OPUS▶

RESEARCH ARTICLE

The Use of Artificial Intelligence for Decision-Making Process for Strategic Management

Osman Kurter[1]

[1] Dr., Karabük University, Economic & Administrative Sciences, Karabük/Türkiye

ORCID: 0000-0001-7581-1316

E-Mail:
osmankurter@karabuk.edu.tr

Citation:
Kurter, O. (2025). The use of artificial intelligence for decision-making process for strategic management. *OPUS– Journal of Society Research, 22*(2), 195-210.

Abstract

Artificial intelligence (AI) is a rapidly developing technology with the potential to create profound changes across various domains, from societal structures to economic systems. This study focuses specifically on the impact of AI on strategic management decision-making processes. The primary aim is to explore how AI can enhance the quality of these processes and contribute to improved organizational performance. A literature review method was employed in the research, through which the theoretical foundations of artificial intelligence, its historical development, and its application areas in decision-making processes were thoroughly examined. The findings indicate that AI accelerates decision-making processes, leading to significant time and cost savings, while also minimizing human error. Decision support systems empowered by AI technologies enable organizations to make more accurate, consistent, and data-driven decisions in strategic management. However, to effectively integrate and benefit from these technologies, organizations must be adequately prepared in terms of both technological infrastructure and organizational culture. In this regard, the study emphasizes that AI is not merely a technical tool, but also a strategic asset that can offer competitive advantages when effectively adopted and utilized.

Keywords: *Artificial Intelligence, Decision Making, Strategic Management, Application of Artificial Intelligence, Effective Decision Making.*

Öz

Yapay zeka, günümüzde toplumların işleyişinden ekonomik yapılara kadar pek çok alanda köklü değişimlere yol açma potansiyeline sahip, hızla gelişen bir teknolojidir. Bu çalışma, özellikle yapay zekanın stratejik yönetim karar süreçlerine olan etkisini incelemeye odaklanmaktadır. Temel amaç, yapay zekanın bu süreçlerin kalitesini nasıl artırabileceğini ve organizasyonel performansa nasıl katkı sağlayabileceğini ortaya koymaktır. Araştırmada, literatür taraması yöntemi kullanılmış ve bu bağlamda yapay zekanın teorik altyapısı, tarihsel gelişimi ve karar verme süreçlerindeki uygulama alanları detaylı biçimde ele alınmıştır. Elde edilen bulgular, yapay zekanın karar alma süreçlerini hızlandırarak zaman ve maliyet açısından önemli avantajlar sağladığını, ayrıca insan kaynaklı hataları büyük ölçüde azaltabildiğini ortaya koymaktadır. Yapay zeka destekli karar destek sistemleri sayesinde, stratejik yönetimde daha isabetli, tutarlı ve veriye dayalı kararlar alınması mümkün hale gelmektedir. Ancak bu teknolojilerin etkin bir şekilde kullanılabilmesi için, organizasyonların hem teknolojik altyapı açısından donanımlı olmaları hem de yeniliklere açık bir organizasyonel kültüre sahip olmaları büyük önem taşımaktadır. Bu yönüyle çalışma, yapay zekanın yalnızca teknik bir araç değil, aynı zamanda stratejik bir avantaj unsuru olduğuna dikkat çekmektedir.

Anahtar Kelimeler: *Yapay Zeka, Karar Alma, Stratejik Yönetim, Yapay Zeka Kullanımı, Etkili Karar Verme*

Introduction

The recent expansion of the use of smart information systems has had a significant impact on all institutions and industrial sectors. The innovation of Artificial Intelligence (AI) aims to reformulate the strategy of institutions in line with rapid technological advancements, as it focuses attention on simulating human intelligence to accomplish the greatest possible amount of work that requires high intelligence capabilities in the shortest possible time (Venkatraman, 2017).

Following its first usage as terminology in 1958, research on AI's usage and application in many different industries has expanded rapidly. The accumulation and use of big data and the creation of new technological capabilities and capacity to handle said large volumes of data; called metadata, followed suit (Kedra et al., 2019). The introduction of new systems to handle big data, which was not possible earlier, was a natural progress that would have been impossible to handle by the human mind. Due to AI's application in so many different areas, it has become a frequently used term in daily life in the recent decade, and its potential application area has been researched and expanded in almost every segment of human life and scientific fields. Literature is rich with research exploring the use of AI in telecommunication (Morocho-Cayamcela, Lee, & Lim, 2019); civil engineering (Yigitcanlar, Desouza, Butler & Roozkhosh, 2020); education (Alenezi & Faisal, 2020; Harry, 2023); medicine (D'Souza, Prema, & Balaji, 2020; Foulquier, Redou, Le Gal, Rouvière, Pers & Saraux, 2018; Kedra et al., 2019; Orgeolet, Foulquier, Misery, Redou, Pers, Devauchelle-Pensec & Saraux, 2020); accounting (Sezer, Güdelek & Özbayoğlu, 2020); computer science (Zheng, Chien, & Wu, 2018; Wang, 2019); sustainability (Nishant, Kennedy, & Corbett, 2020); engineering (Rupali & Amit, 2017), and other areas.

While the utilization of AI and big data in the business administration domain has created corporate giants such as Amazon, Google, and Uber, the study of AI in strategic decision-making has rarely been explored in depth because 'strategy' has always been associated with the human mind and intuition (Wilson & Daugherty, 2018; Bean, 2019; Vasiljeva, Kreituss, & Lulle 2021). The change

of this misconception may have started to change with the World Chess Champion Garry Kasparov's loss to the Deep Blue computer developed by IBM in 1997. Therefore, research about this complex area has gained popularity in the last decade. After all, decision-makers in the business community have mixed feelings toward AI, because of its complexity and the research area's involvement in so many different scientific fields, hardware, and software systems.

This study will research the prospects of this new technology's usage in management and decision-making processes in detail using a Systematic Literature Review (SLR) in detail (Davenport & Ronanki, 2018; Leavy, 2020; Cubric, 2020; Büyükyılmaz, 2024). Alongside the positive perception of AI, such as IBM CEO Ginni Rometty claiming AI will enhance human intelligence further (Duan et al, 2019), there is also a negative perception, such as a bleak prediction of machines replacing human beings in the coming years attributed to Steven Hawking (Cellan-Jones, 2014; Haenlein & Kaplan, 2019; Dwivedi et al., 2019). Bill Gates' recommendation that humans should be worried about AI and machines competing with human beings in the future is also in line with this bleak prediction (Rawlinson, 2015). Along with these individual predictions, The World Economic Forum (WEF) analysis predicts that 20% of jobs in the UK, and 26% in China and India will be affected by the adoption of AI (Dwivedi, Rana, Jeyaraj, Clement, & Williams, 2019). Approximately one-third of researchers anticipate that the widespread adoption of AI in the future could have detrimental effects on humanity (Müller & Bostrom, 2016). From an ethical standpoint, the study provides a detailed analysis of the positive and negative impacts of this technological application.

