

# The Role of Artificial Intelligence in Achieving Environmental Sustainability: An Analytical Study of the Opinions of a Sample of Employees at the Ship Captain Company, Najaf Al-Ashraf Factories

\*Naghham Rasool Radhi, \*\*Firas Adnan Abbas

#Mohammed Hadi Basim Jasim, \*Hussien Kareem Jassim

\*University of Kufa, college of Administration and Economics, Najaf, IQ.

\*\*Al-Qadisiyah University / College of Administration and Economics

#Ministry of Justice / Iraqi Reform Department

DOI:10.37648/ijtbm.v16i01.008

<sup>1</sup>Received: 28 December 2025; Accepted: 30 January 2026; Published: 28 February 2026

## Abstract

This research aims to study the role of artificial intelligence (AI) in achieving environmental sustainability by analyzing the current situation of the company under study. One hundred and thirty questionnaires were distributed to employees of the Najaf Al-Ashraf Factories Company, with a 95% response rate. The research results showed a statistically significant impact of AI, in its four dimensions (awareness, use, ethics, and evaluation), on the company's environmental sustainability. This impact is reflected in (environmental damage, environmental health, and environmental importance). The research employs an analytical approach to study the impact of AI on the company's environmental sustainability, focusing on how AI can be used to improve and support the environment through coordination and integration among the company's various departments to achieve environmental goals.

The study concluded that AI and its dimensions have a positive impact on environmental sustainability at the company level. It also recommended the adoption of AI systems for monitoring energy consumption, thus urging the company to invest immediately in AI solutions.

**Keywords:** *Artificial intelligence; environmental sustainability; Najaf Al-Ashraf Factories Company.*

## 1. Introduction

The rapid growth of artificial intelligence (AI) and its far-reaching impact across various sectors necessitate an assessment of its influence on achieving the Sustainable Development Goals (SDGs). AI has the greatest impact on the global economy, playing a crucial role in achieving environmental sustainability, from eradicating hunger and poverty to ensuring sustainable energy, promoting gender equality, and protecting and conserving biodiversity. The SDGs are divided into three categories: society, the economy, and the environment. This categorization allows us to gain an overview of the general impact of AI. AI is used in a wide range of environmental sectors, including natural resource conservation, energy management, wildlife protection, pollution control, agriculture, clean energy, and waste management. AI will support low-carbon, energy-efficient energy systems, which are essential for addressing climate change. AI can help manage the complex structure and functions of ecosystems effectively. In addition to the

<sup>1</sup> How to cite the article: Radhi N.R., Abbas F.A., Jasim M.H.B., Jassim H.K. (February 2026); The Role of Artificial Intelligence in Achieving Environmental Sustainability: An Analytical Study of the Opinions of a Sample of Employees at the Ship Captain Company, Najaf Al-Ashraf Factories; *International Journal of Transformations in Business Management*, Vol 16, Issue 1, 123-145, DOI: <http://doi.org/10.37648/ijtbm.v16i01.008>

applications mentioned above, it can also help identify desertification trends across large areas and inform environmental decision-making and planning. The design of advanced AI-based products, technologies, and research may require enormous computing resources, which can be provided through large computing centers. These facilities require enormous energy consumption and have a massive carbon footprint. AI-based ecosystem information may lead to resource exploitation, although this type of misuse is not adequately reported. AI development must be supported and protected by the appropriate regulatory body. This oversight will inevitably lead to gaps in safety, transparency, and ethical standards. The need today is to develop more environmentally conscious AI, not just for today, but for future generations.

With the emergence of novel environmental challenges, artificial intelligence (AI) has turned out to be an indispensable instrument in creating sustainable solutions that will enable us to save our planet and pass it down to the new generations. Environmental sustainability is complex and a difficult task to manage. Nevertheless, most of these issues can be effectively addressed with the assistance of human resources with the introduction of AI. Sustainability is inseparably connected with the economy, the environment, and society.

## 2. Research Methodology

### 2.1 Research Problem

In recent years, the growth of interest in new technologies like artificial intelligence (AI) has been stimulated by environmental concerns, discussions, and programs, which have created awareness and interest in the topic of environmental concerns. With the environmental concerns of the 21st century, AI has emerged as a crucial and specific area of research to solve many of the environmental sustainability problems (Chaudhary, 2023:1411). Consequently, many studies seek to understand AI's role in environmental sustainability across fields such as biodiversity, water, energy, and transportation (Yadav & Singh, 2023:214). Therefore, this research attempts to examine the impact of the relationship between AI and environmental sustainability within the company "Ruban Al Safina" (Ship Captain). The research problem can thus be formulated as follows: How can "Ruban Al Safina" utilize AI tools to achieve environmental sustainability? The main research problem branches into several sub-questions, including:

- What is the level of AI's impact on environmental sustainability?
- To what extent do the dimensions of AI impact environmental sustainability?

### 2.2 Importance of the Research

The importance of this research can be summarized in the following points:

- Determining the extent of employees' awareness of the role of artificial intelligence in environmental sustainability: The research helps measure the level of knowledge and understanding among the study sample regarding the importance of applying artificial intelligence technologies to achieve resource efficiency and reduce the environmental impact of industrial processes.
- Evaluating the feasibility of applying artificial intelligence solutions at the Ship's Captain Company: This provides direct analytical results that can be used as a basis for adopting AI-related sustainability strategies and solutions, thus supporting the company's efforts to transition towards environmentally friendly practices.
- Contributing to the promotion of sustainable development at the national level: The study presents a practical model from the industrial sector in Najaf, enriching the literature and supporting decision-makers in developing national policies for integrating technology and sustainability.

### **2.3 Research Objectives**

The research objectives can be summarized as follows:

- To analyze the awareness and perceptions of employees at the Ship Captain Company/Najaf Factories regarding the role and impact of artificial intelligence (AI) in supporting and achieving environmental sustainability.
- To assess the potential and opportunities for using AI technologies in the company's operations, as well as to identify and analyze the challenges and obstacles that hinder the application of these technologies to serve environmental goals.
- To develop and present a set of practical and informed recommendations and solutions that the company can adopt to enhance the integration of AI into its strategies to achieve higher environmental efficiency and reduce negative impacts.

### **2.4 Research Hypotheses**

- The first main hypothesis: There is a significant and positive impact of artificial intelligence on environmental sustainability at the macro level of the company under study. The following sub-hypotheses stem from this main hypothesis:
- There is a significant and positive impact of the awareness dimension on environmental sustainability at the macro level of the company under study.
- There is a significant and positive impact of the application dimension on environmental sustainability at the macro level of the company under study.
- There is a significant and positive impact of the evaluation dimension on environmental sustainability at the macro level of the company under study.
- There is a significant and positive impact of the ethics dimension on environmental sustainability at the macro level of the company under study.

- A research hypothesis was developed on the basis of a system of assumptions that provide definite explanations of the research variables (artificial intelligence, environmental sustainability). Figure 1) illustrates this.

