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Artificial intelligence and financial decisions: Empirical evidence from developing economies

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A B S T R A C T

Recent technological advancements are endless and have had a profound influence on everyone in every part of life throughout the preceding decades. Artificial intelligence is one such invention that has the potential to change the world. Now, artificial intelligence is being used in almost all commercial operations. Hence, this research attempted to investigate the impact of artificial intelligence dimensions, including natural language processing, machine learning, expert systems, and computer vision on the financial decisions of pharmaceutical companies in Jordan. A cross-sectional approach was used through a comprehensive survey to collect research data from 148 accountants and financial managers in pharmaceutical companies listed on the Amman Stock Exchange with a response rate of 81.3%. The research hypotheses were examined using structural equation modeling of the collected quantitative data. The results indicated that the dimensions of artificial intelligence positively impact financial decisions. Accordingly, companies should spend on building strong artificial intelligence infrastructure and skills. Access to modern artificial intelligence technology, data analysis tools and cloud computing resources are also essential to rationalizing financial decision-making. Besides, Jordan's pharmaceutical sector can overcome these limitations and realize the full potential of artificial intelligence in financial decision-making by solving data privacy issues, encouraging ethical AI re-search, investing in artificial intelligence expertise, and enhancing collaboration.

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1. Introduction

Financial decisions have a pivotal role in the financial well-being and the future of companies (Ahakhatreh & Al-Hawary, 2022). Financial decisions entail a wide variety of remedies, such as how to manage a company's revenues and costs, as well as the financial risks that must be recognized when making new investments (Ucar, 2019). Making educated financial decisions includes, in addition to financial literacy, an understanding of comprehensive organizational goals, an assessment of opportunity cost, and an awareness of the uncertainty involved with the decision-making process (Finkler et al., 2022). Moreover, it entails combining a company's immediate requirements with long-term objectives while considering a variety of issues such as budget limits, investment possibilities, tax ramifications, and changing economic circumstances (Kimmel et al., 2020). According to Klapper and Lusardi (2020), poor financial judgments could result in financial stress, debt, missed opportunities,

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and even bankruptcy. Contrarily, rational choices may lead to financial independence, development, as well as the effective and efficient execution of the company's strategic goals.

Artificial intelligence has gained great traction since the onset of the Fourth Industrial Revolution, because of advancements in processing power, the accessibility of data, and algorithm innovations. These advancements have ushered in a new era of artificial intelligence, in which robots may do feats previously thought to be limited to human capabilities (Zhang & Lu, 2021). Artificial intelligence refers to the simulation of human intelligence in computers capable of performing activities ordinarily requiring human intellect, such as visual perception, voice recognition, decision-making, learning, and solving problems (Goralski & Tan, 2020). It aspires to mimic human cognitive powers, allowing computers to evaluate huge volumes of data, comprehend complicated patterns, and adjust their behavior depending on experience (Raisch & Krakowski, 2021). Haenlein and Kaplan (2019) stated that artificial intelligence-driven improvements have assisted industries such as healthcare, transportation, manufacturing, education, and entertainment. In the field of financial management, it facilitates algorithmic trading, fraud detection, and customer care chatbots (Sangeetha et al., 2022).

As artificial intelligence technologies evolve and acquire importance in the global business environment, pharmaceutical businesses in Jordan are wrestling with the problems and possibilities that this disruptive force presents. Therefore, this industry is attempting to deal with the complexity of implementing artificial intelligence-based financial decision-making processes while adhering to legal frameworks and upholding ethical norms. Artificial intelligence becomes increasingly prevalent in financial analysis, forecasting, and risk management, thus pharmaceutical companies in Jordan must adapt to remain competitive and survive. However, the systematic investigation revealed a scarcity of practical studies that attempted to explore the relationship between artificial intelligence and financial decisions, particularly in one of the most significant industrial sectors of developing countries. Accordingly, the current study provides empirical evidence from the Jordanian business environment on the extent to which artificial intelligence influences financial decisions. Furthermore, it makes a variety of suggestions and recommendations that could improve Jordan's industrial sector's global position.