Just like the application of automation systems used in manufacturing and other areas, organizations use AI to make more accurate decisions in the shortest time in strategic management and organizational behavior areas to increase their competitive edge, boost their profit margins, and save time. The decision-makers in the organizational settings started to develop awareness and full conviction of AI to utilize the maximum use of technological in-

novations. The precise procedures for making accurate and beneficial organizational decisions whilst relying heavily on automation systems such as AI and the Internet of Things to carry out their activities with increased efficiency became possible with the use of these new technological systems (Cockburn, Henderson & Stern, 2019; Sadat, 2023; Bruno, 2024; Büyükyılmaz, 2024). The creation of management information systems, AI, and expert systems is intended to provide the necessary support for decision-makers at all levels of management activities to perform their functions better and more accurately. Therefore, it is important to conduct practical research on the relationship between AI, and the decision-making process from the point of cost-benefit analysis. If there is a greater benefit than the cost while using these systems in an organizational setting, the utilization of them is advisable since the trend is toward more digitalization of the world (Kurter et al, 2021; Buhalis and Moldavska, 2021; Wirtz, Kunz, & Paluch, 2021; Ismanov, Qayumov, Mukhamadjonova, & Akhmadaliyev, 2024).

The Subject of Study

The objectives of this study are to investigate, and analyze the literature to discover how AI will impact strategic decision-making in the following management areas:

- Identifying the role of using AI and its impact on the decision-making processes for the organization.
- Discovering the most prominent strategic decision-making advantages, and the benefits for organizations while using the AI applications.
- Demonstrating the role of AI and its impact on the management activities and decision-making processes for the management team.
- Proposing solutions for organizational decision-makers while initiating and using AI.

Study Problem

Traditional decision-making processes used by management teams are based on intuition and provide insufficient data which results in inaccurate critical decisions that can be avoided by the usage of "AI". The utilization of "Artificial intelligence" can also benefit teams in the sense that it is practical and eliminates the time-consuming aspects that negatively affect management teams with the usage of traditional decision-making methods.

Data Collection Methodology

A literature review, a scientifically accepted research methodology is used to examine existing literature on a particular topic in a comprehensive and structured manner. This methodology offers a systematic approach to summarize existing knowledge on a topic, answer a clear research question, and identify gaps in the literature. The data of the study carried out for this purpose was obtained from databases such as PubMed, Scopus, Web of Science, and Google Scholar. The databases searched in question were made with the keywords "Artificial Intelligence", "Strategic Decision Making", and "Management Systems" only from peer-reviewed articles published between 2015-2023 excluding student theses and dissertations. In addition, reports from official sources, and statistics on the subject were examined and included, limited to the scope of the study.

Literature Review

Craig, Goldstein, Rougier, and Seheult (2001), investigated Bayesian forecasting for complex systems using computer simulators. The study indicates that when an organization needs to solve a complex problem, it usually resorts to expert advice because they have the experience and are aware of the available alternatives and opportunities for success. The research concludes that expert systems are decision-making systems or any computer devices and software packages used for solving problems that can reach a certain level of performance, equal to or exceeding human expertise.

The study explains that expert systems are by nature an applied branch of AI and that widespread in complex application fields such as real estate management, corporate plans, marketing, health care, and error analysis in many other industries.

Negnevitsky (2008), investigated computational intelligence applications in crisis management and power systems. This study considers expert systems as the key to the success of AI despite the vast new developments in human knowledge. This study concludes that expert systems are limited by a specific scope of expertise "as human psychological factors." Expert systems are not coherent and flexible enough, and it is difficult to verify their accuracy and integrity. Currently, there is no method to analyze the degree of their imperfection and inconsistencies.

Duan, Edwards & Dwivedi (2019), conducted detailed research to investigate the evolution of AI during the last six decades which includes the challenges and benefits associated with this new technology. This study proposes advanced research areas for Information Systems (IS) professionals who work in the areas of designing and implementing new AI systems for organizational decision-making applications.

Chang (2019) conducted a Data Envelopment Analysis (DEA) on the efficacy of using AI-based environmental management systems in the convention and exhibition industry in China. A quantitative methodology based on questionnaires and a qualitative methodology derived from interviews were used to achieve this study's objectives. The results indicate that the performance level of AI-based environmental management systems was effective and qualified in performing various administrative tasks. As the size of their companies expanded, and the usage of AI-driven decision-making systems continued, they were able to further improve their efficiency and ensure their competitive edge in the industry.

Borges, Laurindo, Spínola, Gonçalves, and Mattos (2021) conducted a detailed systematic literature review to discover the challenges, opportunities, and benefits of using AI. Their research concludes with the benefits, challenges, and research opportunities in 'decision support, customer and employee engagement, automation,' and 'new product and service offerings.'

Duangekanong (2022), conducted a research titled "Applications of AI for Strategic Management of Organization." This rare empirical research employs 231 academicians, strategic management specialists, organizational strategists, and consultants as their subject groups employing the Modified Unified Theory of Acceptance and Use of Technology (UTAUT) model to distinguish factors in their organizations that help the application of AI systems. UTAUT is a widely accepted empirical calculation method that figures out how likely a new technology will be employed by certain industries (Dwivedi et al., 2019). The researcher attempts to see how likely the sample group mentioned above would be to use AI systems by measuring these four different factors of 'performance expectancy, effort expectancy, social influence' and 'facilitating conditions.' The research result shows that all the measured variables were influential while employing AI-related expert systems. The most important factor was found to be the organization's technological preparation for this adaptation. The 'performance expectancy,' and 'effort expectancy' were measured to be intermediaries, while 'organization culture' had a significant effect, but was the least of all measured variables. This study shows a greater need for evaluation of the ethical considerations and utility of AI.

The Concept of Artificial Intelligence

It is claimed that early research started by British Mathematician Alan Matthison Turing who discussed the idea of developing advanced computing programming to create AI in 1947 in his university lectures (McCarthy, 2007). The development concept of artificial intelligence was later announced by American Computer Scientist, Stanford University Professor John McCarthy during the Dartmouth Conference at Dartmouth College in 1956. AI was initially built on two aspects. One is 'rationalist,' or machine-centered, bringing together mathematics and engineering performed by a computer (Trappl, 1986), and the other one is centered around 'empirical' human behaviors of ex-

periment and hypothesis (Haugeland, 1989). AI refers to the machines' ability to acquire intelligence and think logically, similar to the human ability to think and progressively learn from its actions. This is done through programs that computers are equipped with to help them benefit from data and think logically to reach the desired result (Wang, 2019).

The Organization for Economic Co-operation and Development (OECD) defined artificial intelligence as "a machine-based system capable of making predictions, recommendations and effective decisions in real and virtual environments to achieve a set of goals specified by humans, and uses machine or human inputs to visualize real or virtual environments and converts these visualizations into abstract models in an automated manner, and uses typical reasoning to formulate options for information or actions" (Yeung, 2020). Despite the above OECD definition, there is no single accepted definition of AI by the researchers in the literature. According to Sharma (2024), a 1983 survey shows 143 different definitions of AI definitions used by different researchers.

From here we conclude that the main goal of AI is to enable computers to perform tasks that the human mind traditionally performs, i.e. to simulate the behavior of another intelligent human being.