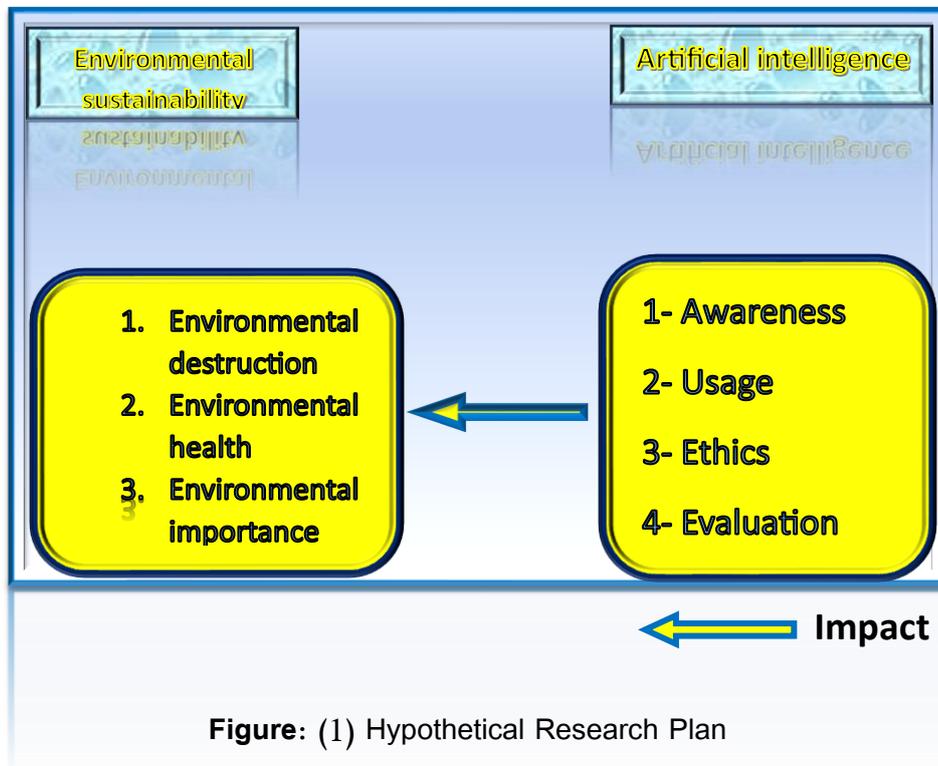


Figure: (1) Hypothetical Research Plan

Source: Prepared by the Researchers

2.5 Research Items, Dimensions, and Variables Coding.

To conduct the research, it used rigorous scales that measured its main and sub-variables, having adapted most of the items to the specifics of the Iraqi environment.

Table: 1 demonstrates the items used in the scales and the sources that were used in calculating the scale items:

Source	Paragraphs	Research dimensions	Key variables	
(Ma et al.,2024)	AW <sub>1</sub> -AW <sub>6</sub>	Awareness) AW(	artificial intelligence AI	1
	US <sub>1</sub> -US <sub>6</sub>	Usage) US(		
	EV <sub>1</sub> -EV <sub>6</sub>	Evaluation) EV(		
	ET <sub>1</sub> - ET <sub>6</sub>	Ethics )ET(		
(Imani et al.,2019)	ED <sub>1</sub> -ED <sub>3</sub>	Environmental destruction )ED(	Environmental sustainability ES	2
	EH <sub>1</sub> -EH <sub>3</sub>	Environmental health )EH(		

	EI <sub>1</sub> -EI <sub>6</sub>	Environmental importance )EI(		
--	----------------------------------	----------------------------------	--	--

Source: Prepared by the researcher

### 2.6 The research population and sample

The study population consisted of 180 senior management, in addition to the employees of the Captain of the Ship Company, Najaf Al-Ashraf Factories, according to (Krejcie & Morgan, 1970:608). The sample required (123) responses to represent this population. Therefore, the researcher decided to distribute (130) questionnaires randomly, of which (125) were returned, and the number of unreturned questionnaires was (5). As for the questionnaires that were not valid for statistical analysis, the number was (2), while the valid responses for statistical analysis were (123), which represented the study sample, with a percentage of (95%). The number of forms distributed in the high-voltage transformer factory was (50), of which (48) were valid for statistical analysis. As for the number of forms distributed in the cable factory, the number was (33), of which (30) were returned. As for the number of questionnaires distributed in the pole casting factory, the number was (47), of which (45) were returned. The questionnaires were distributed according to the number of individuals working in the aforementioned factories. Table (2) shows this:

Table: 2 Research Sample

Response rate	Number of returned forms	Number of forms distributed	Company	
%96	48	50	High-voltage transformer factory	1.
91%	30	33	Cable factory	2.
%96	45	47	Column casting plant	3.
95%	123	130	Total	

### 3. First: Artificial Intelligence

Global environmental issues in the 21st century have made artificial intelligence (AI) a recognized field of research for addressing the most current environmental sustainability challenges. AI has been referred to as the science and engineering of creating intelligent machines. Essentially, computer science is the field under which AI falls, and its performance relies on prior learning, which is used to increase the success rate in solving environmental problems (Nti et al., 2022:1).

- **The Concept of Artificial Intelligence**

Conceptual and model knowledge give rise to the next level of knowledge referred to as wisdom. To learn and apply wisdom, a person must use moral values and principles, as well as being a specialist. This takes time and some maturity that comes along with age and experience. The ancient Greek philosophers, including Plato and Aristotle, also wrote on the idea of wisdom; yet it has not been an issue of discussion in recent times. There are many ways that seem to lead to wisdom. An individual might be endowed with encyclopedic knowledge of facts and figures about the countries of the world, but this fact will not render him or her wise. Rather, one is wise when he or she uses knowledge in solving complex problems of an ethical and practical nature and finds possible solutions. Intelligence is another step toward improving wisdom. The objective of an entity is intelligence to become a complete and artificially intelligent entity (Akerkar, 2019:3).

Artificial intelligence (AI), first introduced by John McCarthy in 1956, refers to the study and development of intelligent machines. Computer science encompasses AI, which relies on learning from past experiences to improve its ability to solve complex environmental problems. AI is the scientific and engineering field that aims to create machines with intelligence comparable to that of humans. It has been observed that AI robots acquire knowledge through experience while performing tasks initiated by humans, in order to adapt to new inputs and overcome environmental obstacles. Therefore, in our current digital age, AI has addressed the limitations of human reasoning, leading to the emergence of intelligent machines equipped with artificial brains capable of interacting with human minds (Raihan et al., 2024:65).

Chaudhary (2023:1411) views artificial intelligence (AI) as the engineering and science behind the development of intelligent machines. It is a branch of computer science, and its capabilities are based on learning experiences that help increase the chances of success in solving environmental problems. As Poole argues, the intelligence of high-order machines that occurs through the instinctive intelligence of animals and humans can be artificial intelligence, scientific and technological knowledge that enables machines to be just as intelligent as human beings. Researchers have also discovered that AI systems are able to experience and learn in order to generate artificial services and adjust inputs to evolving environmental factors. In the contemporary world, AI has broken the boundaries of human thinking, and it has brought a new world where smart machines with artificial minds interact with human ones

Belk et al. (2023:2-3) explain that AI is the ability to combine perception, reasoning, learning, and execution by an autonomous, non-biological system that replicates or surpasses human capabilities, or a system that demonstrates such capabilities. In other words, AI exhibits some aspects of intelligence, meaning it is capable, at least to some extent, of adapting to different contexts and learning from experience. Borges et al. (2021:2-3) added that artificial intelligence (AI) can be considered a technology introduced as a means to mimic human performance while possessing the ability to draw its own inferences through learning. This enables it to assist human cognition or even replace humans in tasks requiring cognitive function. In general, AI technologies can improve performance in terms of speed, flexibility, personalization, scale, innovation, and decision-making. Furthermore, companies can leverage AI to generate value across various business dimensions: automating processes, gaining insights from data for decision-making, attracting customers and employees, and designing and delivering new products and services.

