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ARTIFICIAL INTELLIGENCE USAGE IN SUSTAINABILITY REPORTING
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SÜRDÜRÜLEBİLİRLİK RAPORLAMASINDA YAPAY ZEKA KULLANIMI

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Abstract

Sustainability reporting, which enables the disclosure and measurement of information regarding businesses' environmental, social, and economic activities, policies, and risks, aims to enhance trust and transparency between businesses and their stakeholders. In this context, the accuracy and reliability of the information included in sustainability reporting gain significance for sustainable production and, more importantly, for a sustainable world. At this point, artificial intelligence, which is increasingly integrating into all aspects of our lives, is expected to contribute to the accuracy and reliability of the information that businesses need for sustainability practices and reporting, as well as the information they disclose to their stakeholders. This study aims to identify the potential contributions of artificial intelligence applications to the sustainability reporting process and the possible challenges that may arise from their use in the future. It has been concluded that while artificial intelligence will contribute to the sustainability reporting process by collecting, analyzing, and reporting data more efficiently, accurately, and transparently, it will also bring potential challenges, such as ensuring that the data is accurate, impartial, and complete, and considering ethical issues related to how artificial intelligence technology is used and its potential impacts on society and the environment.

Keywords: *Sustainability Reporting, Artificial Intelligence, Sustainability*
JEL Classification: *M41, M49, Q56*

Öz

İşletmelerin çevresel, sosyal ve ekonomik faaliyetleri, politikaları ve risklerine yönelik bilgilerin açıklanması ve ölçülmesine olanak sağlayan sürdürülebilirlik raporlaması işletmeler ile paydaşlar arasındaki güveni ve şeffaflığı arttırmayı amaçlamaktadır. Bu bağlamda sürdürülebilir üretim ve daha da önemlisi sürdürülebilir bir dünya için sürdürülebilirlik raporlamasında yer alan bilgilerin doğruluğu ve güvenilirliği önem kazanmaktadır. Bu noktada hayatımızın her alanına girmeye başlayan yapay zekanın, sürdürülebilirlik uygulamaları ve raporlamasında işletmelerin ihtiyaç duyacağı ve paydaşlarına açıklayacağı bilgilerin doğruluğu ve güvenilirliğine katkı sağlaması beklenmektedir. Çalışmada yapay zeka uygulamalarının sürdürülebilirlik raporlaması sürecinde sağlayabileceği katkıları ve bu uygulamaları kullanmanın gelecekte yaratabileceği muhtemel zorlukları tespit etmek amaçlanmıştır. Sürdürülebilirlik raporlaması sürecinde yapay zekanın, verileri daha verimli, doğru ve şeffaf bir şekilde toplayıp analiz etmesi ve raporlaması gibi katkıları olacağının yanı sıra yapay zeka teknolojisinin nasıl kullanıldığı ve toplum ile çevre üzerindeki potansiyel etkileri hakkındaki etik konuların göz önüne alınması, verilerin doğru, tarafsız ve eksiksiz olmasının sağlanması gibi muhtemel zorlukları olacağı sonucuna varılmıştır.

Anahtar Kelimeler: *Sürdürülebilirlik Raporlaması, Yapay Zeka, Sürdürülebilirlik*
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EXTENDED ABSTRACT

Background:
Advancements in production technologies have led to increased levels of production and consumption, which in turn have resulted in the rapid and unplanned depletion of natural resources and have begun to cause both direct and indirect harm to the environment. The rise in production has brought about numerous consequences that negatively affect the future of our planet, including water pollution, an increase in waste, and the climate crisis. This situation has transformed environmental sensitivity from a mere necessity into an obligation for businesses, creating a demand for more responsible corporate behavior. The growing awareness of sustainability has prompted companies to disclose the environmental and social impacts of their operations. In this context, sustainability reporting has become increasingly widespread, aiming to inform stakeholders about the implications of non-financial information related to corporate activities.

Research Purpose:
One of the key challenges businesses face in the context of sustainability is the implementation of reporting systems related to environmental, social, and governance (ESG) criteria. In this regard, it becomes evident that possessing a strong infrastructure alone is not sufficient; it is also essential to explore how artificial intelligence (AI), which already plays a significant role in current accounting practices, can contribute to enhancing sustainability reporting. Establishing a sustainability reporting system can be particularly demanding for businesses due to the large volume of data that must be collected and the need to systematize reporting processes. Therefore, AI is expected to provide substantial support in these processes. This study aims to investigate the current and potential applications of AI in sustainability reporting, with a particular focus on how this technology can enhance the reliability of the implementation phase of such a critically important reporting system.

