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ARTIFICIAL INTELLIGENCE AND TECHNOLOGY TRANSFER

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Abstract

Industry 4.0 brought many changes at the societal level, impacting the social, economic as well as the environmental pillars and shifting to a new vision on life. This Industrial Revolution introduced many disruptive technologies with the purpose of bettering human lives and well-being. In the economy it has focused on increasing productivity and efficiency by implementing robots and AI-based tools that would complement human labor. All of the disruptive technologies that 4IR has brought with are gravitating around artificial intelligence. The most visible change that came with these technologies is the adoption of robots which have both physical and virtual forms.

Keywords: *artificial intelligence, technology transfer, The Fourth Industrial Revolution, digitalization, automation*

JEL Classification: O30, O33, O39

Introduction

The term artificial intelligence was firsly mentioned in 1955 by Dartmouth math professor John McCarthy, who wrote a conference paper on this topic (McCarthy et al. 2006).

Artificial intelligence can be defined as the ability of computers to perform functions that would normally be associated with human intelligence as learning and reasoning. However, this concept does not possess a generally accepted definition. Given to the interest in the capability of AI to learn, one of its main sub-domains, machine learning has been one of the most studied topics by researchers worldwide. The terms machine learning and artificial intellignce can sometimes be utilized interchangeably (Kühl et al. 2022).

Technologies allow the new devices and systems to be automated in an efficient manner of intelligence-cost, that allows control and monitoring support in real time. By gathering relevant information in real time, these new disruptive technologies enable to combine and process data collected in an innovative manner, which leads to a more effective control over decision making (Sava, 2018).

Artificial intelligence tools have the capacity to perceive the environment, learn from past experiences, process data and solve specific tasks for which they are usually programmed to execute (Javaid et al. 2021).

The functioning principle of machine learning (ML) is learning based on past experiences or by recognizing specific models using algorithms. Dedicated AI algorithms are provided with learning datasets from which they retrieve specific models as in image recognition for different diseases in the medical field. In this way artificial intelligence contributes to the early detection of severe diseases, thus expanding the life expectancy of the patient. By recognizing the learned models, the algorithms can suggest what decisions to take next. As a result, the decision-making process is improved and has a higher degree of accuracy (Alzubi et al. 2018).

The easiest to implement form of artificial intelligence is robot process automation or RPA which also has a rapid and high return on investment compared to other types of AI as physical robots. RPA is a software type of artificial intelligence that is usually used in logistics and other precision tasks as taking customer orders. The tasks this form of AI can overtake are the ones at which humans generally tend to make errors (Hofmann et al. 2019).

Artificial intelligence is a vast field based on computers that seek to replicate human intellectual activities and behaviors. Although it is a technology itself, it can be described as an entire domain from which other important technological tools such as robotics derive. It

comprises many disciplines as logic, computer science and philosophy and has made important results in the past years in a variety of industries (Xu et al. 2021).

As a social concept, AI became indispensable for development and brought significant results in what consists reduced labor costs, optimized labor efficiency and generating new jobs based on technological advancements (Miller, 2018).

Nowadays, artificial intelligence is able to execute tasks that were usually only performed by humans. Although it promises an improved standard of living by impacting all the significant pillars from the economic, social to environmental one, it also has a great negative impact on workforce. AI will be able to replace humans in clerical jobs that perform tedious tasks that require a high level of attention. Humans are prone to making mistakes, especially at repetitive tasks, where, in this case artificial intelligence will play an important supportive role (Howard, 2019).

Artificial intelligence will mainly threaten low-qualified and medium-qualified workers that will also have difficulties in job reconversion. The higher-qualified workers instead not only will be spared from the risk of losing their jobs, but also will be encouraged to improve their skills in order to be able to work along technological improvements such as robots and dedicated tools. This will expand inequality among workers and will cause income differences as specialized workers will benefit from increased salaries, while low and medium qualified workers that will be lucky enough to either maintain their jobs or make reconversion will benefit from a lower income than the aforementioned category (Jarrahi, 2018).

The evolution of artificial intelligence plays an important role in the development strategy for countries at the global level by enhancing national competitiveness and at the same time maintain security (Wamba et al. 2019).

Presently, given to the scientific and technical evolutions, modern complex technologies can now be created. These are the outcome of an amalgamate various branches of sciences and technologies. The combination is the result of intellectual activity and the formation of a complex of proprietary intellectual rights for such a technology given to the requirement of using cutting-edge technology on a broader scale and in various areas. Modern technologies are in general created in the area of basic industrial standards, mainly in the production sectors in which PR are widely utilized such as IT& C and digital technologies.

Technology transfer (TT) represents a mechanism dedicated to produce knowledge, innovations and developments available for the general population. This is a complex process involving many stakeholders and factors done via scientific research papers, educational and

governmental initiatives and technology. It requires feasibility studies for technology, economic options and understandability (Spiegel, 2007).

TT involves a dynamic mechanism that adapts to the technological progress with various models proposed and validated by the scientific community. The international level of technology transfer varies across nations and is correlated to the innovation level (Bozeman, 2000).