- **The Importance of Artificial Intelligence**

Companies have recognized the relevant business opportunities arising from the adoption of artificial intelligence (AI) to enhance competitiveness, re-engineer products or services, or rethink business strategies. The growing interest in AI in business stems from the technological maturity achieved in both computational capabilities and the ability to analyze massive amounts of data in real-time and in short periods. From a business perspective, AI systems and data analytics allow individuals to organize information, which is typically already available in the market in a fragmented manner, and transform data into business decisions, thus focusing only on the tools that are useful for facilitating decision-making processes within the company (Sestino & Mauro, 2022: 1-2).

The revolutionary potential of artificial intelligence (AI) is being harnessed to address these business challenges and advance the vision of a sustainable and environmentally friendly world. AI, a broad field within computer science, is crucial for creating machines capable of learning, reasoning, problem-solving, and decision-making—functions historically reserved for humans. Equipped with powerful algorithms and processing capabilities, AI systems analyze massive datasets, identify trends, and generate predictions. AI becomes an effective tool for improving many aspects of environmental management when used to combat climate change and promote sustainability. This includes developing environmentally friendly technologies, conserving resources, monitoring the environment, and improving energy efficiency (Satpathy et al., 2024:2).

- **Akerkar (2019:6) further emphasizes the importance of AI by highlighting its ability to**

Identify valuable and useful patterns in large volumes of data, regardless of their type, such as text, images, videos, and any other unstructured data.

Effortlessly adjust to changes in your data patterns and underlying operating conditions with enable self-learning models.

Make superior, quicker selections by making the most of all your information, and leave predictive analytics behind and shift to descriptive analytics.

Gain unique insights into data prototypes, enabling optimal customer segmentation and processing.

Make it easier for business users and data scientists to interpret, respond to, and use data by improving visualization and transparency.

Introduce new business models and create value by accelerating innovation through discovering new patterns in data and fully leveraging knowledge assets.

- **Characteristics of Artificial Intelligence**

Artificial intelligence (AI) is characterized by its ability to mimic human behavior through self-learning, data processing, and highly efficient, complex decision-making. Key characteristics of AI include accuracy, speed, adaptability to changing environments, and the ability to predict and analyze patterns in ways that surpass traditional human perception. Several researchers have identified several AI characteristics:

The integration of AI has emerged as a transformative force, reshaping traditional work practices within organizations. The rapid advancement of AI technologies has led to their widespread adoption across various industries, from manufacturing and healthcare to finance and retail. As AI systems become increasingly complex, organizations are leveraging their capabilities to automate routine tasks, improve decision-making processes, and drive innovation (Murire, 2024:1).

The core idea is the importance of creating supportive environments that minimize threats and foster resilience and trust in AI applications. This aims to enhance positive experiences and encourage employee adoption. Furthermore, it has been suggested that ideas from the field of positive technology, which encompasses human-computer interaction, should be integrated. This field focuses on how the development and deployment of technology contribute to enhancing human well-being and prosperity by generating positive experiences from technology use, such as supporting self-actualization, positive impact, and enhanced human connection (Brivio et al., 2018:1).

In the field of environmental sustainability, artificial intelligence (AI) technologies are used for the continuous monitoring of complex environmental data and for identifying patterns, trends, and effective interventions to reduce the environmental impact of human activities. These rapid advancements have been made possible by the increasing availability of data and the development of AI. This progress has enabled organizations to explore promising opportunities to improve operational efficiency, boost productivity, enhance decision-making processes, and support managerial decisions. By leveraging available data and AI technologies, organizations have been able to generate value and drive innovation in ways previously unimaginable (Romeo & Lacko, 2025:2).

The collaborative processes between human work teams and artificial intelligence provide an important social resource by providing social support, feedback, and interactions outside the organization, which helps humans better cope with AI control as a stressor at work. AI can also support human team members during high-pressure situations by enhancing their situational awareness (Klonek & Parker, 2025:2-3).

- **Dimensions of Artificial Intelligence**

Artificial intelligence (AI) is an emerging technological science that strives to mimic and broaden human intelligence. The advent of AI technology has consequently rendered AI cognition critical in explaining the ability of people to utilize this technology. Digital technology is an electronic computer science and technology, and a general concept. AI technology is a field of computer science that dwells in the nature of intelligence. It tries to come up with a new machine that is intelligent enough to react in a manner, just like human intelligence. Technically, the AI technology is based on digital technology. Conceptually, AI has extensive interconnection with cognitive neuroscience concepts and others. Many ethical and moral issues are involved in the development of AI. Nevertheless, to be learned about a technology, a user must possess more than a utilitarian view of technology. Consequently, the whole interaction process should be comprehended and the right attitude and values to AI systems identified. Wang et al. (2023:2-3) reported that in the AI cognition framework, there are four dimensions: awareness, use, evaluation, and ethics.

1. Awareness: The concept of awareness is concerning the capacity to recognize and contrast AI technology and use AI-related apps. The cognitive process of awareness is something that goes on prior to engaging in the use of a specific technology, and the notion of awareness is another significant parameter of understanding and knowledge of the users. According to these facts, awareness is also regarded as an important driver of AI literacy, and positive behavior also leads to the readiness of people to utilize digital products. Ma and Chen (2024:9) point out that one of the core concepts and principles of AI is awareness. The behavioral intentions of individuals that are formed by Wang et al. (2025:4) are largely based on the knowledge base and the belief systems as the primary cognitive requirements that influence and shape the way individuals make such decisions. The responsible use of AI can be predetermined by the public awareness of AI ethics. The increasing tendency is to assume that AI ethical awareness is constituted of 5 major dimensions, including transparency, fairness, privacy, accountability, and non-harm.

Usage: According to Ma and Chen (2024:9), usability is the capacity of utilizing AI in everyday life and education. According to Wang et al. (2023:4), it is the capability to utilize and use AI technology effectively to get things done. This framework is interested in the operational levels, such as the availability of the AI applications and tools, the effectiveness of working with AI applications and tools, and the possibility to combine various forms of AI applications and tools. In addition, the AI literacy will be directly connected to the everyday use of AI products and applications by users. Efficient users of digital products will be positively disposed to digital technology, i.e., AI literacy will be positively related to attitudes of users.

Evaluation: The definition of Ma and Chen (2024:9) is the capacity to critically examine AI tools and the content these tools can generate. According to Wang et al. (2023:4), it is the possibility to approach and examine AI applications and their results critically, select and evaluate them. Due to the obscurity of AI and its complexities, its product needs to be studied and analyzed. Consequently, assessment is a core skill in the AI literacy. Assessment of information and outcomes is a common term that is used as the evaluation, whereas in the context of AI literacy, the evaluation also demands the ability of the users to make correct opinions about AI applications and products. Moreover, the users who are able to assess AI applications or products are usually those who have a great deal of experience in the use of the applications or products. According to Wang et al. (2025:4), the critical evaluation of AI can be deemed as an important part of the AI ethical reasoning. It is related to the fact that people should be able to critically analyze the information that AI offers them and draw conclusions about whether its output is proper. Moral judgment, which refers to what one must believe or do, is also largely dependent on critical thinking, which entails the skills to subject oneself to rational and analytical thinking. Artificial intelligence (AI) can be influenced by algorithmic bias, though it is a powerful tool. The uncritical trust may cause adverse effects, including discrimination and social exclusion, when people act upon the suggestions of AI based on its bias or even harmful content. To prevent this threat, critical thinking can be crucial in the moral reflection of AI, which is the capability of people to analyze critically processes and output AI to recognize and resolve the biases that may exist in the AI system.