History of Development of Artificial Intelligence

In the old days in 1940, the French philosopher Paul Valéry was the first to talk about the future of machines and the extent of their coexistence with men. He said that "every human being is in the process of transforming into a machine, and the truth is that it is the machine who is in the process of evolving to transform into a human being" (Valéry, 1989).

Initially, the most difficult thing for the researchers was to figure out how machines can enumerate mathematical formulation of things that are easily and traditionally done by humans (Abramson, Braverman & Sebestyen, 1963). Overcoming this challenge required AI to acquire capabilities that allowed extracting patterns from big data called 'metadata' and creating its own knowledge

(Solomonoff, 1985; Michie, 1968). This new challenging ability, called Machine Learning (ML), was attained at the beginning of this century, allowing computers to detect prevailing patterns without any explicit instruction and programming. This ability of machines and software programs to mimic human behavior, and learn from its mistakes, allowed AI to enter into its current advanced standings. When Multiple-Complex (ML) abilities described above are working at the same time hierarchically, advancing from simple to complex levels, we call this complicated higher learning ability of machines 'deep learning' state (LeCun, Bengio, & Hinton, 2015).

Starting in 2010, AI became a very popular term and part of our daily jargon. In association with AI, the common use of ML, and 'data mining' terminology is also reflective of recent technological changes. Especially following the wide media reports of the AlphaGo system defeating its most competitive human counterpart (Koch, 2016) and IBM's Watson system beating the TV Jeopardy champion on the US TV show (Gladwell, 2010), the AI and its associated technologies had spotlight shine on them.

Types of Artificial Intelligence

As shown in the following Figure 1, several types of AI can be distinguished. Other than Weak AI, all other two types of AI are still in their theoretical form and have not fully materialized yet.
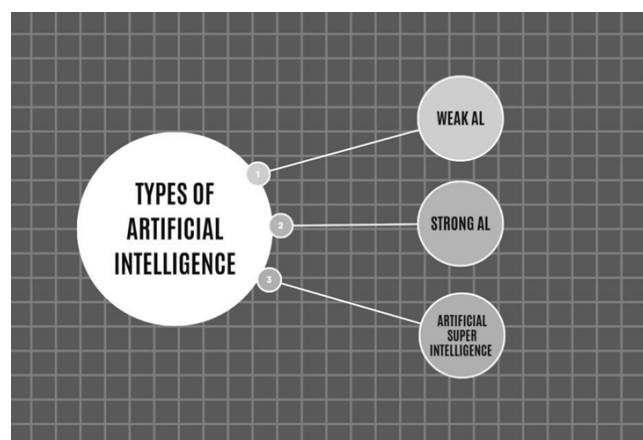

Figure 1: Types of AI
Source: Researcher's depiction.

Weak AI, also known as narrow AI, has been programmed to analyze data to write news reports, check the weather, and play chess (Fjelland, 2020). Computers can be trained to carry out a single function much faster and more efficiently than the human mind. These systems cannot function out of their programmed functions. Apple's Siri, Google's Assistant, Amazon's Alexa, and ChatGPT type of systems are all examples of Narrow or Weak AI. Narrow AI can be trained to be used as visual identifiers such as image recognition, object recognition, tracking, and facial recognition. Robots in industrial settings also use narrow AI.

Strong AI, also known as Artificial General Intelligence (AGI), is a type of intelligence that can perform any intellectual task with the efficiency of a human. This type of AI is characterized by collecting and analyzing information and benefiting from the process of accumulating experience, which qualifies it to make independent and autonomous decisions (Al-Imam, Motyka, & Jędrzejko, 2020).

Super AI exceeds the human intelligence level, which worries many skeptics of this technology. One of those cautious scientists is Physicist Stephen Hawking, who announced that in the future he "fears that artificial intelligence will completely replace humans." Another skeptic is Bill Gates who stated that AI represents a threat to humanity, to the point that it could lead to the extinction of the human species (Rawlingson, 2015; Cellan-Jones, 2014).

Some major categories of AI

AI applications are used in many areas including health care, security, education, and many other industries. They are divided into many subfields and groups, but for our purpose, we will only identify the major categories.

Robots' behaviors resemble human beings, facilitating human-like thinking and acting to carry out tasks that are sometimes impossible, dangerous, cumbersome, and costly for humans to accomplish. Working on a car manufacturing assembly line to lift heavy vehicle parts, or carrying out duties in hazardous nuclear reactors are examples of jobs that are impossible for humans to accomplish, but can easily and safely be achieved by robots (Perez et al., 2018).

Other than the customary areas of use, Robots and AI-assisted applications are finding extensive use in our daily lives. In the dental and medical fields, the role of robots and AI-assisted diagnosis and treatment is expanding rapidly. Due to its increased accuracy, precision, and efficiency, the use of AI and robots is being preferred over traditional human utilization in the Prosthodontics and Restorative areas of dentistry (Karnik, Chhajer, & Venkatesh, 2024).

The use of robots and AI in the field of assisted living enables individuals with disabilities to perform the daily activities that without AI-supported systems they are unable to. Steven Hawkings' AI-supported system that facilitated his mobility and communication with others is an example of this type of system. According to the World Health Organization (WHO), about 15% of the world's population is living with some sort of physical disability. With the use of home automation systems using AI, most of these people can carry on their daily lives without any major hindrance thanks to AI-assisted robots (Pancholi, Wachs, & Duerstock, 2024).

Computer vision is based on equipping computers with the ability to "see;" in other words, interpret a visual image. Examples of this include facial recognition with a success rate of up to 99%, and reading handwriting with intertwined letters and complexity (Lemley, Bazrafkan, & Corcoran, 2017). The other types of applications based on AI-supported visual cues can be seen in safety, security, and legal areas under the realm of forensic sciences.

Along with the basic form of this application seen in smartphones, facial recognition applications are gaining popularity in data-driven marketing areas using AI applications. Srivastava and Bag (2024) conducted empirical research on AI-assisted marketing activities, discovering that following the COVID-19 pandemic, data-driven marketing activities are currently taking over conventional marketing activities. According to this research, although this application is not fully explored by the industry yet, the modern marketing

strategies enabled by AI support using information from visual cues such as facial expressions, neuro signals, and behaviors can boost sales revenue and slash costs drastically in the marketing industry. Like Srivastava and Bag (20224), many other researchers in the marketing sector recommend AI-assisted advertising and Customer Service (CS) to be an essential part of their operational activity and not an optional one (Micu et al., 2022).

The last major category where AI applications are utilized is speech recognition. This application makes computers more interactive with the users, as it searches for ways to give computers human speech recognition ability, capable of directing commands to computers verbally, and the computers understanding these commands and executing them as needed (Basak, Agrawal, Jena, Gite, Bachute, Pradhan & Assiri, 2023).