Methodology:
The documentation review method was used as the data collection tool. Relevant literature and selected company data were examined, and data related to the subject were collected. The data were analyzed, discussed, and evaluated. At the end of the process, the findings of the study were identified, leading to the conclusion.

Findings:
Artificial intelligence (AI) can enable companies to collect, analyze, and report sustainability data more efficiently, accurately, and transparently. Overall, AI has the potential to play a significant role in advancing sustainability reporting; however, realizing this potential requires careful consideration of various issues related to its implementation. The role of AI in sustainability reporting is expected to become increasingly important, and it will be critical for businesses to understand and leverage the full potential of these technologies in order to achieve their sustainability objectives.

Conclusion:
The use of artificial intelligence in the sustainability reporting process necessitates careful consideration of several critical factors. These include ethical issues concerning how AI technology is used and its potential impacts on society and the environment; ensuring that the data is accurate, unbiased, and complete; securing a qualified workforce with the necessary knowledge and skills to accurately interpret AI-generated data; ensuring the transparency of AI systems; maintaining continuous investment in research and development to keep pace with new advancements; implementing robust measures to protect data privacy and security; achieving integration with existing systems within the organization; and conducting cost-benefit analyses to determine the most appropriate approach for resource allocation. Considering these factors is of great importance for ensuring the accuracy and reliability of sustainability reporting.

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1.INTRODUCTION

Developments in manufacturing technologies, which came with the industrial revolution, caused some problems also with the increase of consumption. The fast and unplanned consumption of natural resources damaged the environment both directly and indirectly. It also brought problems that affect our world, such as the increase of waste caused by rapidly increasing production, the pollution of water resources, global warming, climate crisis, and desertification. This situation turned businesses' necessity of being sensitive to the environment into an obligation and brought them the demand to be more responsible.

The sustainability reporting emerged with the increase of shareholders' expectations and pressures about explaining the impacts that the increasing public awareness about sustainability and the corporate actions have on the environment and society. With the increase in this interest and pressure, the demand of reporting the environmental and social effects of corporate actions increased, as well. Following this demand, sustainability reporting became widespread with the aim of informing shareholders about the impacts of businesses' non-financial data. Researches showed that enterprises' social and environmental impact has also an effect on the share value of the businesses. This finding made sustainability reporting more important for the companies to show their commitment to environmental, social, and governance factors to their shareholders.

One of the difficulties that businesses face is the implementation of the reporting systems related to environmental, social, and governance standards. To that effect, it turns out that it is not enough for the businesses to have a strong infrastructure and it becomes crucial to investigate how artificial intelligence, which already has an important role in accounting applications, can improve sustainability reporting.

Artificial intelligence is expected to contribute to reporting processes because it can be challenging for businesses to establish a sustainability reporting system due to the high volume of data to be collected as well as the placement of reporting processes into a system. Being accountable to the regulators and shareholders in regard to their sustainability performance, businesses have a natural need for effective data management systems and tools that can efficiently collect, analyze, and report sustainability data in order to overcome the difficulties they face both internally and externally within this period.

The sustainability reporting aims to increase the trust and transparency between the business management and the shareholders. Artificial intelligence has a potential of increasing the reliability of the implementation step of a reporting system that has such a critical importance, and this study intends to investigate artificial intelligence's existing and potential utilization within this process.

2. SUSTAINABILITY REPORTING

Nowadays, it is not that much possible for businesses to leave a mark only with their products, profitability ratio, or share prices. They also need to showcase their sensitivity particularly to their employees, and to the environment and society they are in. With society becoming conscious, businesses discovered that operations conducted only to generate profits have low chances for success. Therefore, businesses understood the importance of presenting reports of non-financial data together with reports including financial data. At this point, the importance of sustainability reporting, which has a critical role in the presentation of businesses' non-financial data, emerged (Gümrah and Güngör Tanç, 2018: 336).