1.1 Artificial intelligence

The multidisciplinary approach to artificial intelligence enables better decision-making, increased operational efficiency, and promoted innovation across management functions and various industries. Artificial intelligence systems try to mimic human cognitive processes such as perception, reasoning, learning, and problem-solving (Zhang et al., 2020). Furthermore, data science provides the tools and procedures for gleaning meaningful insights from massive data sets, which is required for training AI models and making data-driven management choices (Raisch & Krakowski, 2021). Artificial intelligence has been described as the replication of human intellectual skills in computers that can execute activities ordinarily performed by people, such as visual perception, voice recognition, decision-making, learning, and problem-solving (Huang et al., 2019). Artificial intelligence is typically divided into two categories: narrow artificial intelligence and general artificial intelligence. Narrow artificial intelligence refers to computer systems that are created and trained to execute certain jobs or handle specific issues with great efficiency (De Bruyn et al., 2020). These artificially intelligent systems excel in specialized fields and can outperform humans at specific tasks, but they lack human-like general intelligence (HRI). General artificial intelligence describes systems with human-like intelligence and the capacity to accomplish any intellectual work that a human person is capable of (Sangeetha et al., 2022). In contrast to narrow artificial intelligence, general artificial intelligence has wide and adaptable cognitive capabilities, allowing it to transfer knowledge and skills across areas (Haenlein & Kaplan, 2019). The frameworks and conceptual dimensions used to measure artificial intelligence have varied as a result of the field's multidisciplinary approach. Nevertheless, Zhang et al. (2020) argued that the four-dimensional model which is composed of natural language processing, machine learning, expert systems, and computer vision considers the most widely used framework in the managerial field of artificial intelligence.

Natural language processing (NLP) is a discipline of artificial intelligence that deals with computer-human interaction. NLP allows robots to perceive, interpret, and synthesize human language, making activities like language translation, sentiment analysis, and chatbot interactions possible (Zhang & Lu, 2021). Machine learning (ML) is concerned with the development of mathematical models and algorithms which permit computers to learn from data without having to be explicitly programmed. Based on the data they analyze, ML algorithms discover patterns, make predictions, or take actions, increasing their performance via experience (Goralski & Tan, 2020). Expert systems (ES) are programs that imitate human experts' decision-making skills in certain fields. Based on a set of predetermined experiences and patterns, expert systems employ knowledge bases to deliver answers or suggestions to resolve issues (Qasim & Kharbat, 2020). Computer vision (CV) is the field that deals with how machines can interpret and comprehend visual information from photographs or videos. It enables artificial intelligence systems to recognize things, discover patterns, and execute tasks like facial recognition and object tracking (Chowdhury, 2023).

1.2 Financial decisions

Financial decisions are critical for companies as they entail judgments about how to allocate and manage financial resources in order to achieve particular objectives. A variety of theoretical frameworks provide a philosophical basis for understanding financial decisions. According to capital structure theory, a suitable combination of debt and equity financing is determined

for a company to maximize its value. It entails making financial decisions to trade off the cost of debt, the benefits of tax shelters, and the hazards associated with rising leverage (Zaman et al., 2023). On the other hand, financial planning models, such as cash flow analysis, budgeting, and sensitivity analysis, assist companies in making educated decisions about spending, saving, and investing to accomplish strategic financial goals (Iqbal et al., 2020).

Several widely accepted definitions have been found in the field of company management around financial decisions. Financial decisions are the process of deciding the optimal option among several ones to choose to allocate financial resources, control assets, responsibilities, and investments, and choose the most effective strategy to meet certain financial objectives (Kimmel et al., 2020). Ucar (2019) stated that financial decisions are related to organizational processes, such as planning, implementing, and controlling the mechanism for allocating the company's resources to accomplish stakeholder goals and financial sustainability. Moreover, Klapper and Lusardi (2020) indicated that financial decisions were considered among the most complex organizational decisions, as they are related to the future of the company and the planning of its capital structure to maximize the wealth of the owners and increase its market value.

The financial decisions taken by companies have been classified into three categories: the investment decision, the financing decision, and the dividend decision (Agung et al., 2021). The investment decision implies the method of assessing and adopting alternative investment possibilities or projects with the purpose of allocating financial resources in a way that optimizes returns or meets certain financial goals (Mahjub et al., 2023). This decision entails evaluating potential threats, estimated returns, and the overall acceptability of investment alternatives. The financing decision is concerned with selecting the best combination of debt and equity funding to sustain a company's operations and investment endeavor (Sharma & Mittal, 2023). It entails deciding on the sources of cash that a company will utilize to obtain capital for a variety of goals, such as growing operations, funding initiatives, or satisfying financial commitments. The dividend decision, which is also known as the dividend policy, describes the manner of identifying how much of a company's profits will be dispersed as dividends to shareholders and how much will be kept for reinvestment in the company's operation (Finkler et al., 2022). It entails deciding on the amount, timing, and frequency of dividend distributions to shareholders.