Ethics: According to Ma and Chen (2024:9), ethics is also related to the ethical and safe utilization of artificial intelligence. According to Wang et al. (2023:4), ethics means having the capability to identify the duties and dangers of the use of AI technology. Ethical concerns have never ceased to be the topic of discussion in the sphere of AI. On

the one hand, AI technology is convenient, but on the other hand, it forces individuals to consider thoroughly and discuss intelligence and ethics in it openly. That is why an AI-literate person should be capable of comprehending ethical concerns and right judgment so that to secure the correct and adequate utilization of AI technology. Most researchers believe that ethics is an essential part of their frameworks in other related aspects of literacy. The most essential behaviors and emotional considerations of ICT literacy are attitudes, values, and ethics. As a result, one can predict that ethics of users regarding AI literacy will be positively related to their attitude towards AI literacy. To use in daily life, misuse of digital technology typically implies the decrease in the awareness about ethical problems, and those, who consume more digital products, are more likely to be aware of the problems since they have a higher chance of becoming victims of abuse.

#### 4. Second: Environmental Sustainability

Environmental sustainability is a fundamental pillar in global development contexts. Recent studies confirm that escalating environmental pressures, such as climate change and biodiversity loss, have necessitated advanced resource management models based on efficiency and resilience. Numerous studies indicate that adopting low-carbon technologies, green governance policies, and a circular economy is a key requirement for reducing the environmental footprint of production and service sectors. Some recent studies have shown that integrating environmental innovation into organizational strategies reduces risks associated with regulatory compliance and climate change, while also enhancing competitiveness. Therefore, environmental sustainability has become a strategic approach adopted by governments and organizations to ensure the well-being of present and future generations. From this perspective, this research examines mechanisms for enhancing environmental sustainability through institutional transformation, green technology, and integrated resource management (Chang, 2024:1).

- **The Concept of Environmental Sustainability**

The term environmental sustainability was first coined by scientists at the World Bank. Initially, the term "environmentally responsible development" was used (World Bank, 1992). Later, the term "environmentally sustainable development" was adopted. Finally, the concept of environmental sustainability was developed. According to Goodland, environmental sustainability seeks to "improve human well-being by protecting the sources of raw materials used to meet human needs and ensuring that human waste disposal does not exceed its capacity to prevent harm." Goodland's concept of environmental sustainability falls within the resource-limited eco-economic framework, which is defined as the limits of growth. Environmental sustainability is also defined as a set of constraints on the four main activities that regulate the parameters of the human economy subsystem: "the use of renewable and non-renewable resources at the source, and pollution and waste absorption at the disposal" (Moldan et al., 2012:6).

The concern for environmental sustainability was implicit in the need for sustainable development based on three pillars: economic, social, and environmental. An environmentally sustainable system must maintain a stable base of natural resources and avoid the over-exploitation of renewable resources, including agricultural productivity and air balance. Environmental sustainability is at the heart of sustainable development. It has been defined as making decisions to minimize the negative impacts of human activities, as well as taking measures to use non-renewable resources wisely, equitably, and fairly for current and future generations. Morelli defined it as a state of balance, resilience, and consistency provided to meet the needs of society, provided that these needs do not exceed the capacity of sustainable ecosystems to continuously regenerate products to meet those needs. In the same vein, Moldan observed that environmental sustainability is the maintenance of natural services at the required levels due to the relationship between these services and human well-being. Thus, the nature of this relationship is the fundamental characteristic of supporting and maintaining ecosystems. Therefore, environmental sustainability depends on the responsible management of natural and human resources that supports the needs of current generations and safeguards the interests of future generations. This is a challenge for individuals and communities and requires significant efforts to educate the population about this issue (Massoudi et al., 2019:480).

Usubiaga-Liaño & Ekins (2021:3) define environmental sustainability as the preservation of essential environmental functions, thereby maintaining the capacity of natural capital to provide those functions. This includes the ability to

preserve valuable qualities in the physical environment and maintain nature services at an appropriate level. Olayinka & Owolabi (2021:488-489) argue that environmental sustainability reporting can be defined as a crucial means of enhancing transparency in communicating information to stakeholders about an organization's strategy regarding the conservation of the natural environment. In other words, it is an important tool for gaining a competitive advantage, improving economic performance, and enhancing an organization's legitimacy and reputation. The Global Reporting Initiative (2011) defined environmental sustainability reporting as a dimension of sustainability reporting that addresses the impact of organizations on living and non-living natural systems, such as ecosystems, land, air, and water. Therefore, environmental sustainability reporting communicates information about corporate responsibility for the environment and its stewardship through strict adherence to regulatory requirements and investment in conservation.

Nandagopal et al. (2018:161) assert that sustainability symbolizes a just world with responsible governments, businesses, and individuals striving to protect the natural environment and promote social justice, while simultaneously pursuing economic growth. Environmental sustainability is defined as "the practice of responding to environmental issues in a socially responsible manner."

Omardin et al. (2015:108) explain that the core idea of environmental sustainability is to focus on environmental conditions to create a constructive product that is environmentally conscious and minimizes undesirable aspects. Awareness of environmental sustainability is the first step toward achieving sustainability in projects. Awareness of environmental sustainability and its importance has increased globally over the past few decades.

It is worth noting that the concept of environmental sustainability, as indicated by Vanderheiden (2008:435), defines a state and gives it a normative dimension: about the basic capacities of the life-supporting environment (providing clean air, water, food, and a stable climate), sustainability results from actions or policies that allow for the continuous human use of environmental services without depletion (the ideal to which the concept is linked), avoiding those that are unsustainable and incompatible with this goal.

Naturally, from a humanistic perspective, Ekins (2011:637) argues that what matters concerning the environment is not specific stocks of natural capital per se, but rather the capacity of the capital stock as a whole to continue performing the environmental functions that make a significant contribution to human well-being. Therefore, it is logical to define environmental sustainability as the preservation of important environmental functions, and thus the preservation of the capital stock's capacity to provide those functions. This closely approximates the strong end of the distinction between weak and strong sustainability. The researcher believes that environmental sustainability is a smart management of resources that can balance social, economic, and environmental systems while maintaining their vital functions as well as their natural resources over time, taking into account reducing the negative impact of humans and ensuring that the balance between development and nature's regenerative capacity is long-term.

- **The Importance of Environmental Sustainability**

The latest concerns, discussions, and initiatives into the environmental field have increased the level of social awareness and enthusiasm, which triggered the desire to explore new technologies, including artificial intelligence (AI). The notion of environment sustainability is a complicated and challenging issue to manage. Nevertheless, through the introduction of AI, most of the issues might be effectively resolved with the help of human resources. Sustainability is related closely to the economy, the environment and the society. AI is vital in managing environmental sustainability and making sure that the present and future needs are fulfilled, and it has gained significance in the new and urgent environmental issues (Chaudhary, 2023:1411). Some researchers have emphasized the importance of environmental sustainability as highlighted as follows:

1- The importance of sustainability lies in achieving a balance between society, the environment, and the economy through the adoption and implementation of necessary policies, strategies, and technologies. It is clear that environmental sustainability in organizational strategic planning projects, and more importantly in the built environment, will only be achieved if planning methods work in conjunction with the organization's policy concepts

and applications. It is evident that collaborative work during project implementation will undoubtedly bring benefits to the entire project in the end (Cubukcuoglu, 2022:250). 2. The environmental importance of sustainability is evident in its pursuit of improving human well-being by protecting the sources of raw materials used to meet human needs and minimizing the harm caused by them. The environmental perspective, also known as the ecological dimension, is primarily embodied in preventing the negative impacts of production processes.