Other than the forensic and security-related applications of Voice Assisted or Voice-Activated (VA) AI usage, many new applications are emerging and becoming popular. One of the major recent research projects conducted in VA AI is Buhalis and Moldavska, (2021). They researched VA AI usage in the hospitality and CS fields. This study along with many other studies discovered that although still in its infancy, VA AI applications are increasingly becoming the norm due to their operational capabilities such as the use of multilingual operations and the ability to slash operating costs drastically (Liang-Pholsena, 2020; Tussyadiah, 2020; Samala, 2020; Wirtz et al., 2021).

AI Applications Supporting Strategic Decision-Making

AI's effectiveness and usefulness would only be realized when these applications are integrated into organizational IT systems and used by decision-makers (Edwards, Duan & Robins, 2000). Let's look at major application support systems and their functions.

Expert systems are information programs that attempt to simulate human logic and were very popular up until 2000, and lost their popularity afterward (Dhaliwal & Tung, 2000; Duan, Edwards & Dwivedi, 2019).
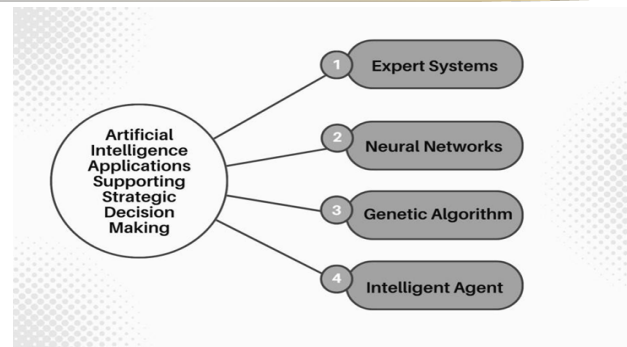

Figure 2: AI Applications Used for Decision-Making
Source: Athour's depiction.

This system is an application of AI that models human experience in a specific field of knowledge to solve problems in a computerized manner. Expert systems rely on the latest developments through the following stages (Edwards et al, 2000; Bahrammirzaee, 2010).

- The first stage is for identifying the problem, classifying it, and showing its severity.
- The second stage is selecting alternative solutions to conduct further analyses that help to show alternative solutions for complex problems.
- The third stage is choosing the appropriate alternative for decision-making.
- The last and the fourth stage for execution or implementation of the solution.

Neural networks is an application utilizing AI that teaches computers to process data in a way inspired by the human mind. It is also known as Artificial Neural Networks (ANN). It is a type of deep learning process that computers use to learn from their mistakes and to continuously improve their functionality and accuracy. The most important fields of application are 'targeted marketing' by filtering social networks and analyzing behavioral data; financial forecasting by processing historical data of financial instruments, and 'processing of quality control mechanisms' (Bose, 1994; Duan et al, 2019). Although it is at the forefront of AI research currently, Neural Network applications have been in use since the 1980s (Ford, 1989; Bose, 1994). The most recent 2024 Nobel Prize for Physics was awarded to two Scientists, John J. Hopfield and Geoffrey E. Hinton for developing ML technology using ANN. This shows how important and current this field is.

Genetic algorithms are an important application in random searches, and they represent the prevailing belief that human intelligence is innate and acquired largely through heredity. They are computer programs that simulate biological processes to analyze problems in evolutionary systems. This discovery is based on the course of events and is routinely used to find useful solutions to improve and investigate problems. It is used in many fields such as financial and banking, business fields, investment applications, solving logistical problems, and applied in modern technology such as space technology, materials, and biotechnology (Vas, 1999).

Intelligent Agents are autonomous intelligent systems in AI that perform specific tasks without any human intervention. Organizations use intelligent agents using AI to achieve specific goals with more efficient business outcomes. Teams are expected to be more productive when they delegate repetitive tasks to AI agents that do not require any comprehension and judgments (Spangler, 1991).

Using AI in the Decision-Making Process for Strategic Management

Although not to the current extent, AI has been employed in businesses since the 1980s in a simpler format such as computer vision systems, expert systems, and other software and hardware systems using computer automation technology (Boden, 1984; Ford, 1989; Bose, 1994). Despite the fact AI was still in its infancy, in the past it was quoted by researchers and businesspeople as a competitive advantage and strategic tool to differentiate companies from the competition (Porter and Millar, 1985). The use of AI continued until the turn of the millennium with its basic functions focusing on algorithms to improve current ones or add similar new functions. Starting in 2001, the researchers realized that in the field of AI, and IT in general, the major challenge was the volume of data compiled in large databases. Because of these shortcomings, new AI technologies needed hardware evolution to eradicate this obstacle. The new hardware storage advancement capabilities allowed a larger volume of data storage, lightning speed to process

these large amounts of data from multiple databases, cross-reference to identify certain elements and obtain needed insights and analysis (Boyd & Crawford, 2012; Zhuang, Wu, Chen & Pan, 2017).

The recent developments in modern management science, resulting from the use of state-of-the-art AI applications, require reconsideration of many aspects related to how business is conducted. With these current settings, the most important tool decision-makers need is sound hardware systems comprising large storage space and a fast Central Processing Unit (CPU) to handle the demands of efficient decision-making functions and speed (Jarrahi, 2018).

Simon (1987) believes that decision-making is the heart of management. Decisions are nothing but a series of connected choices, and every critical selection is followed by a series of connected verdicts, decisions may appear insignificant until the goals are implemented and achieved fully. He believes that all organizational processes revolve around decision-making and that organizational behavior is nothing but a result of successive decision-making (Simon, 1979).

The importance of decision-making lies in all management functions and activities. When management exercises the planning function, it makes certain decisions at each stage of developing a plan, whether when setting the goal, or preparing new programs. When management creates an appropriate organization for various tasks and activities, it also designs the organizational structure. When the manager assumes his leadership function, he makes a set of decisions, whether directing his subordinates, coordinating their efforts, consulting their motives, motivating them to perform well, or solving potential problems. When management performs its duty, it also makes important decisions regarding the selection of appropriate technological tools, and standards for measuring work performance (Simon, 1987; Westerman, Bonnet & McAfee, 2014). This is why choosing an appropriate technological tool such as an AI system is very critical for an organization's well-being, profitability, and competitive edge.

It is expected that utilizing AI in an organization can benefit the company in multiple ways

from decision-making to measuring customer expectations and designing new products (Eisenhardt & Zbaracki, 1992; Eisenhardt, 1999; Barnabè, 2011; Westerman, Bonnet & McAfee, 2014).

The Role of Expert Systems in The Decision-Making Process of Strategic Management

The role played by expert systems in decision-making functions is different from the other information systems used for other industries and functions. They rely on what the human element has already learned and apply the results of this learning in specific circumstances and situations. They utilize AI tools to identify and diagnose problems, and access information used to solve them through the knowledge base, which is one of the components of the expert system. They can also identify alternatives to solve problems, evaluate them, and suggest appropriate alternate solutions. Although evaluation of the viability of the solution is the responsibility of the system user, the expert system provides him with the logic that helps him carry out this process. Expert systems are usually used in the business field to play an advisory role. It is always better for the human element to exercise influence in objecting to the output of computers. However, expert systems provide sufficient knowledge to the decision-maker and help them collect the necessary alternatives in the decision-making process. This helps in reducing the percentage of error and managing the state of uncertainty more efficiently. Thus, decisions are made according to a sound scientific methodology. Expert systems also help in the process of monitoring the implementation of decisions during carrying out the work (Edwards et al, 2000; Kersten, 1989).

