

The Role of Knowledge Sharing in the Impact of Artificial Intelligence on Sustainability in Jordanian Pharmaceutical Companies

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Abstract

This study aimed to investigate the role of knowledge sharing in the impact of artificial intelligence (AI) on sustainability in Jordanian pharmaceutical companies. The descriptive-analytical approach was used, and the study population consisted of Jordanian pharmaceutical companies. The sampling unit was employee's at all administrative levels, and a convenient sample of 261 individuals was selected. Data was collected via questionnaire. The study concluded with several key findings, most notably a statistically significant impact ($\alpha \leq 0.05$) of AI, with its organizational, global, technological, legal, and ethical dimensions, on sustainable performance (economic, social, environmental, governance, and innovative) in Jordanian pharmaceutical companies, mediated by knowledge sharing. Among the recommendations is the importance of aligning with international standards to enhance their reputation, growth potential, and sustainability.

Keywords: Artificial Intelligence, Sustainable Performance, Knowledge Sharing, Jordanian Pharmaceutical Companies.

1-1 Introduction:

Interest in artificial intelligence (AI) has emerged recently due to the increasing number of security breaches and privacy violations affecting e-commerce companies. This study examines the challenges AI has posed in the modern world. With advancements in AI-related technologies, its applicability across various fields has sparked a wide range of ethical debates. AI-based decision-making processes and ethical values have been the subject of numerous studies (Huang and Rust, 2018; Olan et al., 2021). AI encompasses a number of information and communication technologies that mimic human intelligence to enhance functions and boost efficiency (Arakpogun et al., 2021).

Sustainability is a challenge facing business organizations in general, and Jordanian pharmaceutical companies in particular. Therefore, it is necessary to highlight the most significant obstacles hindering its sustainability, whether related to contributing to economic development or addressing social, environmental, and economic issues within these companies (Rashid et al., 2024).

1-2 Research Problem and Questions:

The rapid advancement of artificial intelligence (AI) has led to several transformations across various sectors, including the business sector. These companies face increasing pressure to maintain sustainability amidst numerous competitive and environmental challenges. While AI offers solutions to enhance operational efficiency and decision-making, its full benefits are often not realized without effective knowledge-sharing practices within organizations. Interviews with managers revealed weaknesses in the safeguards ensuring sustainability, necessitating a study to identify ways to achieve it.

Furthermore, there is a scarcity of studies related to sustainability, particularly within the context of Jordanian pharmaceutical companies. A gap in the literature has emerged, requiring a comprehensive investigation to understand how AI, when supported by effective knowledge-sharing mechanisms, can impact and improve performance in companies.

Therefore, the research problem can be formulated through the following two main questions:

What is the impact of using AI on the sustainable performance of Jordanian pharmaceutical companies?

What is the impact of using AI on the sustainable performance of Jordanian pharmaceutical companies, considering knowledge sharing as a mediating variable?

1-3 Significance of the Study:

- Theoretical Significance:

This study presents a literature-based framework on artificial intelligence (AI) technologies, knowledge sharing, and sustainability, using an integrated comparative approach to examine three complementary factors of the company's perception of AI, knowledge sharing, and sustainability.

- Applied Significance:

The study's practical significance lies in its potential to improve sustainability in Jordanian pharmaceutical companies through the adoption of AI technologies and enhanced knowledge sharing. It offers practical solutions that enhance production

efficiency, helping decision-makers take effective steps toward achieving sustainability. The study provides a literature review outlining the practical basis for the study variables, presents a methodology explaining data collection and analysis, and presents the study's findings. Finally, it discusses the results, limitations of the study, and opportunities for future research.

1-3 Objectives of the Study:

The main objective is to identify the impact of AI, with its various dimensions (organizational, global, technological, legal, and ethical), on sustainability, with its various dimensions (economic, social, environmental, governance, and innovation), in the context of knowledge sharing within Jordanian pharmaceutical companies.

1-4 Study Model:

The study model, its variables, and methods for measuring those variables are as follows: The independent variable is artificial intelligence, the dependent variable is sustainability, and the mediating variable is knowledge sharing.