3. Environmental sustainability is beneficial in terms of improving air quality, improving water quality, and reducing energy and water consumption. Common benefits include reducing negative environmental impacts, mitigating the risk of environmental disasters, contributing to the development of natural resources, and reducing the use of non-renewable materials, water, emissions, waste, and pollutants (Fauzi et al., 2021:238-239).

4. The term business sustainability, also known as corporate sustainability, refers to the management and coordination of environmental, social, and financial demands and concerns to ensure responsible, ethical, and sustainable success. A sustainable organization engages in and embodies these activities, ultimately contributing to eliminating destructive impacts on the biosphere and society and improving their health. A sustainable organization is also one that engages in and embodies these activities, ultimately contributing to the elimination of destructive impacts on the biosphere and society, and improving their health. Having a sustainable company can raise awareness of the importance of sustainability (Vartavičiūtė et al., 203:104).

It can be argued that an environmental approach to sustainability enables organizations to gain a competitive advantage through their ability to confront all challenges, address environmental problems, adapt to crises, and transform them into strengths that distinguish them from other organizations. From this perspective, an organization can rely on its ability to develop a successful sustainability strategy capable of navigating all stages of crises.

- **Dimensions of Environmental Sustainability**

Environmental sustainability represents a fundamental framework for understanding the capacity of the natural system to support all human activities without disrupting its vital functions. Studies also highlight the importance of integrating these dimensions of environmental sustainability into urban planning and economic policies to ensure a long-term balance between the environment's regenerative capacity and growth. Studying the dimensions of environmental sustainability is a pivotal step in guiding institutions and societies towards more responsible and sustainable practices. Imani et al. (2019) identified three main dimensions of environmental sustainability:

- **Environmental Destruction**

This refers to actions by individuals that cause direct or indirect changes to the physical, chemical, and/or biological environment that exceed standard criteria for environmental damage (Mispansyah et al., 2023:13). In recent decades, business organizations have witnessed a significant increase in concern about environmental degradation (environmental destruction). This growing awareness is reminiscent of the period following World War I, when European society began to realize the extent of the devastation and damage inflicted on the environment. Consequently, this growing awareness within organizations today has contributed to reshaping and restructuring the understanding of the nature of business and economic processes. These processes are no longer isolated from their environmental impacts, but rather are considered part of a reality that necessitates acknowledging organizational responsibilities towards the environment and the risks of environmental degradation (destruction) resulting from their operational practices (Johnson, 2013:221).

- **Environmental Health**

The past centuries have witnessed increasing interest in the intersection between health and the environment. This trend is reflected in the emergence of the concept of "environmental health." Environmental health encompasses all external physical, chemical, and biological factors affecting humans, and all related factors that influence their behavior. It includes assessing and monitoring environmental factors that may affect health. Its aim is to prevent

disease and create environments that support health. This definition excludes behaviors unrelated to the environment, as well as behaviors related to the social, cultural, and genetic environment. Environmental public health focuses on protecting populations from threats posed by their environments to their health and safety. Protecting people from environmental health threats requires an understanding of basic human needs and how the environment affects them (Santos et al., 2019: 471-472). In business organizations, environmental health is defined as the organization's ability to manage environmental factors affecting the health and safety of employees, as well as the quality of the work environment and the environmental impact of production and service processes, including the safety of materials used, indoor air quality, compliance with environmental and occupational health regulations, and environmental risk management (Melville, 2010: 3).

- **Environmental Relevance**

The environmental significance criterion considers the method used to measure the environmental impacts of an organization's activities. Environmental impact measures the state of environmental change over a specific period. Gaudreault et al. (2015:9-75) identified environmental significance as a comparative factor for measuring environmental impact. It refers to the extent to which the methodology used in the model or assessment accurately reflects the actual environmental impacts of the system, accurately reflecting the results and relating to the real environmental changes resulting from the organization's use or management. Furthermore, ISO 14044 defines environmental significance as "the degree of correlation between the outcome of a category indicator and the category endpoints." For this reason, it is often said that endpoint determination methods are more environmentally significant, as acknowledged in the technical report for ISO 14047, which states that "the environmental significance is usually higher for indicators selected later in the environmental mechanism." Jin & High (2004:295) explain that environmental significance can be understood as the extent to which a measure or indicator relates to real environmental impacts and its ability to reliably and accurately express actual effects. The environment associated with the activity under study or the organization's ecosystem.

- **The Applied Aspect of the Research**

**First: - Analysis of Demographic Factors**

Description of the Research Sample

**Table (2):** describes the sample members as follows:

**Table (3):** Description of the Study Sample

Percentage	Number	Attribute Distribution	Variables	
%58	70	Male	<b>Gender</b>	
%42	50	Female		
<b>%100</b>	<b>120</b>	Total		
%33	40	25-18Year	<b>Age groups</b>	
%21	25	32-26Year		
%17	20	39-33Year		
%21	25	47-40Year		

%8	10	48above		
<b>%100</b>	<b>120</b>	<b>Total</b>		
%1	1	Company Manager	<b>Job Title</b>	
%2	2	Assistant Manager		
%6	7	Head of Department		
%33	40	Foreman (Engineer)		
%58	70	Other		
<b>%100</b>	<b>120</b>	<b>Total</b>		
%38	45	Secondary School	<b>Academic Qualifications</b>	
%17	20	Diploma		
%25	30	Bachelor's		
%9	12	Advanced Diploma		
%8	10	Master's Degree		
%2	3	Doctorate		
<b>%100</b>	<b>120</b>	<b>Total</b>		
21	25	5-1Year	<b>Years of service</b>	
25	30	10-6Year		
29	35	15-11Year		
25	30	16Above		
<b>%100</b>	<b>120</b>	<b>total</b>		

**Source: Prepared by the researcher based on the questionnaire form**

Table (3) shows that the sample members were distributed according to their personal data, with a total of (70) males and (50) females out of a total of (120) individuals. The highest age group was the first (18-25) years, with 40 individuals, and the lowest age group was the last (48 and above), with 10 individuals in each group. The highest percentage of job positions in the sample size was recorded for (other) with a total of (70) individuals, and the lowest percentage in the sample size was for (company manager) with a total of (1) individual. The highest percentage of

educational qualifications among the sample members was for the first group, from (preparatory) with (45) individuals, and the lowest educational qualifications among the sample members for the last group was (doctorate) with a total of (3) individuals. The highest percentage of years of service among the sample members in the last group was 16 or more. Years with (30) individuals, and the shortest period of service among the sample members for the first group was (1-5) years. (25) Individuals.

**Second: - Assessment of the Validity and Reliability of the Measurement Instrument.**1. Assessing the Trustworthiness and Dependability of the Measurement tool of the Artificial Intelligence Variable.

The items' reliability, reliability of dimensions and variables will be measured using SPSS version 27. Table (4) below shows the outcome of the Artificial Intelligence variable test.

Table (4) Validity and Reliability of Questionnaire of the Independent Variable: Artificial Intelligence.

