate business use cases. Summarizing, these problems can be grouped as data, people, or business issues.

Hungary after shifting to the service sector in the early 2010s enjoyed GDP growth due to the increase of employees, and AI technologies also play a significant role in this. According to the reports, Hungary should consider threats of the use of AI and figure out whether the return on investment on AI technologies will multiply. Moreover, social aspects should also be considered, as according to the survey 38% of Hungarians are skeptical towards AI. However, in some sectors in the country, AI has already been presented, especially in the financial sector.

To cope with the 2018 declaration signed between member states of the EU, Hungary has created an AI coalition. The declaration intends to increase cooperation in the field of AI Research and Development. For that the AI coalition has launched an AI challenge, the aim of which is to conduct training to the Hungarian citizens. The plan is expected to cover at least one hundred thousand of the population in the initial stage.

According to the reports, in the coming years, Hungarian industries will be heavily impacted by the latest technology solutions. It will impact jobs in different industries as well by the 2030s. Now only financial, agriculture, social work, and foodservice fields have been automatized, but by the 2030s, it is expected that mainly manufacturing, warehouse, and construction industries will be heavily affected.

REFERENCES

- AIC (2019) *AI Coalition, Hungary* [Online] Available at: <https://www.slideshare.net/IVSZ/ai-coalition-hungary> (Accessed: 09 April 2020)
- Andrew Ng (2018) *AI Transformation Playbook, How to lead your company into the AI era*, [Online] Available at: <https://landing.ai/ai-transformation-playbook/> (Accessed: 15 March 2020)
- Bergstein, B. (2020) *What AI still can't do* [Online] Available at: <https://www.technologyreview.com/s/615189/what-ai-still-cant-do/> (Accessed: 05 April 2020)
- Doucette, A. (2019) *Five Hypotheses as to why Artificial Intelligence and Machine Learning projects fail* [Online] Available at: <https://towardsdatascience.com/five-hypotheses-as-to-why-artificial-intelligence-and-machine-learning-projects-fail-7c6b2c456d41> (Accessed: 13 March 2020)
- EC (2018) *Member States and Commission to work together to boost artificial intelligence "made in Europe"* [Online] Available at: https://ec.europa.eu/commission/presscorner/detail/en/IP_18_6689 (Accessed: 09 April 2020)
- Fine, D., Havas, A., Hieronimus, S. Jánoskúti, L., Kadocsá, A. and Puskás, P. (2018) *Transforming our jobs: automation in Hungary*, McKinsey & Company Report
- Gassmann, O., Frankenberger, K. and Sauer, R. (2017) A primer on theoretically exploring the field of business model innovation. *The European Business Review*, Vol. 4, pp. 45–48.
- Gonfalonieri, A. (2019) *Choosing The Right AI Business Model* [Online] Available at: <https://medium.com/predict/choosing-the-right-ai-business-model-df5d81420d74> (Accessed: 13 March 2020)
- Hofstee, E. (2019) *What are the infrastructure requirements for Artificial Intelligence?* [Online] Available at: <https://blog.leaseweb.com/2019/07/04/infrastructure-requirements-ai/> (Accessed: 04 April 2020)
- Kessler, J. and Gwozdz, G. (2018) *Artificial Intelligence Implementation in 5 Steps* [Online] Available at: <https://neoteric.eu/blog/artificial-intelligence-implementation-in-5-steps/> (Accessed: 11 March 2020)
- Martinez, D.M. and Fernandez-Rodriguez, J.C. (2015) Artificial intelligence applied to project success: a literature review, *International Journal of Interactive Multimedia and Artificial Intelligence*, Vol. 3, No. 5, pp. 77–84
- Marvin, R. and Horowitz, B.T. (2018) *10 Steps to Adopting Artificial Intelligence in Your Business* [Online] Available at: <https://www.pcmag.com/news/10-steps-to-adopting-artificial-intelligence-in-your-business> (Accessed: 11 March 2020)

- Origo (2019) *Hungary is also preparing for the age of artificial intelligence* [Online] Available at: <https://www.origo.hu/techbazis/20191017-magyarorszag-sztaki-mesterseges-intelligencia-kozpont.html> (Accessed: 13 March 2020)
- Pandya, J. (2019) *How Artificial Intelligence Is Transforming Business Models* [Online] Available at: <https://www.forbes.com/sites/cognitiveworld/2019/07/10/how-artificial-intelligence-is-transforming-business-models/#356530602648> (Accessed: 13 March 2020)
- Polachowska, K. (2019) *12 challenges of AI adoption* [Online] Available at: <https://neoteric.eu/blog/12-challenges-of-ai-adoption/> (Accessed: 05 April 2020)
- PWC (2019) *How will AI impact the Hungarian labour market?* [Online] Available at: <https://www.pwc.com/hu/en/publications/assets/How-will-AI-impact-the-Hungarian-labour-market.pdf> (Accessed: 13 March 2020)
- Shuja, U. (2017) *Implementing Artificial intelligence Solutions: Are Your Operations Ready?* [Online] Available at: <https://iiot-world.com/connected-industry/implementing-artificial-intelligence-solutions-are-your-operations-ready/> (Accessed: 11 March 2020)
- Singh, g. (2017) *Five components that artificial intelligence must have to succeed* [Online] Available at: <https://www.bloomberg.com/professional/blog/five-components-artificial-intelligence-must-succeed/> (Accessed: 20 March 2020)
- Turan, M., Almalioglu, Y., Araujo, H., Konukoglu, E. and Sitti, M. (2018) Deep endovo: A recurrent convolutional neural network (rcnn)based visual odometry approach for endoscopic capsule robots, *Neurocomputing*, Vol. 275, pp. 1861–1870,
- Veres, D. (2019) *Artificial Intelligence in Everyday Life - Hungarian-developed "machine eyes" are already a part of our lives* [Online] Available at: <https://translate.google.hu/?hl=hu#view=home&op=translate&sl=hu&tl=en&text=Mesters%C3%A9ges%20Intelligencia%20a%20mindennapokban%20%E2%80%93%20A%20magyar%20fejleszt%C3%A9s%C5%B1%20%22g%C3%A9pi%20szemek%22%20m%C3%A1r%20az%20%C3%A9let%C3%BCnk%20r%C3%A9szei> (Accessed: 09 April 2019)