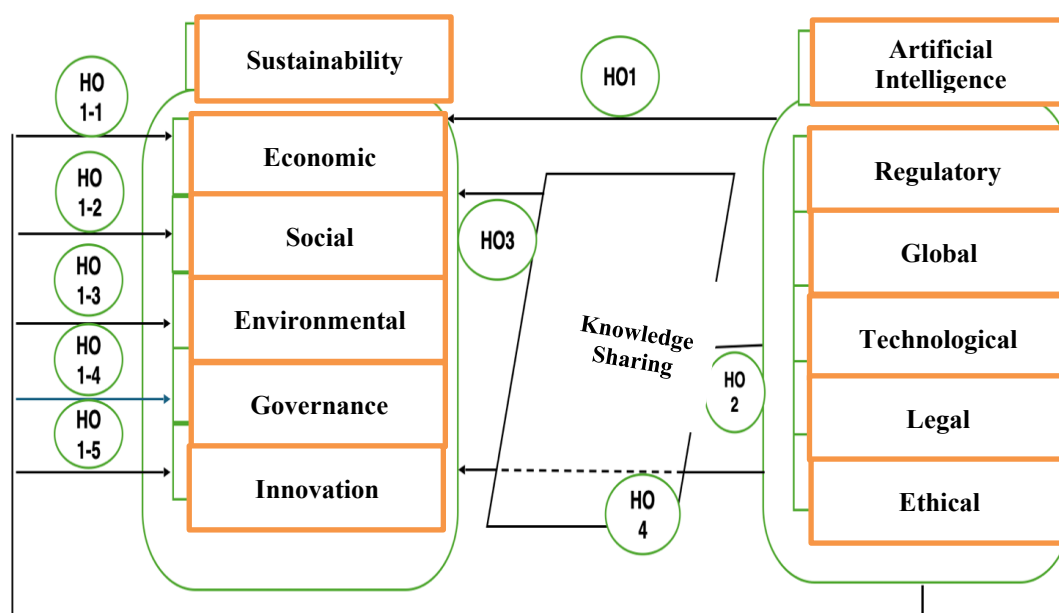


Figure 1.1 Study Model))

Source: Prepared by the researcher based on the following studies:

Independent variable: Artificial intelligence: Strubell et al., 2019; Olan et al., 2021; Al-Ghamdi & Al-Dharman, 2022.

Dependent variable: Sustainability: Molopa, 2020; Rashid et al., 2024; Sharma et al., 2023; Rong et al., 2021.

Mediating variable: Knowledge sharing.

1-5 Study Hypotheses:

First Main Hypothesis:

H01: There is no statistically significant effect at the significance level ($\alpha \leq 0.05$) of artificial intelligence, with its combined dimensions (organizational, global, technological, legal, and ethical), on sustainability, with its combined dimensions

(economic performance, social performance, environmental performance, governance, and innovative performance) in Jordanian pharmaceutical companies.

Second Main Hypothesis:

Ho2: At the significance level ($\alpha \leq 0.05$), knowledge sharing does not mediate the effect of using artificial intelligence, with its combined dimensions (organizational, global, technological, legal, and ethical), on sustainability, with its combined dimensions (economic performance, social, environmental, governance, and innovative performance) in Jordanian pharmaceutical companies at the significance level ($\alpha \leq 0.05$). 1-6 Scientific Terms of Study:

Artificial Intelligence (AI): A set of information and communication technologies (ICTs) that mimic human intelligence with the primary goal of improving jobs, increasing efficiency, and stimulating economic growth (Arakpogun et al., 2021).

Sustainability: The ability of an organization to achieve balanced and sustainable financial, social, and environmental outcomes over the long term. Sustainable performance aims to integrate economic, social, and environmental objectives into an organization's operations to ensure its long-term growth and survival. Sustainable performance focuses on improving operational efficiency, achieving profitability, meeting social needs, and protecting the environment (Robbins, 2019; Argote & Fahrenkopf, 2015).

Knowledge Sharing: The process by which individuals, teams, or units within an organization exchange information, knowledge, and experiences to help others solve problems, make decisions, and improve performance. Knowledge sharing is a fundamental part of knowledge management, contributing to enhanced innovation, productivity, and the achievement of the organization's strategic goals (Malik et al., 2020). Artificial Intelligence

The 21st century witnessed a massive information revolution in technology applications, and reliance on artificial intelligence has become one of the most important developments that has added a new dimension to the modern era, because it has exceeded the limit in the effectiveness of its use and production; which has led to an increased interest in researching the possibility of harnessing it and making the most of it to support management processes in business organizations.

Several modern trends have emerged, including artificial intelligence (AI), which is reshaping services to adapt to the demands of this trend. Companies are at the forefront of adopting these new technologies.