Challenges and Benefits of AI Applications Adaption at Organizations

With the use of faster data storage space and faster CPU systems, AI has changed the business environment and decision-making process significantly and permanently. At the same time, decision-makers are having difficulties identifying the best solution for their organizational need in this

rapidly changing technological era, since these decision-making support systems and applications come with challenges, risks, and difficulties along with the expected benefits (Shiau, Chen, Wang, & Dwivedi, 2023). It would be wise to review the literature on expected benefits, issues, and obstacles while converting traditional human intellect-based businesses into AI-equipped organizations.

While planning a business model change to include AI systems in organizational IT infrastructure, one of the most important challenges to decide on is the cost-effectiveness of the system (Jarrahi, 2018; Pillai & Sivathanu, 2020). A thorough investigation is needed to evaluate the relative advantage of the AI system as opposed to its cost-effectiveness before initiating the conversion. In basic business terminology, a detailed cost-benefit analysis must be conducted to ensure potential benefits from the system. The other challenges are related to the end users' beliefs and capabilities. Their trust in the system and attitude toward the AI system could be challenging and overcoming these issues ensures the success of the conversion (Pillai & Sivathanu, 2020).

Let's summarize the major areas where decision-makers and organizations would be challenged by the implementation of AI-supported decision-making as we conclude this section:

- The initial investment amount for the system could be high and amortization may take time, especially for small businesses (Kejriwal, 2022; Ismanov, Qayumov, Mukhamadjonova, & Akhmadaliyev, 2024).
- Privacy issues and the security of organizational data may be challenged greatly (Zekos & Zekos, 2021; Brown, Ward, & Duane, 2024).
- Employees may resist change while switching to AI-supported decision-making applications (Li, Ashraf, Amin, & Safdar, 2023).
- AI-supported systems may use older and biased data leading to skewed decision-making practices as seen in Amazon's recruiting policies displaying prejudices against minorities (Keding, 2021)

- The last important challenge is the ethical considerations, which are studied in detail separately in later pages of this research.

Benefits of Adapting AI at an Organization

It is expected that AI will enhance doing business for decision-makers, reduce processing time, improve quality, bring out innovation, allow the use of big data, engage with employees and customers, and large operational costs reduction (Venkatraman, 2017; Davenport & Ronanki, 2018; Wilson, & Daugherty, 2018). As shown in Figure 3, based on the findings of Ashritha and Reddy (2023), there is a linear improvement in decision-making quality each year following the implementation of AI applications or decision support systems (DSS) by businesses (Ashritha, and Reddy, 2023).
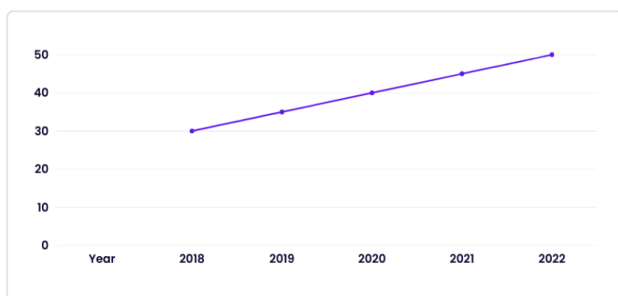
Improved Decision Quality

Figure 3: Application of Decision Support Systems (DSS)-time Versus Improved Decision Quality
Source: Ashritha, and Reddy (2023).

As we can observe in Figure 4, the same study also finds improved efficiency with the application of AI-supported DSS by surveyed businesses (Ashritha & Reddy, 2023).
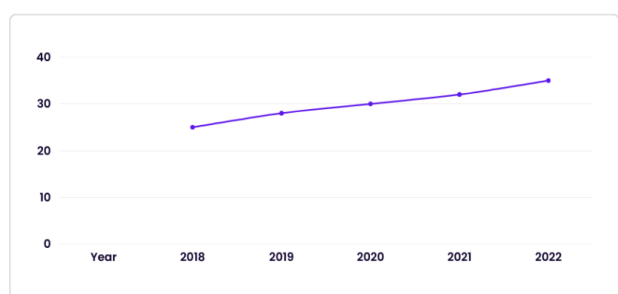
Increased Efficiency

Figure 4: AI Application Versus Improved Efficiency by Businesses (%)
Source: Ashritha, and Reddy (2023).

Let's summarize the major areas where decision-makers and organizations benefit from the application of AI-supported systems as we conclude this section:

- With the application of AI-supported DSS, the decision quality will improve by eliminating human biases and errors by improving the accuracy of the decisions (Oguntibeju, 2024).
- With the use of AI-supported strategic management practices and access to large data quickly, competitive advantage may be ensured by following market trends and greater profitability (Chintala, 2024).
- The application of AI in organizations could help improve risk management and loss prevention (Baryannis, Validi, Dani, & Antoniou, 2019; Zekos & Zekos, 2021).
- AI-supported systems' use can guarantee cost reduction through optimal resource utilization and procurement practices (Ismanov et al, 2024).
- Efficiency and speed can be ensured greatly with the help of AI-supported systems while making strategic decisions (Ashritha, & Reddy, 2023).

Risks of AI Applications and Ethical Consideration

While AI has numerous advantages in multiple areas of science and our daily lives, it also has risks and ethical concerns that need our attention before its wide application. Just like other technological advancements in the past, while human beings can benefit greatly from new technology, it can also create undesirable and unpredicted outcomes for humanity. The case of fossil fuel combustion machine development causing global warming and environmental issues, and nuclear developments causing nuclear incidents, such as the Chornobyl incident, and increasing the fear of nuclear war are great examples of technological developments' adverse effects (Russel & Norving, 2010; Stein, 2022).

Some of the potential risks and ethical issues can be summarized as the autonomous ML ability of AI enhancing its capabilities without any spe-

cific algorithms and instruction, which was mentioned in the earlier quote of Steven Hawking's famous warning. Unregulated ML activities acting oversights can create major legal and human rights issues, posing a threat to human safety and security (Bostrom, 2014). Misuse of sensitive information such as racial, religious, or other confidential data could create serious social and legal rights issues (Bostrom, 2014). Cybersecurity issues such as data theft and hacking activities become a serious concern to consider as AI usage expands into sensitive areas.

Some biases were discovered in the recruitment practices of Amazon using an automated hiring system that discriminated against women and ethnic minorities (Stahl et al, 2021; Popova & Karadzhov, 2023). Similarly, AI used in risk assessment programs such as Correctional Offender Management Profiling (COMPAS) for surveillance areas and in legal areas was discriminatory against certain groups and created legal dilemmas for the authorities in the past (Yeung, 2020; Popova & Karadzhov, 2023).