Thanks to sustainability reporting, businesses are able to publish and measure data on their environmental, social, and economic operations, policies, and risks. Sustainability reporting is also an important tool for businesses to showcase their stance on the dynamics of the society (Özata Canlı and Serçemeli, 2024: 129). Sustainability reporting provides shareholders with information about the contributions and effects of non-financial data on the businesses' capacity for creating

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value. In other words, sustainability reporting is a report that informs shareholders about the organization's contribution and role in the society, and that enlightens the society about the organization's performance in social, environmental, and governance fields (Akdoğan, 2024: 225).

On the other hand, sustainability reporting makes also important contributions to organizations, such as finding financing or developing a strategy. The benefits of sustainability reporting for organizations can be listed as follows (Özsözgün Çalışkan, 2012: 60; Ertan, 2018: 465):

-By increasing transparency, it helps the organization to find long term and appropriate financing,
-It enables a more efficient management of the organization's environmental, social, and economic strategies by increasing risk awareness,
-It increases the reputation, brand value, customer loyalty, and market share of the organization,
-It aims to increase the motivation and awareness of the employees, and it supports innovation,
-Through supporting continuous improvement, it increases organizations' ability to reach their targets,
-It contributes to the sustainability of the operations by increasing the efficient utilization of the resources.

In addition to the benefits it offers to organizations, sustainability reporting has also a vital importance in regard to the creation of a globally sustainable economic system by enabling governments to evaluate organizations' environmental, social and economic impacts and contributions.

It has been a challenging process for companies to embrace sustainability as an indispensable part of an organization model. Although it is a widely accepted fact that sustainable ecosystems are a necessity for the continuity of organizations, companies' tendency for sustainability reporting has not accelerated in a manner to tackle the problems related to sustainability (Özbirecikli, 2006: 74).

KPMG's research on organizations' sustainability reporting shows that in 1993, 12% of the largest 100 companies located in 52 countries were conducting sustainability reporting whereas this rate increased to 80% in 2020. While in 1997, 35% of world's largest 250 companies that were in the Fortune 500 list were doing sustainability reporting, this ratio reached 96% in 2020. During the developments within this period, the financial impacts of adopting sustainability practices on companies have been an important factor in the decision-making processes. For example, organizations have not had the tendency of decreasing their greenhouse gas emissions as its costs surpass the benefits, whereas they have been making efforts to decrease water and air pollution, whose costs are below the benefits it brings (Abeysekera, 2022: 1387).

Several global foundations developed many guiding documents and frameworks about explanations on sustainability in a response to shareholders' demands for reliable sustainability reporting standards. In this context, several initiatives and directives have been published, primarily the Global Reporting Initiative (GRI), the International Financial Reporting Standards (IFRS) Foundation, the European Financial Reporting Advisory Group (EFRAG), the Sustainability Accounting Standards Board (SASB), the International Integrated Reporting Council (IIRC), and the European Commission. The Task Force on Climate Related Financial Disclosure (TFCD), the G20, the G7, and studies carried out by the World Economic Forum are among the other initiatives (Moodaley and Telukdarie, 2023: 3).

Sustainability reporting is based on the goal of ensuring companies are held accountable for the environmental, social, and economic impacts of their operations. On the other hand, frameworks, standards, and the diversity in the practices related to sustainability reporting show the complexity of sustainability that includes many actors, stakeholders, and various interests.

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Since there are both voluntary and obligatory preparation approaches for sustainability reporting, organizations either report voluntarily and define the reports' contents themselves, or they do it as an obligation and prepare their reports based on the rules identified. Turkish Sustainability Reporting Standards (TSRS) and the board's decision on the implementation of the standards, which were published in the Official Gazette on 29.12.2023, identified the criteria for the organizations that do mandatory sustainability reporting in our country, and mandated them to publish sustainability reports as of 01.01.2024 (Korga and Aslanoğlu, 2024: 4).

3.THE CONCEPT OF ARTIFICIAL INTELLIGENCE

There are multiple definitions and approaches about artificial intelligence nowadays. In 2018, the European Commission came up with a general definition of artificial intelligence. According to this definition, "*Artificial intelligence refers to systems designed by humans that, given a complex purpose, act in the physical or digital world by perceiving their environment and interpreting the structured or unstructured data collected."* (EU Commission, 2018).