1.3 Artificial intelligence and financial decisions

The capacity of artificial intelligence to analyze enormous volumes of data, discover patterns, and make predictions with speed and accuracy has transformed how financial decisions are made. Pramod and Raman (2022) investigate the impact of reflecting postgraduate students' intention to employ artificial intelligence technologies in their financial investment decisions. The findings suggested that students have a good attitude toward technology and that their awareness influences their willingness to employ financial robots and artificial intelligence tools when making investment decisions that lessen technological discomfort. Njegovanović (2018) conducted a comprehensive literature analysis to establish a conceptual framework on documented artificial intelligence in rationalizing financial decisions for the financial services sector. The review's findings indicated that artificial intelligence plays an important role in making financial decisions in the real world. Furthermore, the perception of neural decision-making was discovered to have a difference in response frequencies ranging from the real environment to the hypothetical environment, indicating that subjects struggle to imitate financial decisions in real situations when asked under hypothetical conditions. Sujith et al. (2022) conducted a descriptive analysis utilizing structural equation modeling on 229 replies from banks and financial institutions in India to investigate the important components of machine learning, one of the fields of artificial intelligence, effective financial decisions amongst companies. According to the study results, machine learning techniques enable pattern analysis and identification from an enormous amount of data to offer the essential information to make efficient financial decisions in a variety of industries such as finance, marketing, supply chain, and human resources. According to this literature review, the hypotheses of the current research could be formulated as follows:

Hypothesis 1 (H1): *Natural language processing positively impacts financial decisions*.
Hypothesis 2 (H2): *Machine learning positively impacts financial decisions.*
Hypothesis 3 (H3): *Expert systems positively impact financial decisions.*
Hypothesis 3 (H3): *Computer vision positively impacts financial decisions.*

Fig. 1 illustrates the proposed research model and summarizes the hypotheses that the research seeks to evaluate.

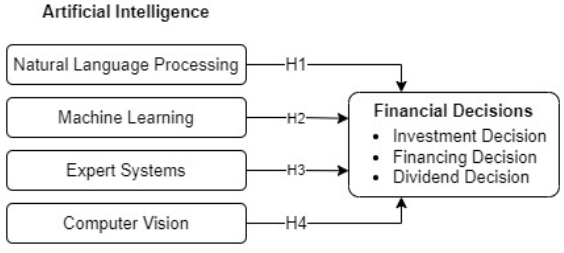

Fig. 1. Proposed model.

2. Methodology

2.1 Data collection

The study utilized a cross-sectional research design as its fundamental framework to systematically gather and analyze data pertaining to the impact of artificial intelligence on the financial decision-making processes within the pharmaceutical industry located in Jordan. This methodological choice was guided by the aim of obtaining a snapshot of the prevailing financial practices and attitudes towards artificial intelligence within this specific sector. The primary data collection strategy involved the self-administrated questionnaire, following the methodology prescribed by Merdjanovska and Rashkovska in their seminal work (2022). To execute this data collection process, an electronic version of the questionnaire was thoughtfully crafted and disseminated via email. The questionnaire was dispatched to a targeted group comprising 182 individuals, who were identified as accountants and financial managers within pharmaceutical companies listed on the Amman Stock Exchange. This specific group was chosen due to its proximity to financial decision-making processes and its relevance to the study's research objectives. The data collection process extended from June 20, 2023, to August 5, 2023, allowing respondents ample time to provide thoughtful and comprehensive answers. A total of 162 questionnaires were duly completed and returned by the participants, reflecting a commendable response rate. However, during the data cleaning and validation process, it was noted that 14 responses exhibited patterns of duplication. To maintain data integrity and eliminate redundancy, these duplicated responses were rigorously reviewed and subsequently excluded from the dataset.

As a result of this meticulous data validation process, the final dataset used for analysis comprised 148 unique and non-repetitive responses. These 148 responses represented a robust and reliable sample size, constituting approximately 81.3% of the total questionnaires that were initially dispatched. This substantial sample size ensured that the findings and conclusions drawn from the research were statistically sound and reflective of the broader population of interest within the pharmaceutical industry in Jordan.