The last, but one of the most important issues for social and labor scientists is the issue of labor force reduction with the application of AI-supported systems and automation. Although labor-cost reduction is looked upon as one of the most beneficial aspects of AI technology for the business community, it is also one of the risky areas that require active management from social service and political authorities. Management of labor and social issues to avoid any major unemployment shifts, social problems associated with job force reduction, employee retention, and economic crises may need to be reconciled if AI applications become widespread. Eurobarometer 2017 surveys reveal that 88% of the surveyed population fear job loss and economic problems with the widespread use of AI-supported system applications and the use of automated robots (Yeung, 2020; Burlacu & Luta, 2023).

Conclusion

Organizations should evaluate their technological infrastructure and employees' adaptation to these technologies before integrating AI into their existing systems. For this conversion, the compatibility of existing systems with AI, data quality, organizational hardware, and software requirements should be reviewed in detail. To increase the knowledge and skills of employees, training programs should be organized for users, and management strategies should be adapted before the implementation of AI applications to avoid any due problems. Therefore, comprehensive preparation should be carried out by taking organizational culture, ethical concerns, and the compatibility of AI-support systems with organizational strategic goals into account. These steps ensure that AI-capable systems' integration is successful and it provides the maximum expected benefits.

Considering the ethical dimensions and potential risks of AI applications, it is thought that these technologies should be included in a balanced manner in management processes. Issues such as data privacy, algorithmic neutrality, and employee job security are critical for the ethical and social use of these technologies. Additionally, problems such as the risk of AI systems making wrong decisions and lack of transparency should be managed with human supervision and oversight. AI should be integrated into the organizational grid in a balanced way as a supporting tool, without the exclusion of organizational, ethical, and human factors.

We must be cognizant that AI is one of the modern technological sciences that aims to understand the nature of human intelligence and simulate intelligent human behavior through computer programs.

AI plays an important role in increasing the effectiveness of the decision-making process by deconstructing and analyzing problems to find solutions and choosing the optimal solution. The decision-making process is the basis, axis, and essence of the decision-making process through which all activities can be accomplished, and the success of this process requires reliance on advanced systems, namely AI.

Prior to the implementation or integration of AI-capable systems within organizations, it is essential to ensure a sufficient level of readiness

among employees regarding the adoption of artificial intelligence technologies. This readiness is crucial, as AI has the potential to enhance organizational efficiency and foster strategic thinking.

The decision-makers must pay attention to the distinguished mental capabilities possessed by the employees, who are described as the intellectual capital of the organization. After all, they are the ones contributing to organizational excellence and creativity, by applying the aforementioned AI-supported systems.

Recommendations

After a thorough investigation of benefits, challenges, and ethical considerations for the use of AI-supported systems and applications in strategic management areas, the following recommendations are advised:

- It is recommended that before the digitalization of organizations and the use of AI applications, investment in a viable training program for all of the involved would eliminate, or minimize the potential complications.
- Before any organizational change, consideration of ethical issues and rectification of these potential issues must be considered and appropriate measures must be put in place.
- A transitional period must be planned before a full conversion or use of AI-supported systems, tapping a hybrid approach of human expertise and AI-driven application solutions working together.

Following the adaptation of an AI-driven decision-making system, a continuous performance evaluation and monitoring period must be implemented to assess accuracy, efficiency, and avoidance of any said biases to ensure a smooth transition and trouble-free operation.

References

Abramson, N., Braverman, D., & Sebestyen, G. (1963). Pattern recognition and machine learning. *IEEE Transactions on Information Theory, 9*(4), 257–261.

Al-Imam, A., Motyka, M. A., & Jędrzejko, M. Z. (2020). Conflicting opinions in connection with digital superintelligence. *IAES International Journal of Artificial Intelligence, 9*(2), 336-348.

Alenezi, H. S. & Faisal, M. H. (2020). Utilizing crowdsourcing and machine learning in education: Literature review. *Education and Information Technologies, 25*(4), 2971-2986.

Ashritha, P. & Reddy, P. S. (2023). Impact of artificial intelligence on management decision-making. *International Journal of Advances in Business and Management Research (IJABMR), 1*(2), 10-18.

Bahrammirzaee, A. (2010). A comparative survey of artificial intelligence applications in finance: artificial neural networks, expert system and hybrid intelligent systems. *Neural Computing and Applications, 19*(8), 1165-1195.

Barnabè, F. (2011). A "system dynamics-based Balanced Scorecard" to support strategic decision making: Insights from a case study. *International Journal of Productivity and Performance Management, 60*(5), 446-473.

Baryannis, G., Validi, S., Dani, S., & Antoniou, G. (2019). Supply chain risk management and artificial intelligence: state of the art and future research directions. *International journal of production research, 57*(7), 2179-2202.

Basak, S., Agrawal, H., Jena, S., Gite, S., Bachute, M., Pradhan, B. & Assiri, M. (2023). Challenges and limitations in speech recognition technology: A critical review of speech signal processing algorithms, tools and systems. *CMES-Computer Modeling in Engineering & Sciences, 135*(2), 1053-1089.

Bean, R. (2019). Why fear of disruption is driving investment in AI. *MIT Sloan Management Review*.

Boden, M. A. (1984). Impact of artificial intelligence. *Futures, 16*(1), 60-70.

Borges, A. F., Laurindo, F. J., Spínola, M. M., Gonçalves, R. F., & Mattos, C. A. (2021). The strategic use of artificial intelligence in the digital era: Systematic literature review and future research directions. *International journal of information management, 57*, 102225.

Bose, B. K. (1994). Expert system, fuzzy logic, and neural network applications in power electronics and motion control. *Proceedings of the IEEE, 82*(8), 13031323.

Bostrom, N. (2014). *Superintelligence: Paths, dangers, strategies.* Oxford University Press.

Boyd, D. & Crawford, K. (2012). Critical questions for big data: Provocations for a cultural, technological, and scholarly phenomenon. *Information, Communication and Society, 15*(5), 662–679.

Brown, J. A., Ward, A., & Duane, J. N. (2024). Data privacy, ethics and strategic leadership. In *Handbook of Research on Strategic Leadership in the Fourth Industrial Revolution,* 330-347. Edward Elgar Publishing.

Bruno, Z. (2024). The impact of artificial intelligence on business operations *Global Journal of Management and Business Research, 24*(1), 1-9.

Burlacu, F. & Luta, G. D. G. (2023). The crucial importance of the European Union AI act as the world's first regulation on artificial intelligence. *Journal of Information Systems & Operations Management, 17*(2), 59-76

Büyükyılmaz, O. (2024). İşletme yönetim süreçleri ve yapay zekâ. in Gürkan, S. & Aydoğan, D. (Eds.) *Işletme ve Yapay Zekâ,* 1-18. Ekin Basım Yayın Dağıtım.

Cellan-Jones, R. (2014). Stephen Hawking warns artificial intelligence could end mankind. *BBC news, 2*(10), 2014.

Chang, W. Y. (2019). A data envelopment analysis on the performance of using artificial intelligence-based environmental management systems in the convention and exhibition industry. *Ekoloji Dergisi,* 107, 4897.

Chintala, S. (2024). Next-Gen BI: Leveraging AI for competitive advantage. *International Journal of Science and Research (IJSR), 13*(7), 972-977.