John McCarty, known as the father of artificial intelligence, first used the term artificial intelligence at a conference in 1956. Although artificial intelligence is known as a new field, studies on this concept started in the 1950s. Alan Turing and other scientists on this field have developed the Turing test to evaluate the thinking ability of a machine by starting writing computer programs that will mimic human behaviors and thoughts. Statistics on artificial intelligence, which is regarded as the most widespread technology of the last decade, show that artificial intelligence has been adopted in many matters and its impact on society is great. It is a known fact that people utilize artificial intelligence nowadays from daily decisions such as getting film and product suggestions to decisions on more complex areas like autonomous systems (Koçyiğit and Darı, 2023: 430).

Having made big progress since its appearance, artificial intelligence provided economic and social benefits especially with its developments in areas like data mining, machine learning, natural language processing, automation systems, and robotic applications. The fact that the benefits that automation and artificial intelligence bring to businesses and users have also significant contributions to economic growth has increased the interest in artificial intelligence. Considering the focus that large technology companies like Google, Amazon, and Apple put on artificial intelligence, it is possible to say that its place in many areas of economic and social life will become more important (Ulukapı Yılmaz and Yılmaz, 2024: 173).

It would be beneficial to explain the sub-components of artificial intelligence to understand its utilization in business processes. Sub-components of artificial intelligence can be summarized as follows (Bellikli, 2024: 4):

-Machine learning: It is the sub-component that can improve itself via computer systems that learn from experiences. Machine learning includes operations, such as modelling and predicting with data.

-Deep learning: It is the sub-component that uses multi-layered neural networks to learn complex associations and patterns. It operates at high efficiency with very large data sets.

-Natural language processing: The sub-component focusing on producing, interpreting, and understanding the human language. It conducts operations like text inferencing, text classification, and grammar analysis by working on texts.

-Image processing: It is the sub-component that processes images and performs tasks like image analysis, face recognition, and object recognition. It detects and defines patterns.

--Robotics: It is the sub-component developing robots that are able to make decisions and perform tasks by using motors, artificial intelligence techniques and sensors that enable the robots to interact with the surroundings.

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-Automatic decision-making: A sub-component that automatizes decision-making processes by analyzing data. The aim is to make the best decision by using machine learning algorithms or pre-identified rules.

Developments in artificial intelligence show that this technology has a high potential for transforming several industries and ways of operation. Recently, artificial intelligence has made fast progress in many areas and industries, such as communication, education, and public institution practices. The spread and progress of these technologies provide individuals with different capabilities. Artificial intelligence practices, whose place in day-to-day life has also grown with the developments, have started to transform into a digital assistant, which people are able to communicate with, and have also begun to appear in almost every part of people's lives with the increase of human interaction caused by the rise in smartphone usage (Koçyiğit and Darı, 2023: 431-432).

4.ARTIFICIAL INTELLIGENCE USAGE IN SUSTAINABILITY REPORTING

With its ability to develop and automatize data collection and interpretation processes, artificial intelligence is transforming sustainability reports. Some opinions argue that artificial intelligence has not completely reached its transformative potential yet and will have a greater impact on shaping sustainability reporting in the future.

By enabling the collection, analysis, and effective transmission of organizations' sustainability data, artificial intelligence contributes to the improvement and automatization of sustainability reporting. This process has the potential to have an impact on decreasing human error and increasing accuracy and comprehensiveness by integrating sustainability data retrieved from various resources, such as records, surveys, audits, third party providers, and rating systems. Furthermore, artificial intelligence can uncover the insights, patterns, trends, and anomalies in sustainability data, create meaningful and applicable sustainability reports, and can also contribute to processes, such as materiality assessment, benchmarking, and adapting the reports based on the interests and expectations of the shareholders (Sulkowski, 2024: 10).

To a certain degree, artificial intelligence can increase the reliability of sustainability reporting by assisting in verifying the reliability of the data and providing assurance, and it can increase the reports' probability to conform with applicable law, regulations, and standards. Additionally, by contributing to the communication and interaction processes with the shareholders, artificial intelligence could support the reports' processes of collecting shareholders feedback, conducting the materiality assessment, and presenting the sustainability information in a personalized and interactive way for users (Sulkowski, 2024: 10-11).