Researchers have focused on the topic of artificial intelligence, defining it as: performing tasks similar to human tasks through computer systems, at the highest levels, including critical thinking (Musa, 2021). Abdul Aziz and Ibrahim (2022) defined it as: the process of simulating human mental, sensory, and perceptual abilities through computer systems. Applications include language analysis, learning, creativity, and many others.

Based on these definitions, researchers define artificial intelligence as computer systems that think and mimic human behavior, performing operations at high levels. Dimensions of Artificial Intelligence:

The Regulatory Dimension: As a regulatory dimension, artificial intelligence refers to the process of developing policies and laws that govern it. This presents a significant challenge. Regulating AI through mechanisms such as review boards can be considered a social means of controlling AI (Jaber, 2022).

The regulatory dimension is essential for fostering AI innovation and managing its associated risks. Business organizations play a pivotal role in establishing and implementing trustworthy AI, adhering to proven principles, and assuming responsibility for mitigating risks (Al-Khatib, 2023).

The Global Dimension: Undoubtedly, humanity has sought an invention that mimics the human mind in its thinking patterns. Over time, numerous technologies have emerged, most notably artificial intelligence, which has created a qualitative shift globally and contributed to providing numerous advantages and benefits. Business organizations and all sectors have benefited from it in accomplishing tasks with speed and high efficiency.

The Legal Dimension: The legal dimension of artificial intelligence has sparked debate among many academic and legal circles regarding the extent of AI's impact on legislative regulation.

The Technological Dimension: The emergence of technology is one of the most important achievements of this era, contributing to the development of numerous applications, including artificial intelligence (AI), which has constituted a true revolution. AI applications have been used in many fields, including medicine, renewable energy, and others.

The Ethical Dimension: Al-Khatib (2023) stated that while AI has developed significantly and offers many advantages and benefits, it also presents numerous risks in various fields and sectors.

Sustainability: The third millennium witnessed a rapid scientific revolution and a widespread technological and civilizational renaissance. This has impacted companies, which now face challenges stemming from new technologies. The use of these technologies has become essential for companies to achieve survival, growth, continuity, and competitiveness. Sustainability is the inherent characteristic of development, ensuring its continuity. It is a renewable and ongoing developmental phenomenon aimed at building life in the present and future eras, while drawing upon the lessons of the past. Its foundation is the principle of balanced resource allocation, preserving resources, and granting them permanence and the means of life, including maintenance, continuity, and improving the quality of human life. It is a system of continuous development that benefits the individual, increasing resources and efficiency to ensure their sustainability while achieving environmental balance. It is the golden rule: "They planted, and we ate; we plant, and they will eat" (Wang et al., 2022).

Pham et al. (2021) indicate that sustainability is the organization's possession of beliefs, ideas, and principles that are integrated into its culture. It is the driving force behind the principles of modern society, in light of the risk society theory, which states that the increasing risks in the world will significantly impact the principles of modern society and lead to changes in the values and actual models used to understand and comprehend the surrounding world.

Dimensions of Sustainability:

Most studies indicate that sustainability consists of three dimensions (Pham et al., 2021):

Economic Performance: Focusing on developing the economic sector, enhancing the efficiency of economic performance, and increasing productivity. This dimension is based on the idea that "the use of resources today should not be less than the real income in the future." This means that economic systems must be managed in a way that allows us to live off the profits from our resources, maintain the base of material assets, and realize them (Iqbal et al., 2021).

Social Performance: Improving the living conditions of local communities and the equitable distribution of available resources. This dimension is considered a cornerstone of the economic, social, and environmental sustainability triangle, as social issues in sustainable development address several elements that lead to improving social characteristics in a sustainable manner (Muqaymah, 2019).

Environmental Performance: Maintaining ecological balance, protecting the natural and built environment, and using environmental resources rationally and sustainably without extravagance or waste. The term "Triple Bottom Line" indicates that these dimensions are interconnected, overlapping, and integrated as a foundation for achieving sustainable economic and social performance. Environmental considerations must be taken into account simultaneously for economic growth, achieving social justice, and improving environmental quality (Madhuri et al., 2023).

Governance: The term "governance" has imposed itself, both voluntarily and forcibly. Some consider it the verbal extension of globalization and privatization, which were the subject of much debate at their inception. The term "corporate governance" refers to the Arabic translation of the original English word, "Corporate Governance," which the Arabic Language Academy arrived at after several attempts to Arabize the term. Previously, other terms were used, such as "good management," "good administration," "institutional control," "institutional governance," and others. However, the most common and widely used term among writers and researchers is "corporate governance" (Al-Saigh and Al-Jaid, 2023).