2.2 Measures

The electronic questionnaire employed in the present research was structured into three distinct sections. The introductory section served the purpose of elucidating the overarching objectives of the research, which revolved around investigating the influence of artificial intelligence on financial decision-making processes. Additionally, the introduction underscored the researcher's commitment to upholding ethical research standards and principles. The questionnaire's subsequent sections encompassed a total of 27 items, which were meticulously designed to assess both exogenous and endogenous constructs relevant to the research inquiry with a five-point Likert scale.

Artificial intelligence (AI) constituted the exogenous construct within the research, consisting of 16 items in alignment with the framework proposed by Zhang et al. (2020). This construct was structured along four distinct dimensions, each of which encapsulated essential components of artificial intelligence. These dimensions comprised five items dedicated to probing natural language processing (NLP), three items targeting machine learning (ML), four items devoted to expert systems (ES), and an additional four items aimed at exploring computer vision (CV).

Concomitantly, the financial decisions (FDs) construct served as the exogenous variable within the research framework, comprising a total of 11 items designed in accordance with the framework delineated by Agung et al. (2021). This construct was delineated into four discernible dimensions, encompassing four items dedicated to the assessment of investment decisions (IND), four items tailored to the examination of financing decisions (FID), and three items formulated to investigate dividend decisions (DID).

3. Findings

3.1 Measurement model

Confirmatory factor analysis (CFA) represents the statistical methodology chosen to assess the validity and reliability of the constructs pertaining to artificial intelligence and financial decision-making within the context of this research. CFA is a form of structural equation modeling (SEM) that finds common application when researchers possess a well-defined theoretical framework or pre-existing knowledge of latent constructs and their interrelationships. Furthermore, CFA serves the critical function of ascertaining whether the empirical data collected aligns with the underlying theoretical assumptions (Tariq et al., 2022). The outcomes of this rigorous CFA procedure, along with detailed statistics, are presented in Table 1. This table serves as a valuable resource for gaining insights into the outcomes of the validity and reliability assessments conducted on the measurement model used in this study.

The findings elucidated in Table 1 substantiate the robust association between the observable variables and their respective latent constructs. This assertion is underpinned by the factor loadings, which ranged from 0.653 to 0.824. These factor loadings comfortably exceed the lower threshold of 0.50. The Average Variance Extracted (AVE) values surpassed the minimum benchmark of 0.50, confirming the attainment of convergent validity, in accordance with the criteria stipulated by Al-Alwan et al. (2022). Additionally, the measurement model demonstrated discriminant validity, as evidenced by the AVE values

exceeding the values of Maximum Shared Variance (MSV), and the square root values of AVE exceeding 0.70, as well as the correlation values among constructs, aligning with. This establishes that the constructs under scrutiny are distinct from one another, emphasizing their unique contributions to the overall model.

Table 1
Measurement model evaluation.

Constructs	Items	Loadings	AVE	MSV	√AVE	CR	VIF
NLP	NLP1	0.781	0.555	0.438	0.745	0.861	2.384
	NLP2	0.662					
	NLP3	0.814					
	NLP4	0.756					
	NLP5	0.702					
ML	ML1	0.793	0.591	0.461	0.769	0.813	3.415
	ML2	0.770					
	ML3	0.743					
ES	ES1	0.682	0.534	0.406	0.731	0.821	2.615
	ES2	0.722					
	ES3	0.731					
	ES4	0.785					
CV	CV1	0.711	0.560	0.472	0.748	0.836	1.957
	CV2	0.764					
	CV3	0.737					
	CV4	0.779					
IND	IND1	0.824	0.549	0.502	0.741	0.829	---
	IND2	0.734					
	IND3	0.725					
	IND4	0.672					
FID	FID1	0.724	0.565	0.498	0.752	0.838	---
	FID2	0.653					
	FID3	0.816					
	FID4	0.803					
DID	DID1	0.701	0.550	0.487	0.742	0.786	---
	DID2	0.785					
	DID3	0.737					

Note: NLP: natural language processing; ML: machine learning; ES: expert systems; CV: computer vision; IND: investment decision; FID: financing

Reliability, as evaluated using Macdonald's omega coefficients, was also confirmed, with coefficients falling within the range of 0.786 to 0.861. These values highly exceed the 0.70 threshold conventionally employed for assessing composite reliability. This underscores the internal consistency and reliability of the measurement model. Furthermore, the examination of multi-collinearity among the independent constructs, specifically the artificial intelligence constructs, revealed that they were devoid of multicollinearity concerns. This is evidenced by the Variance Inflation Factor (VIF) values, which were well below the upper threshold of 5. Consequently, it can be inferred that the independent artificial intelligence constructs are not unduly influenced by collinearity issues, thereby enhancing the model's overall robustness and interpretability.