Cockburn, I. M., Henderson, R., & Stern, S. (2019). The impact of artificial intelligence on innovation: An exploratory analysis. (Ed.: A. Agrawal, J. Gans & A. Goldfarb), *The Economics of Artificial Intelligence: An Agenda,* 115-148. Chicago: The University of Chicago Press.

Craig, P. S., Goldstein, M., Rougier, J. C., & Seheult, A. H. (2001). Bayesian forecasting for complex systems using computer simulators. Journal of the American Statistical Association, *96*(454), 717-729.

Cubric, M. (2020). Drivers, barriers and social considerations for AI adoption in business and management: A tertiary study. *Technology in Society, 62,* 101257.

D'Souza, S., Prema, K. V., & Balaji, S. (2020). Machine learning models for drug–target interactions: current knowledge and future directions. *Drug Discovery Today, 25*(4), 748-756.

Davenport, T. H. & Ronanki, R. (2018). Artificial intelligence for the real world. *Harvard Business Review, 96*(1), 108-116.

Dhaliwal, J. S. & Tung, L. L. (2000). Using group support systems for developing a knowledge-based explanation facility. *International Journal of Information Management, 20*(2), 131-149.

Duan, Y., Edwards, J. S., & Dwivedi, Y. K. (2019). Artificial intelligence for decision making in the era of Big Data–evolution, challenges and research agenda. *International Journal of Information Management,* 48, 63-71.

Duangekanong, S. (2022). Applications of artificial intelligence for strategic management of organization. *ABAC ODI Journal Vision. Action. Outcome, 9*(2), 202-217.

Dwivedi, Y. K., Rana, N. P., Jeyaraj, A., Clement, M., & Williams, M. D. (2019). Re-examining the unified theory of acceptance and use of technology (UTAUT): Towards a revised theoretical model. *Information Systems Frontiers, 21*(3), 719-734.

Edwards, J. S., Duan, Y., & Robins, P. (2000). An analysis of expert systems for business decision making at different levels and in different roles. *European Journal of Information Systems, 9*(1), 36–46.

Eisenhardt, K. M. (1999). Strategy as strategic decision making. MIT Sloan Management Review, *40*(3), 65.

Eisenhardt, K. M. & Zbaracki, M. J. (1992). Strategic decision making. *Strategic Management Journal, 13*(2), 17-37.

Fjelland, R. (2020). Why general artificial intelligence will not be realized. *Humanities and Social Sciences Communications, 7*(1), 1-9.

Ford, N. (1989). From information-management to knowledge-management - the role of rule induction and neural net machine learning techniques in knowledge generation. *Journal of Information Science, 15*(4–5), 299–304.

Foulquier, N., Redou, P., Le Gal, C., Rouvière, B., Pers, J. O., & Saraux, A. (2018). Pathogenesis-based treatments in primary Sjogren's syndrome using artificial intelligence and ad-

vanced machine learning techniques: a systematic literature review. *Human Vaccines & Immunotherapeutics*, *14*(11), 2553-2558.

Gladwell, M. (2010). The sure thing." *New Yorker*, *85*.

Haenlein, M. & Kaplan, A. (2019). A brief history of artificial intelligence: On the past, present, and future of artificial intelligence. *California Management Review*, *61*(4), 5-14.

Harry, A. (2023). Role of AI in Education. *Interdiciplinary Journal & Hummanity (INJURY)*, *2*(3), 259-268.

Haugeland, J. (1989). *Artificial intelligence: The very idea*. MIT Press.

Ismanov, I., Qayumov, N., Mukhamadjonova, D., & Akhmadaliyev, B. (2024, April). AI and cost management: Strategies for reducing expenses and improving profit margins in business. in *2024 International Conference on Knowledge Engineering and Communication Systems (ICKECS)* (1), 1-7. IEEE.

Jarrahi, M. H. (2018). Artificial intelligence and the future of work: Human-AI symbiosis in organizational decision making. *Business Horizons*, *61*(4), 577-586.

Karnik, A. P., Chhajer, H., & Venkatesh, S. B. (2024). Transforming prosthodontics and oral implantology using robotics and artificial intelligence. *Frontiers in Oral Health*, *5*, 1442100.

Keding, C. (2021). Understanding the interplay of artificial intelligence and strategic management: four decades of research in review. *Management Review Quarterly*, *71*(1), 91-134.

Kedra, J., Radstake, T., Pandit, A., Baraliakos, X., Berenbaum, F., Finckh, A., ..., & Gossec, L. (2019). Current status of use of big data and artificial intelligence in RMDs: a systematic literature review informing EULAR recommendations. *Rheumatic Musculoskeletal Diseases (RMD) open*, *5*(2), 1-8.

Kejriwal, M. (2022). AI in practice and implementation: Issues and costs. In *Artificial Intelligence for Industries of the Future: Beyond Facebook, Amazon, Microsoft and Google*, 25-45. Cham: Springer International Publishing.

Kersten, F. (1989). *Phenomenological method: Theory and practice* (Vol. 1). Springer Science & Business Media.

Koch, C. (2016). How the computer beat the go player. *Scientific American Mind*, *27*(4), 20-23.

Kurter, O., Temizkan, V., Yılmaz K., & Yetgin, M. A. (2021). *İşletmelerde dijital dönüşüm-Digital-transformation in businesses.* DetayYayıncılık.

Leavy, B. (2020). Marco Iansiti and Karim Lakhani: strategies for the new breed of "AI first" organizations. *Strategy & Leadership*, *48*(3), 11-18.

LeCun, Y., Bengio, Y., & Hinton, G. (2015). Deep Learning. *Nature, 521*(7553), 436-444.

Lemley, J., Bazrafkan, S., & Corcoran, P. (2017). Deep learning for consumer devices and services: pushing the limits for machine learning, artificial intelligence, and computer vision. *IEEE Consumer Electronics Magazine, 6*(2), 48-56.

Li, C., Ashraf, S. F., Amin, S., & Safdar, M. N. (2023). Consequence of resistance to change on AI readiness: Mediating–moderating role of task-oriented leadership and high-performance work system in the hospitality sector. *sage Open*, *13*(4), 21582440231217731.

Liang-Pholsena, X. (2020), "*Asia's hotels warming up to automation thanks togrowing social distancing norms,* https://skift.com/2020/04/22/asias-hotels-warming-up-to-automation-thanks-to-growing-social-distancing-norms/

McCarthy, J. (2007). From here to human-level AI. *Artificial Intelligence, 171*(18), 1174-1182.

Michie, D. (1968). "Memo" functions and machine learning. *Nature, 218*(5136), 19-22.

Micu, A., Capatina, A., Cristea, D. S., Munteanu, D., Micu, A. E., & Sarpe, D. A. (2022). Assessing an on-site customer profiling and hyper-personalization system prototype based on a deep learning approach. *Technological Forecasting and Social Change, 174*, 121289.

Morocho-Cayamcela, M. E., Lee, H., & Lim, W. (2019). Machine learning for 5G/B5G mobile and wireless communications: Potential, limitations, and future directions. *IEEExplore*, 7, 137184-137206.