Technology transfer per se is an activity focalized on knowledge transfer based on requirements and expected results in a broad range of applications within various sectors of activity. It has impacted the economic, administrative, social, academic and technological sectors and led to the implementation of significant technological tools (Wahab et al. 2011).

A technology transfer assumes a number of processes that facilitate the movements of knowledge, skills, ideas and methods between different participants of the property turnover. These comprises both individuals as well as legal entities: inventors, programmers, scientific research centers and various types of organizations (Tyukin et al. 2018).

Formerly, technology consisted of a set of techniques and methods for the processing of raw materials and semi-completed products carried out across different industries. It was associated with a specific production branch such as machine building technology or with the methods of obtaining and processing materials.

Modern technical advancement brought high technologies, science-intensive products as well as hi-tech industries. Nowadays, technology does not limit to certain industries, but has seized various domains such as microelectronics, space, biotechnology and genetic engineering (Pyataeva et al. 2022).

Artificial intelligence is one of the most debated topics in worldwide research and has stirred the interest of both scholars and companies.

AI has had a long development process that took more than 7 decades to evolve to the level we are familiar to in present. Its historichal progress can be traced back to 1943 when the first model of artificial intelligence which opened the path for artificial neural networks (ANNs) research has been proposed (Wu et al. 2017).

At the Dartmouth Conference which took place in 1956 the concept of AI has been debated and the denomination as artificial intelligence began. During this period of time, the topic has been intensively debated by the international academic community. However, in the 1960s the technological advancement of artificial intelligence took a downturn (Khemani, 2020).

In order for a computer to manifest a intelligent behavior, its knowledge has to expressed as input in a manner accepted by it in order to be acquired and improved in practice. This is called machine learning.

The purpose of machine learning is to study human learning mechanisms and the processes of human thinking in order to be able to execute specific tasks in a similar manner. Machine learning or ML is based on a multitude of disciplines as information science, fuzzy mathematics, brain science and neuropsychology (Janiesch et al. 2021).

On of the most important outputs of artificial intelligence result is represented by the introduction of robots. This can take different shapes from physical to virtual (software) and have different degrees of automation. The physical robots can be programmed by an operator to execute specific tasks to which most of them are designed to do. However, most type of robots are limited and can only execute one task that they were originally crafted to do. The other types of more advanced robots that present an intelligent behavior are able to learn from past experiences and require less or none human intervention. At this time, there are no robots that are able to execute tasks completely autonomous and have to be programmed and require human assistance (Gordon, 2018).

In the future when robots will become implemented at a higher scale, humans will be able to work among them. These are called collaborative robots or co-bots as they are designed to complement humans in the work they are performing (Sherwani et al. 2020)

Robots are able to analyze their environment and adapt to change, although there is no guarantee that they will work completely flawless. One example is the autonomous vehicle that has been designed as a driverless car which does not require human intervention. Despite of its science-fiction character, it has become a reality although still in early development stages. One example of error would be a human crosswalking in a restricted area for pedestrians and the car would hit him as its software was not able to make a decision based on a specific situation. It would have lead to human casualties if applied in a real environment. This type of software requires more time to be tested in order to acquire more experience that it will be able to apply in a similar real situation (Singh & Saini, 2021).

Fig. 1 Fields of artificial intelligence

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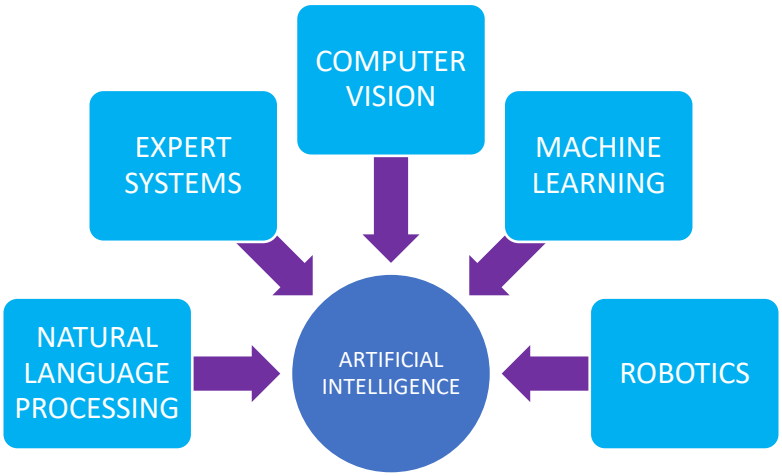

Source: adapted by the authors

Figure 1 shows the five different fields that artificial intelligence comprises. These are: expert systems, computer vision, machine learning, robotics and natural language processing (NLP).

Expert systems use past data and rules to represent human knowledge and simulate reasoning in specific domains, for example medical diagnoses.

Computer vision teaches computers to detect, recognise and/or classify objects visually. May mimic human vision or use parts of the spectrum invisible to humans.

Machine learning represents the ability to learn from data without being specifically programmed.

Robotics combines AI with mechanical engineering to create robots that can carry out physical actions with a level of independence.

Natural language processing represents understanding and communicating in human language. NLP systems enable AI translations, sentiment analysis and chatbots.

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