3.2 Structural model

Structural equation modeling (SEM) served as the analytical framework in this study to examine the relationship between artificial intelligence and financial decision-making. SEM is a powerful statistical technique that enables the assessment of hypotheses concerning both direct and indirect effects among latent constructs (Zahran et al., 2023). Moreover, SEM offers a range of fit indicators that aid in evaluating the degree to which the assumed model aligns with the observed data. Fig. 2 visually represents the structural model employed to investigate the intricate dynamics underpinning the influence of artificial intelligence on financial decisions.

The findings derived from the analysis of Fig. 2 revealed several critical insights regarding the fitness of the structural model employed to assess the impact of artificial intelligence on financial decisions. The chi-squared test statistic (CMIN/DF) yielded a value of 2.067. This value falls below the upper limit of 3, which is commonly accepted as an indicator of good model fit. Furthermore, both the Comparative Fit Index (CFI) and the Tucker-Lewis Index (TLI) exceeded the minimum threshold of 0.90. In addition, the analysis showed that the Root Mean Square Error of Approximation (RMSEA) was calculated at 0.046. Importantly, this value does not surpass the upper limit of 0.80. RMSEA is an indicator of the model's goodness of fit, with lower values signifying a better fit. The value of 0.046 indicates that the model fits the data adequately and does not exhibit substantial misfit. Taken together, these results provide compelling evidence in favor of the structural model's fitness for evaluating the hypothesized impact of artificial intelligence on financial decisions, as indicated by Aityassine et al. (2021). Table 2, which presents the results of the path coefficients, offers a more detailed insight into the specific impacts under investigation, shedding light on the direct relationships between the variables of interest.

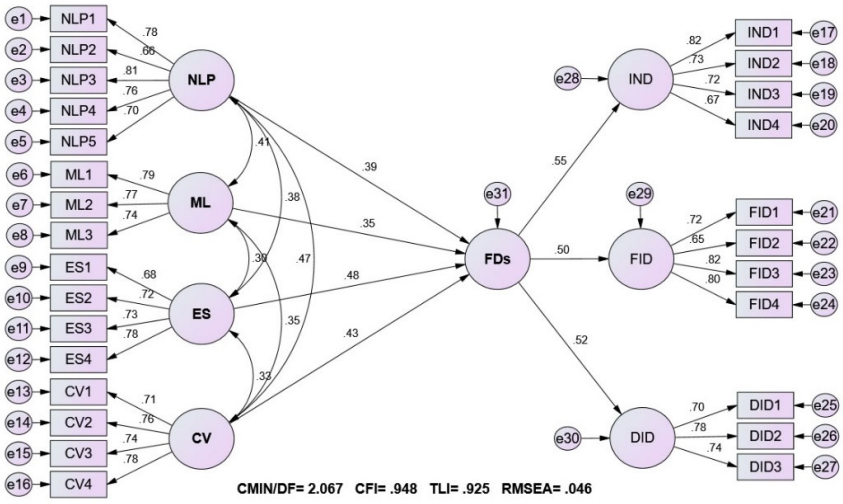

Fig. 2. Structural model for testing the effect of AI on FDs.

Table 2
The result of path coefficients for testing the effect of AI on FDs.

Paths			B	SE	Beta	T	P
NLP	→	FDs	0.455	0.063	0.392	7.222	0.002
ML	→	FDs	0.419	0.066	0.355	6.348	0.007
ES	→	FDs	0.524	0.062	0.481	8.452	0.000
CV	→	FDs	0.477	0.065	0.431	7.338	0.000

Note: NLP: natural language processing; ML: machine learning; ES: expert systems; CV: computer vision; FDs: financial decisions.

The findings presented in Table 2 provide substantial support for the research hypotheses pertaining to the impact of artificial intelligence on financial decisions within the pharmaceutical industry in Jordan. Specifically, it was observed that the expert systems dimension exhibited the most significant effect, with a path coefficient (β) of 0.481. This substantial coefficient indicates a strong and positive relationship between the expert systems dimension of artificial intelligence and financial decisions within the pharmaceutical industry. The associated t-value of 8.452 and a p-value of 0.000 further underscores the statistical significance of this effect, emphasizing its importance in influencing financial decisions.