Innovative Performance: Several definitions of innovative performance have emerged. Kuratko et al. (2019) define innovation as "the process by which business people transform Opportunities (ideas) to marketable solutions: i.e., the process of transforming ideas into results (outputs).

Barca Hammadi (2021) defined it as: "A cognitive process aimed at creating new knowledge directed towards developing applicable business solutions."

Knowledge Sharing:

In recent decades, knowledge management has become a fundamental topic in management across most countries worldwide. This is a result of the effects of information globalization and the significant development in communications, especially the internet. Modern communication systems have led to widespread dissemination and a deep understanding of customer needs, prompting businesses to focus on building intellectual capital, which is a highly effective competitive tool in the knowledge economy.

Scholars have offered various definitions of knowledge sharing from different perspectives, depending on their professional backgrounds. Therefore, it is difficult to arrive at a single, definitive definition. The following is an overview of the most important concepts of knowledge sharing.

Mubarki (2019) defined it as the process of knowledge exchange between two or more people, allowing for the recalibration of existing knowledge and the production of new knowledge. Marghalani et al. (2019) define it as: the process of seeking knowledge in its various locations throughout the organization, followed by the sharing of knowledge by individuals and groups within the organization in designated repositories.

Al-Qarni (2021) defines it as a behavior aimed at exchanging functional, technical, and research experiences and knowledge, both explicit and tacit, with peers in the academic department for collaborative learning, achieving departmental goals, and improving organizational effectiveness.

Previous Studies:

The study by Al-Sununu (2024) aimed to reveal the impact of using artificial intelligence technologies on the quality of performance in Jordanian private universities. It employed a descriptive analytical approach. The study population consisted of all administrative employees who perform administrative work in these universities in the northern region, numbering (5) universities, who use artificial intelligence, totaling (878). The sample consisted of (268) male and female employees who use artificial intelligence, through a simple random sample. An electronic questionnaire was distributed, and (250) questionnaires were returned, representing a percentage of (93.2%), which is a suitable percentage. Several statistical methods were used. Among the most important results: the level of use of artificial intelligence technologies was high, with a statistical significance for the use of artificial intelligence technologies in its dimensions (electronic protection, technical capabilities, human resource management, system capability) in the quality of performance in its dimensions (formal education, employee motivation, employee participation and empowerment, training) in Jordanian private universities. The study recommended further research to identify the factors affecting performance quality in universities and to review the findings of research and studies that

address the use of technology to understand all aspects of the service delivery process.

Al-Azzam's study (2024) aimed to reveal the impact of organizational commitment on performance sustainability in Jordanian exchange companies: the mediating role of competitive advantage. The descriptive-analytical method was used, and the study population consisted of all employees in Jordanian exchange companies, totaling 1200 individuals. The study employed a convenience sample of 291 individuals. The questionnaire was distributed electronically, and 245 questionnaires were returned, representing a response rate of 84.2%. The questionnaire was used as the data collection tool. The study reached several conclusions, most notably: the level of organizational commitment was moderate, the level of performance sustainability was high, and the level of competitive advantage was high. The competitive advantage mediates the impact of organizational commitment, with its combined dimensions (emotional, continuous, and normative), on the sustainability of performance, with its combined dimensions (environmental, economic, and social performance), in exchange companies in Jordan. The study recommended that exchange companies prioritize the continuous use of environmentally friendly technologies in their operations to achieve speed and accuracy in performance and gain a competitive advantage.

A study by Kalogiannidis and Kalfas (2024), conducted in Greece, aimed to investigate the effectiveness of artificial intelligence (AI) in predicting risk assessment and its contribution to ensuring business continuity. The study sample consisted of 360 technology experts, and a questionnaire was used as the data collection instrument. One of the most important findings of this study is that using AI in predictive risk assessment leads to reduced company disruptions and improved recovery from unforeseen events. A key recommendation of this study is that businesses should invest in AI technologies. The Cannas et al. (2024) study aimed to highlight how AI applications can support OSCM processes and identify the benefits and barriers to their implementation. To this end, a multi-case study was conducted with semi-structured interviews across six companies, totaling 17 implementation cases. The Supply Chain Process Reference Model (SCOR) guided the entire study, and the results were analyzed by focusing on specific processes. The findings highlighted how AI approaches in OSCM can enhance companies' competitiveness by reducing costs and lead times and improving service, quality, safety, and sustainability. However, they also identified barriers to AI implementation, such as ensuring data quality, a lack of specific skills, the need for high investment, uncertainty regarding economic benefits, and a lack of expertise in cost analysis for AI projects. While the nature of the study is not suitable for broad generalization, it provides clear guidance for practitioners facing AI challenges in specific SCOR processes and provides a foundation for future research.