Cronbach's Algorithm for the Variable	Cronbach's Algorithm for the Dimensions	Bundles	Items	Dimensions	Variable
0.943	0.843	0.440	AW1	AW	AI
		0.593	AW2		
		0.654	AW3		
		0.570	AW4		
		0.715	AW5		
		0.655	AW6		
	0.852	0.565	US1	US	
		0.612	US2		
		0.518	US3		
		0.731	US4		
		0.598	SU5		
		0.539	US6		
	0.845	0.655	EV1	EV	
		0.584	EV2		
		0.572	EV3		
0.676		EV4			
0.689		EV5			

		0.692	EV6		
	0.776	0.534	ET1	ET	
		0.681	ET2		
		0.666	ET3		
		0.570	ET4		
		0.715	ET5		

Source: SPSS v.27 output

Table (4) of Indicator Reliability is the Outer Loading box. Hair et al. (2017) state that item load values fall into three procedures, as follows:

- Loading more than or equal to (0.7): On this, the item is retained.
- Loading (0.4) to (0.7): Here, the researcher has an opportunity to study the impact of the absence of the item on other criteria of considering the measurement model. In case this results in a rise in the values of the rest of the criteria, the item is dropped. Nevertheless, in case its deletion adversely impacts the rest of the criteria, the item needs to be maintained.
- Loading less than (0.4): deletion of the item occurs in this case.
- Hence, the researcher chose to keep all the items since removing an item of the scale would impact the structure of the scale.
- **Validity and Reliability Testing of the Measurement Instrument of Environmental Sustainability Variable.**

The reliability of the items employed and the reliability of the measure of the dimensions and variables will be measured by using SPSS version 27 to derive the findings of the Environmental Sustainability variable test which is presented in Table (5) below.

Table (5): Validity and Reliability of the Questionnaire to the Dependent Variable: Environmental Sustainability.

Cronbach's Algorithm for the Variable	Cronbach's Algorithm for the Dimensions	Bundles	Items	Dimensions	Variable
0.863	0.686	0.711	ED1	Environmental destruction ED	Environmental sustainability ES
		0.534	ED2		
		0.495	ED3		
	0.746	0.695	EH1	Environmental health	

0.825	0.705	EH2	Environmental importance EI
	0.625	EH3	
	0.492	EI1	
	0.410	EI2	
	0.612	EI3	
	0.662	EI4	
	0.572	EI5	
	0.498	EI6	

Source: SPSS v.27 output

The Outer Loading box is referred to as Table (5) of Reliability of Indicators. Hair et al. (2017) state that item load values fall into three procedures, as follows:

- Loading more than or equal to (0.7): On this, the item is retained.
- Loading (0.4) to (0.7): Here, the researcher has an opportunity to study the impact of the absence of the item on other criteria of considering the measurement model. In case this results in a rise in the values of the rest of the criteria, the item is dropped. Nevertheless, in case its deletion adversely impacts the rest of the criteria, the item needs to be maintained.
- Loading less than (0.4): deletion of the item occurs in this case.
- Hence, the researcher chose to keep all the items since removing an item of the scale would impact the structure of the scale.

The descriptive analysis aims to present the complete picture of the data collected by the researcher and to summarize it using measures of central tendency and measures of dispersion. Through these measures, it is possible to identify the extent of the spread of the study variables and dimensions in the company under investigation, in addition to showing the degree of homogeneity of the responses obtained.

• **Third: Descriptive Statistics of the Research Variables**

**Descriptive Statistics of the Artificial Intelligence Variable**

A set of tests was used to ascertain the opinions of a sample of employees at the Najaf Al-Ashraf Factories Company, as follows:

Table (6) shows the responses of the employees regarding the Artificial Intelligence variable. The arithmetic mean was (3.85), the standard deviation was (0.663), and the coefficient of variation was (0.439). The results showed a normal distribution of data, with skewness (-0.373) and kurtosis (-1.443). All ratios were within the acceptable range of (±1.96). This indicates that the employees have sufficient knowledge of Artificial Intelligence, as the arithmetic mean (3.85) exceeds the hypothetical mean (3). However, the researcher aimed to enhance their understanding of Artificial Intelligence capabilities.

**Table 6:** Descriptive Analysis of the Artificial Intelligence Variable

Discharge	Range	Coefficient of Variance	Standard Deviation	Arithmetic Mean	Notation
-1.139	-0.255	0.587	0.766	3.84	AW
0.334	-0.621	0.509	0.714	3.85	US
-1.147	-0.307	0.532	0.730	3.84	EV
-0.922	-0.383	0.475	0.689	3.86	ET
<b>-1.443</b>	<b>-0.373</b>	<b>0.439</b>	<b>0.663</b>	<b>3.85</b>	<b>AI</b>

Source: SPSS v.27 output

- **Descriptive Statistics for the Environmental Sustainability Variable.**

A set of tests was used to ascertain the opinions of a sample of employees at the Najaf Al-Ashraf Factories Company, as follows:

Table (7) shows the employees' responses regarding the environmental sustainability variable. The arithmetic mean was (3.85), the standard deviation was (0.703), and the coefficient of variation was (0.494). The results showed a normal distribution of data, with skewness (-0.100) and kurtosis (-1.231). All ratios were within the acceptable range of ( $\pm 1.96$ ). This indicates that the employees contribute to environmental sustainability, as the arithmetic mean (3.85) exceeds the hypothetical mean (3). However, the researcher aimed to promote environmental sustainability within the company.

**Table 7:** Descriptive Analysis of the Environmental Sustainability Variable

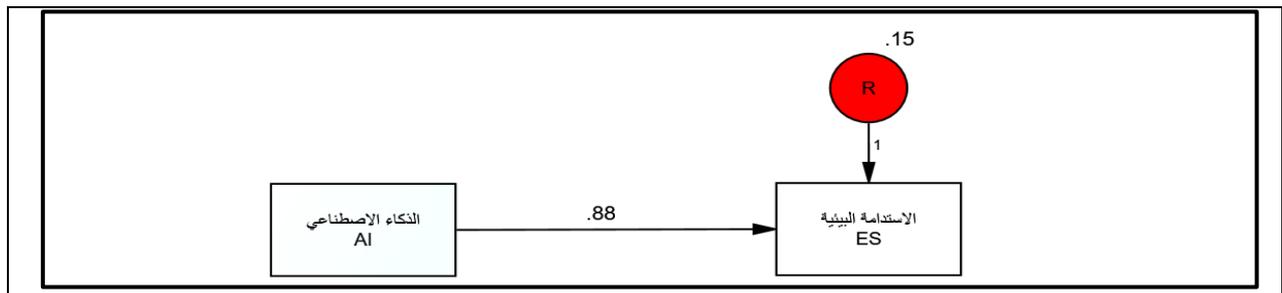
Discharge	Range	Coefficient of Variance	Standard Deviation	Arithmetic Mean	Notation
-0.364	-0.451	0.630	0.794	3.85	Environmental destruction) ED(
-0.384	-0.268	0.673	0.820	3.85	Environmental health (EH)
-0.974	-0.204	0.583	0.764	3.85	Environmental importance (EI)
<b>-1.231</b>	<b>-0.100</b>	<b>0.494</b>	<b>0.703</b>	<b>3.85</b>	<b>Environmental sustainability )ES(</b>

Source: SPSS v.27 output

**Fourth:** Vindication of the Main and Sub-Impact Hypotheses of the Research.

The section deals with testing the effect of relationship between the research variables. The author of the study developed one primary hypothesis of the study, which is the investigation of the role of the association between artificial intelligence and environmental sustainability. The hypothesis of the research was tested with the help of AMOS V.27 software in the form as follows:

Test of the Main Hypothesis: According to the hypothesis, the (there is a significant and positive impact relationship between artificial intelligence and environmental sustainability at the overall level of the company under study) holds. This hypothesis implies that artificial intelligence has a great influence on environmental sustainability in the eyes of the workers of the company. To establish the influence between the variables discussed above a structural equation model was drawn up as depicted in Figure (2). An example of this test would be as shown below:



**Figure 2:** Testing of the first main hypothesis  
**Source:** AMOS v.27 output

Figure 2) was deemed acceptable according to the conformity quality indicators for this model. Based on these indicators, the model is suitable for testing the impact of artificial intelligence on the environmental resilience of university staff. The effect value between the research variables was 0.88, as shown in the table below. The significance level was (0.000), indicating acceptance of the hypothesis. The explanatory coefficient (R<sup>2</sup>) was 0.15, indicating that the artificial intelligence variable explains (15%) of the factors that explain the environmental resilience variable. The remaining percentage is related to factors not identified in the current research.