Following closely, the computer vision dimension exhibited a notable effect with a path coefficient (β) of 0.431. The associated t-value of 7.338 and a p-value of 0.000 emphasize the statistical significance of this relationship, highlighting the meaningful impact of computer vision on financial decisions. Moreover, the natural language processing dimension also demonstrated a substantial effect, with a path coefficient (β) of 0.392. The corresponding t-value of 7.222 and a p-value of 0.002 reaffirm the statistical significance of this dimension's influence on financial decisions. Lastly, the machine learning dimension exhibited a significant effect with a path coefficient (β) of 0.355. While slightly lower than the other dimensions, this coefficient still indicates a meaningful relationship between machine learning and financial decisions. The associated t-value of 6.348 and a p-value of 0.007 confirm the statistical significance of this effect.

In summary, these results not only provide empirical support for the research hypotheses regarding the impact of artificial intelligence on financial decisions but also elucidate the varying degrees of influence among the different dimensions of artificial intelligence.

4. Discussion and conclusion

This research attempted to prove the positive impact of artificial intelligence on the financial decisions of pharmaceutical companies listed on the Amman Stock Exchange. The results of the research indicated appropriate levels of reliability and validity for the model used in the research through confirmatory factor analysis. Moreover, the results of analyzing the research data through structural equation modeling confirmed that the artificial intelligence model consisting of natural language processing, machine learning, expert systems, and computer vision has a positive impact on the financial decisions of pharmaceutical companies in Jordan. Therefore, artificial intelligence technologies are transforming financial decision-making, where it allows Jordanian pharmaceutical companies to benefit from data-driven insights and make more educated, effective, and strategic decisions.

Artificial intelligence algorithms assist Jordanian pharmaceutical companies to acquire a better understanding of medication development costs, market trends, patient demographics, and treatment outcomes. Financial decisions could be made based

on a complete grasp of the market and possible return on investment with more accurate and extensive data analysis. This conclusion is consistent with what Pramod and Raman (2022) stated about artificial intelligence technologies and their impact on the quality of financial decisions. Moreover, solutions based on artificial intelligence have the potential to reduce costs in a variety of domains, including supply chain management, manufacturing, and clinical trials. Pharmaceutical businesses may deploy resources more efficiently and make educated judgments regarding cost-cutting initiatives by finding inefficiencies and optimizing procedures. Artificial intelligence-based predictive analytics forecast market trends, consumer behaviour, and medicine demand, allowing pharmaceutical corporations to make proactive financial decisions. Zhang et al. (2020) stated that these strategies enable precise financial forecasting, improved planning, and resource allocation for the company's future growth.

Overall, the favorable influence of artificial intelligence on financial decisions in Jordan's pharmaceutical companies is varied. Pharmaceutical companies may save costs, speed drug development, improve risk management, and make data-driven choices that lead to increased efficiency and financial success by embracing artificial intelligence technologies. Utilizing artificial intelligence could position Jordan's pharmaceutical industry for future development and innovation. However, careful attention to data protection, ethical issues, and regulatory compliance is required to ensure the industry's appropriate and successful use of artificial intelligence.

5. Recommendations

To fully realize the favorable influence of artificial intelligence on financial decisions in Jordan's pharmaceutical companies, several recommendations should be explored for those companies' management. First, companies should spend on establishing a strong artificial intelligence infrastructure and skills. Access to modern artificial intelligence technology, data analytics tools, and cloud computing resources are all part of this. Second, investing in artificial intelligence talent and educating personnel in artificial intelligence techniques will allow for the successful use of artificial intelligence-based insights in financial decision-making processes. Third, using artificial intelligence-based predictive analytics to forecast market trends, medicine demand, and competition activity. Accurate market projections will help businesses to change financial plans and allocate resources more effectively, enhancing financial decision-making.

Although artificial intelligence has enormous potential to significantly affect the financial decisions in Jordan's pharmaceutical companies, there are certain limits to consider. The pharmaceutical sector in Jordan can overcome these restrictions and realize the full potential of artificial intelligence in financial decision-making by resolving data privacy issues, encouraging ethical artificial intelligence research, investing in artificial intelligence expertise, and fostering cooperation. Artificial intelligence will play an increasingly important role in optimizing financial outcomes, medication research, and patient care in the pharmaceutical business through continuous review and future-directed initiatives.

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