Most of the large organizations have extensive management information that needs to be analyzed, and they are already using artificial intelligence tools to automatize routine and time-consuming tasks in order to increase efficiency. In exceptional cases and in situations where a judgement or selection has to be made, artificial intelligence, together with human interference, can analyze and interpret information faster than humans and can decrease the risk of prejudices to a minimum. Managers have been using both financial and non-financial information in their decision-making processes for a long time. Data that enter the system comes from several resources with different reliability levels. In this regard, financial information plays a more crucial role in decision making processes because it is perceived as more reliable compared to non-financial information. Information on sustainability is more fragmented than financial information because it is generally kept in systems apart from main bookkeeping systems; and therefore, artificial intelligence is able to eventually provide an integrated solution to consolidate financial and non-financial management information. Nowadays, this field is a matter that many organizations try to develop. Therefore, the positive result of the advancements in artificial intelligence could be an increasing perception on the

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reliability of sustainability information among managers; and this could help to promote sustainability agendas internally in organizations (De Villiers et al., 2024: 101-102).

In their 2023 sustainability report, Türkiye Şişe ve Cam Fabrikaları A.Ş. indicated that they had integrated artificial intelligence practices to many processes, such as workplace health and safety, field control, and ramp security systems, and that by this means, they conducted activities towards identifying insecure behaviors and situations by extending digitalization and automation. The report touched on their goal to manage processes from a single center by integrating various technological components, such as data engineering, robotic production, and artificial intelligence, into their digitalization processes. In this context, the company emphasized that their goal was to create a digital transformation ecosystem and indicated that they had adopted the principal of competing with data, and they pointed out that they had been using digitalization in many areas to ensure sustainability. This approach, and the contributions the company's practices made to their sustainability processes together with the fact that they had been processing data with artificial intelligence systems contributed to sustainability reports significantly (Şişe Cam, 2024).

In their integrated annual report in 2023, Coca-Cola İçecek A.Ş. indicated that they had been using artificial intelligence in many areas, such as the supply process, production, resource planning, warehouse management, and customer relations, in order to increase efficiency and contribute to sustainability. The company stated in the report that they had created a reliable corporate reporting infrastructure with artificial intelligence models that they developed, and that through data-oriented transformation programs, data analytics had become the focus of their operation models. In this context, they emphasized that they had been using artificial intelligence in ensuring sustainability and in sustainability reporting (Coca-Cola İçecek, 2024).

As can be understood from the company examples above, some companies have started to utilize artificial intelligence applications in order both to create sustainable operation models, and to share these models with the shareholders in their sustainability reports. It is possible to say that their aim to be sensitive when it comes to analyzing the data obtained through applications in their operation models contributes to them presenting the contribution of the model they apply to sustainability in their reports.

While traditional audit procedures consist of making inferences based on samples, artificial intelligence enables the verification of all operations thanks to its ability to analyze large data volumes quickly. This shows the importance of using artificial intelligence in assurance audit services. Artificial intelligence can provide additional assurance if used for testing conformity to certain standards and rules, and it can help to save time in reporting. In this regard, artificial intelligence can play a crucial role in establishing advanced continuous audit systems. Furthermore, artificial intelligence can contribute to the application by presenting analyses in order to provide regulatory bodies with supportive information in investigation and sanction activities. On the other hand, it can clearly and succinctly offer the regulations related to sustainability and help with communicating the expectations related to these matters (De Villiers et al. 2024: 104).

Artificial intelligence has the potential to transform sustainability reporting in accounting. It can analyze large data sets quickly and correctly, define patterns and trends, and it can predict future performance. These skills can help companies with better understanding their impact on the environment and society, and with taking more conscious decisions to reduce their carbon footprint and improve their sustainability. However, the impact that artificial intelligence will have on sustainability reporting also comes with various potential challenges that could be faced in the future.