**Table 8:** Artificial Intelligence and Environmental Resilience Effect Coefficient

Decision	P	R <sub>2</sub>	C.R	S. E	S.R. W	Path	
Accept	***	0.151	16.352	0.054	0.881	Environmenta l Sustainability	← Artificial Intelligence

**Source:** AMOS v.27 output

Results of the statistical analysis, as shown in table (8) above, reflect clearly strong, positive and significant effect of artificial intelligence on environmental sustainability among the employees of the ship master company. This effect occurs with significance value of (0.000), thus proving this hypothesis.

After testing the main hypothesis that links the impact of artificial intelligence on environmental sustainability we continue to test the sub-hypotheses that were derived out of it as indicated in Figure (2) and Table (6) as follows:

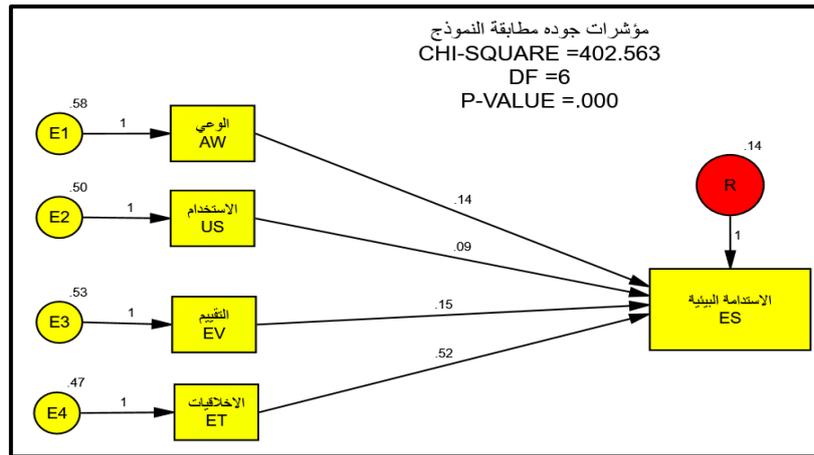


Figure 3: Testing the research sub-hypotheses

Source: AMOS v.27 outputs

Table 9: Testing the research sub-hypotheses

Decision	P	C.R	S. E	S.R. W	Path
Accept	***	3.226	0.045	0.144	(ES) ← ) AW(
Accept	***	10.458	0.048	0.09	(ES) ← (US)
Accept	***	3.105	0.047	0.146	(ES) ← (EV)
Accept	***	10.478	0.050	0.520	(ES) ← (ET)

Source: AMOS v.27 outputs

**First Sub-Hypothesis:** This is the hypothesis that the effect of awareness dimension on the overall level of the environmental sustainability of the company under study is significant and positive. Figure (3) and Table (9) show that (0.114) has a positive influence after reviewing them. Because the obtained value of the critical ratio (CR) is (0.045), which falls short of (0.196) at the significance level (0.00), and (0.05) at the same level, then this hypothesis can be said to be acceptable at the research level. It implies that the employees of the Ship Captain Company are well informed about artificial intelligence tools in order to achieve environmental sustainability.

**Second Sub-Hypothesis:** According to this hypothesis, the use dimension has a significant and positive effect on the environmental sustainability at the overall level of the company in question. The review of Figure (3) and Table (9) shows that (0.213) has a positive impact. The value attained in the Critical Ratio (CR) (10.458) is bigger than the (10.458) -1.96 (-/+ ) provided that the significance level (0.00) is satisfied, and thus, it can be said that this hypothesis is acceptable on the research level. This implies that the people employed in the Ship Captain Company can utilize artificial intelligence devices to make the environment sustainable.

**Third Sub-Hypothesis:** This hypothesis was asserted in the fact that the effect of the overall level of the company under study of the evaluation dimension on the environmental sustainability is significant and positive. Having checked Figure (3) and Table (9), one may assume that there is a positive effect of (0.146). The obtained value of Critical Ratio (CR) (3.105), that falls above (3.105) into a critical value of ( +/-1.96) at a significance level of (0.00) and below (0.05) at a research level is positive and thus this hypothesis is deemed acceptable according to the research

level. This implies that the people in the Ship Captain Company are skilled to assess the utility of artificial intelligence in ensuring environmental sustainability.

**The fourth sub-hypothesis** was that the ethical dimension and environmental sustainability have significant and positive correlation at the general level of the company under study. Figure (3) and Table (9) enabled me to realize that, after the review of the data, there is a positive effect of (0.520). Given that the obtained value of critical ratio (CR) is (10.478), but more substantial than (+/- 1.96) with the significance level (0.00) and less than (0.05), then this hypothesis is satisfactory at the research level. This implies that the people employed in the captain company of the ship have the ethics required to ensure the environment is safe and sustainable.

## 5. Conclusions and Recommendations

### First: Conclusions

**Enhancing Efficiency and Reducing Waste:** Artificial intelligence contributes to improving energy and resource management in industries (such as the Najaf factories) through predictive analysis of consumption patterns, significantly reducing waste and operational emissions.

**Accurate Environmental Monitoring and Decision-Making:** Artificial intelligence enables the monitoring and analysis of big environmental data (air and water quality) with high accuracy and in real time, supporting faster and more effective decision-making to address environmental challenges such as pollution.

**Developing Innovative Sustainable Solutions:** Artificial intelligence encourages the development of new technologies for renewable energy and smart mobility (such as smart grids) and accelerates the discovery of green materials, opening up prospects for achieving deeper and more comprehensive sustainability.

### Second: Recommendations

Adopt AI systems for monitoring and energy consumption. The company should therefore invest immediately in AI solutions to analyze energy consumption patterns in its factories. This will ensure improved efficiency, reduced waste and carbon emissions, with a focus on intelligent management systems that predict demand and adjust production accordingly.

Implement AI in industrial waste management. It is recommended to develop and use AI algorithms to improve the sorting and recycling of industrial waste generated from manufacturing processes. This will support the principles of a circular economy and reduce the environmental impact of waste.

Provide specialized training and enhance environmental awareness. Advanced training programs should be provided to employees on how to use AI tools in sustainability-related tasks, raising their awareness of their crucial role in achieving the company's environmental goals.