Müller, V. C. & Bostrom, N. (2016). Future progress in artificial intelligence: A survey of expert opinion. In Vincent C. (Ed), *Fundamental issues of artificial intelligence*, Springer, 555-572.

Negnevitsky, M. (2008). Computational intelligence applications to crisis management in power systems. International Journal of Automation and Control, *2*(2-3), 247-273.

Nishant, R., Kennedy, M., & Corbett, J. (2020). Artificial intelligence for sustainability: Challenges, opportunities, and a research

agenda. *International Journal of Information Management, 53*, 102104-102117.

Oguntibeju, O. O. (2024). Mitigating artificial intelligence bias in financial systems: A comparative analysis of debiasing techniques. *Asian Journal of Research in Computer Science, 17*(12), 165-178.

Orgeolet, L., Foulquier, N., Misery, L., Redou, P., Pers, J. O., Devauchelle-Pensec, V., & Saraux, A. (2020). Can artificial intelligence replace manual search for systematic literature? Review on cutaneous manifestations in primary Sjögren's syndrome. *Rheumatology, 59*(4), 811-819.

Pancholi, S., Wachs, J. P., & Duerstock, B. S. (2024). Use of artificial intelligence techniques to assist individuals with physical disabilities. *Annual Review of Biomedical Engineering, 26*.

Perez, J. A., Deligianni, F., Ravi, D. & Yang, G. Z. (2018). Artificial Intelligence and Robotics. *arXiv preprint arXiv:1803.10813, 147*, 2-44.

Pillai, R. & Sivathanu, B. (2020). Adoption of artificial intelligence (ai) for talent acquisition in it/ites organizations. *benchmarking, 27*, 2599–629.

Popova, R. & Karadzhov, V. (2023). Artificial intelligence–some ethical issues in the context of state government. in *International Applied Social Sciences Congress, 538-556*.

Porter, M. E. & Millar, V. E. (1985). How information gives you competitive advantage. *Harward Business Review, 63*(4), 149-160.

Rawlinson, K. (2015). Microsoft's Bill Gates insists AI is a threat. *BBC News. 29 January 2015*.

Rupali, M. & Amit, P. (2017). A review paper on general concepts of Artificial intelligence and machine learning. *International Advanced Research Journal in Science, Engineering and Technology, 4*(4), 79-82.

Russel, S. J. & Norving, P. (2010). *Artificial intelligence. A Modern Approach.* (3rd ed.). Pearson.

Sadat, B. (2023). Impact of artificial intelligence on business: An analysis. *International Journal of Science and Research, 12*(1), 705-709.

Samala, N., Katkam, B. S., Bellamkonda, R. S., & Rodriguez, R. V. (2020). Impact of AI and robotics in the tourism sector: a critical insight. *Journal of Tourism Futures, 8*(1), 73-87.

Sezer, O. B., Gudelek, M. U., & Ozbayoglu, A. M. (2020). Financial time series forecasting with deep learning: A systematic literature review: 2005–2019. *Applied soft computing, 90*, 106181.

Sharma, S. (2024). Benefits or concerns of AI: A multistakeholder responsibility. *Futures*, 103328.

Shiau, W. L., Chen, H., Wang, Z., & Dwivedi, Y. K. (2023). Exploring core knowledge in business intelligence research. Internet Research, *33*(3), 1179–1201

Simon, H. A. (1987). Making management decisions: The role of intuition and emotion. *Academy of Management Perspectives, 1*(1), 57-64.

Simon, H. A. (1979). Rational decision making in business organizations. *The American Economic Review*, 69(4), 493-513.

Solomonoff, R. J. (1985). The time scale of artificial intelligence: Reflections on social effects. *Human Systems Management, 5*(2), 149–153.

Spangler, W. E. (1991). The role of artificial intelligence in understanding the strategic decision-making process. *IEEE Transactions on Knowledge and Data Engineering, 3*(2), 149-159

Srivastava, G. & Bag, S. (2024). "Modern-day marketing concepts based on face recognition and neuro-marketing: a review and future research directions." *Benchmarking: An International Journal*, 31(2), 410-438.

Stahl, B. C., Andreou, A., Brey, P., Hatzakis, T., Kirichenko, A., Macnish, K., ..., & Wright, D. (2021). Artificial intelligence for human flourishing–Beyond principles for machine learning. *Journal of Business Research, 124*, 374-388.

Stein, A. L. (2022). Assuming the risks of artificial intelligence. *BUL Rev.,102*, 979.

Trappl, R. (1986). *Impacts of artificial intelligence*. North Holland Publishing Co.

Tussyadiah, I. (2020). A review of research into automation in tourism: Launching the Annals of Tourism Research Curated Collection on Artificial Intelligence and Robotics in Tourism. *Annals of Tourism Research, 81*, 102883.

Valéry, P. (1989). *The Outlook for Intelligence:(With a Preface by Francois Valery)* (Vol. 10). Princeton University Press.

Vas, P. (1999). *Artificial-intelligence-based electrical machines and drives: application of fuzzy, neural, fuzzy-neural, and genetic-algorithm-based techniques* (Vol. 45). Oxford University Press.

Vasiljeva, T., Kreituss, I., & Lulle, I. (2021). Artificial intelligence: The attitude of the public and representatives of various industries. *Journal*

of Risk and Financial Management, *14*(8), 339-368.

Venkatraman, N. V. (2017). *The Digital Matrix: New Rules for Business Transformation Through Technology*. Penguin Random House India.

Wang, P. (2019). On defining artificial intelligence. *Journal of Artificial General Intelligence*, *10*(2), 1-37.

Westerman, G., Bonnet, D., & McAfee, A. (2014). The nine elements of digital transformation. *MIT Sloan Management Review, 55*(3), 1-6.

Wilson, H. J. & Daugherty, P. R. (2018). Collaborative intelligence: Humans and AI are joining forces. *Harvard Business Review, 96*(4), 114–123.

Wirtz, J., Kunz, W., & Paluch, S. (2021). The service revolution, intelligent automation and service robots. *European Business Review, 29*(5), 909.

Yeung, K. (2020). Recommendation of the council on artificial intelligence (OECD). *International Legal Materials*, *59*(1), 27-34.

Yigitcanlar, T., Desouza, K. C., Butler, L., & Roozkhosh, F. (2020). Contributions and risks of artificial intelligence (AI) in building smarter cities: Insights from a systematic review of the literature. *Energies*, *13*(6), 1473.

Zekos, G. I., & Zekos, G. I. (2021). AI risk management. *economics and law of artificial intelligence: Finance, economic impacts. Risk Management and Governance*, 233-288.

Zheng, J. N., Chien, C. F., & Wu, J. Z. (2018). Multi-objective demand fulfillment problem for solar cell industry. *Computers & Industrial Engineering*, *125*, 688-694.

Zhuang, Y. T., Wu, F., Chen, C., & Pan, Y. H. (2017). Challenges and opportunities: From big data to knowledge in AI 2.0. *Frontiers of Information Technology & Electronic Engineering*, *18*(1), 3–14.