Some of the potential challenges that the use of artificial intelligence in sustainability reporting could bring are as follows (Ahmad et al., 2023: 646-647):

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-Ethical Considerations: The usage of artificial intelligence in sustainability reporting raises ethical questions about how technology is utilized and its potential effects on society and the environment. Companies should evaluate the ethical consequences of using artificial intelligence in sustainability reporting and ensure transparency in using this technology.
-Data Accuracy: The accuracy of the data that artificial intelligence systems use in sustainability reporting is critical. Companies have to ensure that the data they use is correct, impartial, and complete so that they do not make false assumptions or achieve false results.
-Human Resources: Artificial intelligence systems might be powerful tools; however, they cannot replace expertise in sustainability reporting. Companies have to ensure that they have the right staff who has the necessary skills and knowledge to utilize artificial intelligence efficiently and interpret the results accurately.
-Standardization: There is currently no standardized framework for artificial intelligence in sustainability reporting, which might cause inconsistencies and confusions among shareholders. Companies will have to cooperate to identify the industrial standards and best practices for using artificial intelligence in sustainability reporting.
-Transparency: The use of artificial intelligence can create challenges around transparency and accountability in sustainability reporting. Companies will have to ensure the transparency of artificial intelligence systems, and they will need to be able to account for the decisions taken by technology.
-Adaptation: The field of artificial intelligence is progressing rapidly, and companies will have to adapt to the changes in the technology and the new developments in the field. This will bring the necessity to constantly invest in research and development, and to be willing to learn and trial with artificial intelligence technologies.
-Privacy: Using artificial intelligence in sustainability reporting raises some concerns about data privacy and security. Companies have to make sure that they collect the data in accordance with the privacy regulations, and they need to take necessary precautions to protect the date from breaches.
-Cost: Implementing artificial intelligence usage in sustainability reporting might require a substantial investment in terms of both technology and personnel. Companies should conduct a cost-benefit analysis for using artificial intelligence and identify the best approach to allocate resources.
-Creativity: One of the challenges that artificial intelligence faces in sustainability reporting is that the technology is limited to the data with which it is trained. Companies have to make sure that artificial intelligence systems are designed in a way that will encourage creativity and innovation in sustainability reporting instead of solely repeating past performance.

Some aspects that organizations should take into consideration while using artificial intelligence applications in sustainability reporting have been pointed out above. While it is known that the use of artificial intelligence will bring great benefits to organizations in terms of reaching accurate and reliable information on time, it is expected that designing the future of sustainability reporting through the controlled use of these applications, which have a transformative power in most fields of life, to achieve their maximum benefit will contribute more to reach a sustainable world.

5.CONCLUSION AND RECOMMENDATIONS

With society understanding the importance of sustainability, the demand for reporting the environmental and social impacts of business operations increased, and with this demand, the notion of sustainability reporting has become crucial. Already being actively used in accounting, artificial intelligence has the potential to make substantial changes in the ways organizations report

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their environmental, social, and governance performance in sustainability reporting, as well. Artificial intelligence can enable companies to collect, analyze, and report their sustainability data more efficiently, accurately, and transparently. In general, artificial intelligence has the potential to have a crucial role in advancing sustainability reporting; however, there are some matters that need to be taken into consideration while using artificial intelligence in order that this potential can be realized. Artificial intelligence's role in sustainability reporting will become more and more important, and it will be critical for organizations to understand and utilize the full potential of these technologies in order to achieve their sustainability goals.

Factors, such as the way how artificial intelligence technology is used and considering the ethical matters about its potential effects on the society and the environment, ensuring the data is accurate, impartial, and complete, finding the appropriate human resource with the necessary knowledge and skills to interpret artificial intelligence data accurately, ensuring the transparency of artificial intelligence systems, constantly investing in research and development, and adapting to new developments, taking necessary precautions towards data privacy and security, ensuring the integration of existing systems in the organization, and identifying the most appropriate approach in resource allocation by conducting a cost-benefit analysis are factors of critical importance in the utilization of artificial intelligence in the sustainability reporting process, and therefore, it is crucial to take these factors into consideration in order that the reporting is accurate and reliable.

In order to integrate the data used in sustainability reporting to the report, necessary updates can be made in the existing accounting programs and other automation systems, and it can be ensured that the information that will be used in the report fits the purpose of the sustainability reporting. Acquiring sustainability-related data on time and on as-needed basis by adding artificial intelligence modules to accounting programs will contribute to the accuracy and reliability of the reporting. On the other hand, in order to provide the human resources that will process the data, teaching subjects related to the importance and utilization of artificial intelligence in accounting courses taught in universities will contribute to the students, who are the future practitioners, and to the inevitable process of change that we are in.

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