## References

- 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. <https://doi.org/10.1016/j.ijinfomgt.2020.102225>
- Belk, R. W., Belanche, D., & Flavián, C. (2023). Key concepts in artificial intelligence and technologies 4.0 in services. *Service Business*, 17(1), 1. <https://doi.org/10.1007/s11628-022-00518-1>
- Chaudhary, G. (2023). Environmental sustainability: Can artificial intelligence be an enabler for SDGs? *Nature Environment & Pollution Technology*, 22(3). <https://doi.org/10.46488/NEPT.2023.v22i3.001>

Nti, E. K., Cobbina, S. J., Attafuaah, E. E., Opoku, E., & Gyan, M. A. (2022). Environmental sustainability technologies in biodiversity, energy, transportation and water management using artificial intelligence: A systematic review. *Sustainable Futures*, 4, 100068. <https://doi.org/10.1016/j.sfr.2022.100068>

Raihan, A., Paul, A., Rahman, M. S., Islam, S., Paul, P., & Karmakar, S. (2024). Artificial intelligence (AI) for environmental sustainability: A concise review of technology innovations in energy, transportation, biodiversity, and water management. *Journal of Technology Innovations and Energy*, 3(2), 64-73.

Satpathy, S., Mahapatra, S., Agarwal, N., & Mohanty, S. N. (Eds.). (2024). *AI for climate change and environmental sustainability*. CRC Press.

Akerkar, R. (2019). *Artificial intelligence for business*. Springer.

Brivio, E., Gaudio, F., Vergine, I., Mirizzi, C. R., Reina, C., Stellari, A., & Galimberti, C. (2018). Preventing technostress through positive technology. *Frontiers in Psychology*, 9, Article 2569. <https://doi.org/10.3389/fpsyg.2018.02569>

Klonek, F., & Parker, S. (2025). Does AI at work increase stress? Text mining social media about human–AI team processes and AI control. *Journal of Organizational Behavior*. Advance online publication.

Murire, O. T. (2024). Artificial intelligence and its role in shaping organizational work practices and culture. *Administrative Sciences*, 14(12), Article 316. <https://doi.org/10.3390/admsci14120316>

Romeo, E., & Lacko, J. (2025). Adoption and integration of AI in organizations: A systematic review of challenges and drivers towards future directions of research. *Kybernetes*. Advance online publication. <https://doi.org/10.1108/K-03-2024-0056>

Sestino, A., & De Mauro, A. (2022). Leveraging artificial intelligence in business: Implications, applications and methods. *Technology Analysis & Strategic Management*, 34(1), 16–29. <https://doi.org/10.1080/09537325.2021.1890308>

Chang, G., Yasin, I., & Naqvi, S. M. M. A. (2024). Environmental sustainability in OECD nations: The moderating impact of green innovation on urbanization and green growth. *Sustainability*, 16(16), Article 7047. <https://doi.org/10.3390/su16167047>

Massoudi, A. H., Fatah, S. J., & Ahmed, M. E. (2019). Incorporating green innovation to enhance environmental sustainability. *Incorporating Green Innovation to Enhance Environmental Sustainability*, 16, 477–486.

Moldan, B., Janoušková, S., & Hák, T. (2012). How to understand and measure environmental sustainability: Indicators and targets. *Ecological Indicators*, 17, 4–13. <https://doi.org/10.1016/j.ecolind.2011.03.006>

Nandagopal, R., Maheswari, B. U., & Kavitha, D. (2018). Comparison of sustainability factors influencing environmental, economic and social sustainability—An empirical study in an emerging economy. *AIMS International Journal of Management*, 12(3), 69–82.

Olayinka, O. M., & Owolabi, S. A. (2021). Corporate governance and environmental sustainability reporting: The Nigerian perspective. *International Journal of Scientific and Research Publications*, 11(4), 487–497. <https://doi.org/10.29322/IJSRP.11.04.2021.p11255>

Usubiaga-Liaño, A., & Ekins, P. (2021). Time for science-based national targets for environmental sustainability: An assessment of existing metrics and the ESGAP framework. *Frontiers in Environmental Science*, 9, Article 761377. <https://doi.org/10.3389/fenvs.2021.761377>

- Wang, Z., Chai, C. S., Li, J., & Lee, V. W. Y. (2025). Assessment of AI ethical reflection: The development and validation of the AI ethical reflection scale (AIERS) for university students. *International Journal of Educational Technology in Higher Education*, 22(1), Article 19. <https://doi.org/10.1186/s41239-025-00485-6>
- Ekins, P. (2011). Environmental sustainability: From environmental valuation to the sustainability gap. *Progress in Physical Geography*, 35(5), 629–651. <https://doi.org/10.1177/0309133311423113>
- Gaudreault, C., Verschuyf, J., & Wigley, T. B. (2015). *Methods for characterizing forest-related land use impacts in life cycle assessment* (Special Report No. 15-04). National Council for Air and Stream Improvement.
- Imani, B., Pashazadeh, A., & Karimi, S. H. (2019). The analysis of environmental sustainability for rural housing using fuzzy interference systems (case study: Rural areas in Marivan county). *Journal of Research and Rural Planning*, 8(1), 79–93.
- Jin, X., & High, K. A. (2004). A new conceptual hierarchy for identifying environmental sustainability metrics. *Environmental Progress*, 23(4), 291–301. <https://doi.org/10.1002/ep.10051>
- Johnson, R. M. (2013). *A suffocating nature: Environment, culture, and German chemical warfare on the Western Front*.
- Melville, N. P. (2010). Information systems innovation for environmental sustainability. *MIS Quarterly*, 34(1), 1–21. <https://doi.org/10.2307/20721412>
- Mispansyah, M., Nurunnisa, N., Mulyawan, A., & Al Faqih, M. (2023). Legal policy of the national food granary program (food estate) on peat land in Central Kalimantan which is environmentally investigent. *International Journal Political, Law, and Social Science*, 4(2), 45–60.
- Omardin, M. A., Abidin, N. Z., & Ali, W. D. W. (2015). Concept of environmental sustainability awareness strategies in pre-construction stage. *Journal of Tropical Resources and Sustainable Science*, 3(1), 103–116.
- Santos, O., Virgolino, A., Santos, R. R., Costa, J., Rodrigues, A., & Vaz-Carneiro, A. (2019). Environmental health: An overview on the evolution of the concept and its definitions. In J. Nriagu (Ed.), *Encyclopedia of environmental health* (Vol. 2, pp. 466–474). Elsevier.
- Vanderheiden, S. (2008). Two conceptions of sustainability. *Political Studies*, 56(2), 435–455. <https://doi.org/10.1111/j.1467-9248.2007.00710.x>
- Hair, J. F., Jr., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2017). *A primer on partial least squares structural equation modeling (PLS-SEM)* (2nd ed.). Sage.
- Imani, B., Pashazadeh, A., & Karimi, S. H. (2019). The analysis of environmental sustainability for rural housing using fuzzy interference systems (case study: Rural areas in Marivan county). *Journal of Research and Rural Planning*, 8(1), 79–93.
- Krejcie, R. V., & Morgan, D. W. (1970). Determining sample size for research activities. *Educational and Psychological Measurement*, 30(3), 607–610. <https://doi.org/10.1177/001316447003000308>
- Ma, S., & Chen, Z. (2024). The development and validation of the artificial intelligence literacy scale for Chinese college students (AILS-CCS). *IEEE Access*, 12, 12345–12356. <https://doi.org/10.1109/ACCESS.2024.XXXXXXX>
- Tanveer, M., Hassan, S., & Bhaumik, A. (2020). Academic policy regarding sustainability and artificial intelligence (AI). *Sustainability*, 12(22), Article 9435. <https://doi.org/10.3390/su12229435>

Yadav, M., & Singh, G. (2023). Environmental sustainability with artificial intelligence. *EPRA International Journal of Multidisciplinary Research*, 9(5), 213–217.