Symbolic Neural AI for Supply Chains and the Increased Adoption of Such Technologies in Supply Chain Practices.

Study Methodology:

The study employed a descriptive-analytical approach, which describes and analyzes the phenomenon and interprets the relationship between independent and dependent variables.

The study methodology was as follows: Study Population: The study population consisted of all Jordanian pharmaceutical companies (Annual Report issued by the Ministry of Industry and Trade, 2025). The sample unit included all employees at various administrative levels. Study Sample:

The study employed a convenience sample of 1204 employees in Jordanian pharmaceutical companies. A convenient sample of 300 individuals was selected according to the approved statistical tables (Sekaran & Bougie, 2020). This indicated that the corresponding sample size at a confidence level of 0.05 was 300. After testing the designed model for reliability and validity, 300 questionnaires were randomly distributed electronically to the study sample through the companies' websites. 261 questionnaires were returned electronically, representing a response rate of 81.7%. After reviewing and verifying the questionnaires, 16 were found to be invalid for statistical analysis, leaving 261 valid questionnaires. (245) Questionnaires.

Research Instrument: The questionnaire was developed as the primary data collection tool, drawing on previous studies to adapt existing scales to the variables of the current study. It was divided into the following sections:

Section 1: Contains questions related to the demographic data of the sample.

Section 2 comprises the questionnaire items.

Reliability of the Research Instrument:

Table (1): Reliability of the Research Instrument for the Variables based on Cornbrash's Alpha

Variable Type	Variable	Cornbrash's Alpha
Artificial Intelligence	Organizational Dimension	0.78
	Global Dimension	0.88
	Technological Dimension	0.86
	Legal Dimension	0.79
	Ethical Dimension	0.81
Sustainable Performance	Economic Performance	0.83
	Social Performance	0.85
	Environmental Performance	0.86
	Governance	0.84
	Innovative Performance	0.85

Knowledge Sharing	Knowledge Sharing	0.86
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Table (1) shows that the reliability coefficients ranged between (0.78-0.88), which are considered acceptable. Hair et al. (2019) consider Cronbach's alpha values greater than 0.70 to be acceptable, indicating that the questionnaire items and their dimensions possess internal consistency.

Statistical Analysis:

The Statistical Package for the Social Sciences (SPSS) was used to test the research hypotheses and answer the research questions.

Study Results and Discussion

(4-1) Introduction:

Chapter 4 presents the testing of the study hypotheses.

(4-2) Testing the Study Hypotheses:

Statistical analysis was used to test the study hypotheses as follows:

H01: There is no statistically significant effect at the significance level ($\alpha \leq 0.05$) of artificial intelligence, with its combined dimensions (organizational, global, technological, legal, and ethical), on sustainability, with its combined dimensions (economic performance, social performance, environmental performance, governance, and innovative performance), in Jordanian pharmaceutical companies.

To test the hypothesis, multiple regression analysis was used according to the table:

Table (2): Model Analysis and Variance for the Main Hypothesis H01

Dependent Variable	R	R ²	Adjusted R ²	Standard error of the model	Degree of freedom	F	F*
Sustainable Performance	0.630	0.397	0.383	0.373	4	28.646	0.000

The data in Table (2) indicates a positive relationship between the independent and dependent variables, with a correlation coefficient of ($R=0.630$) and a coefficient of determination of ($R^2=0.397$). This means that artificial intelligence accounted for (39.7%) of the variance in sustainability, with the remaining percentage attributed to other factors. The table also shows the model's significance, with an F-value of (28.646) and a significance level of less than 0.05 ($\text{SigF}=0.000$). This reveals an effect of the development of both the independent and dependent variables. Therefore, the null hypothesis is rejected, and the alternative hypothesis is accepted, stating that there is a statistically significant effect ($\alpha \leq 0.05$) of artificial intelligence, with its combined dimensions (organizational, global, technological, legal, and ethical), on sustainability, with its combined dimensions (economic performance, social performance, environmental performance, governance, and innovative performance) in Jordanian pharmaceutical companies. This can be explained by the fact that the use of artificial intelligence (AI) by Jordanian pharmaceutical companies in their various activities impacts their sustainable performance by improving operational processes and increasing productivity.

This finding aligns with the results of Al-Sununu's study (2024), which found a statistically significant impact of AI technologies and their dimensions on performance quality in universities. However, it differs from Al-Khatib's study (2023), which found no statistically significant impact of AI technology use on performance quality in banks.

Second Main Hypothesis:

Ho4: Knowledge sharing does not mediate the impact of AI use, across its various dimensions (organizational, global, technological, legal, and ethical), on sustainability, across its various dimensions (economic, social, environmental, governance, and innovative performance), in Jordanian pharmaceutical companies at a significance level of ($\alpha \leq 0.05$). The results of the statistical analysis, as shown in Table (32), indicate that the calculated Chi² value (56.157) is statistically significant (Sig. = 0.000) and less than (0.05). The results also show that the quality fit index (GFI = 0.9799) approaches one, indicating a good-enough fit in the model. Furthermore, the comparative fit index (CFI = 0.9670) also approaches one, and the root mean square error index (RMSEA = 0.02542) approaches zero, further supporting the model's good fit. These findings confirm the model's suitability for regression analysis. The standardized direct effect of AI on sustainable performance was (0.6006), with a significance level of ($\alpha \leq 0.05$). The standardized direct effect of AI through sustainability was (0.6133), and the standardized direct effect of AI on sustainability was (0.4198), also with a significance level of ($\alpha \leq 0.05$). The standardized indirect effect of AI through knowledge sharing was (0.2575). Therefore, knowledge sharing explained (26%) of the indirect effect of the independent variable on the dependent variable through knowledge sharing, with a total effect of (0.8581). The value of the Variance Calculated for (VAF) was (0.30), indicating that the effect of knowledge sharing is only partially effective, as it is less than (0.80) shown in Table (4).

Table (3) Average knowledge sharing between artificial intelligence and sustainable performance

The role of the mediating variable				
Effectiveness power	Inactive	Partially Effective	Effective	Highly effective
Effectiveness	0.0 – 0.15	.35 – 0.160	0.36- 0.80	1- 0.81

Table No. (4) Results of testing the second main hypothesis based on the outputs of the path analysis

Sig.	C.R.	S.E.	Estimate	Overall impact	Indirect effect	Direct impact	Variables	RMSEA	CFI	GFI	Statement
0.000	14.5541	0.0738	0.2503	0.8581	0.2575	0.6006	Artificial Intelligence □ Sustainability □ Knowledge Sharing	0.02542	0.9670	0.9799	Artificial Intelligence □ Sustainability □ Knowledge Sharing
0.000	11.617	0.0551	0.6401	0.6133	----	0.6133	Artificial Intelligence □ Knowledge Sharing				
0.000	9.7019	0.0959	0.4902	0.4198	----	0.4198	Ace □ Sustainability □ Knowledge Sharing				

$$0.6133 \times 0.4198 = 0.2575 + 0.6006 = 0.8581$$

Therefore, the main null hypothesis was rejected, and the alternative hypothesis was accepted, which stated:

Knowledge sharing resulting from the use of artificial intelligence, with its combined dimensions (organizational, global, technological, legal, and ethical), mediates sustainability with its combined dimensions (economic performance, social performance, environmental performance, governance, and innovation performance) in Jordanian pharmaceutical companies at a significance level of ($\alpha \leq 0.05$).

This can be explained by the fact that employing artificial intelligence improves the level of knowledge sharing through information shared with employees, which can be referred to when needed. All of this contributes to providing information about the importance of environmental performance, as this environmental performance contributes to improving the reputation of companies after employing activities related to social responsibility to serve the community and achieve a high level of competitive advantage. This result is consistent with the result of Al-Qarni's study (2021), which concluded that the differentiation climate completely mediates the relationship between original leadership and knowledge sharing behavior among department heads and supervisors. It differs from the result of Al-Khatib's study, which showed that there is no statistically significant effect of using artificial intelligence technologies on the quality of services in banks.

Recommendations

The study recommended the following:

1. Company management should delegate the necessary authority to employees to accomplish their assigned tasks, thereby improving performance.
2. Company management should strive to adapt to the cultures of other companies in international markets to enhance its reputation and its capacity for growth and sustainability.
3. Company management should prioritize leveraging technology through its various applications to improve departmental performance.
4. The company should establish a legal committee to ensure employee accountability, promoting work discipline and preventing misconduct.
5. Company management should prioritize the public interest over private interests in all its activities.
6. The company should consistently utilize environmentally friendly technologies in its operations and foster a company culture that encourages positive values and beliefs for knowledge sharing.
7. Further research is needed to explore the relationship between artificial intelligence and other variables, such as crisis management.

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