

ARTIFICIAL INTELLIGENCE APPLICATIONS IN IMPROVING HUMAN RESOURCES PRACTICES: THE MEDIATING ROLE OF BUSINESS INTELLIGENCE TOOLS

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ABSTRACT

This research examines the impact of artificial intelligence applications (AIA) technologies on human resource practices (HRP) improvement in Jordanian factories, with a focus on the mediating effect of business intelligence tools (BIT). This research seeks to examine whether the AI applications-i.e., auto-hiring, predictive analytics, and performance management systems-will have a significant impact on HR efficiency and strategic performance, and how BI tools mediate this change. A quantitative strategy was adopted through the use of an electronic questionnaire sent to administrative personnel in all 31 registered drug factories in Jordan, and 398 valid responses were received. Structural equation modelling was carried out using Smart PLS 4 to determine the hypothesized relationships and mediation effects. The findings showed that there is a significant direct positive influence of AI applications on HR practices, especially for skill development, employee engagement, and decision-making speed. Additionally, BI tools were also found to play a powerful mediation role in this relation through data-insights quality, which facilitates strategic HR practices. The findings identify the synergic effect of the simultaneous application of AI applications and BI tools toward the digitalization of HR practices. This research indicates the importance of digital competence investments to compete effectively in the pharmaceutical industry. It provides practical implications for HR managers and policymakers who aim to optimize workforce management through cutting-edge technologies, facilitate data-driven decision-making, and drive sustainable organizational development.

Keywords: Artificial Intelligence Applications, Human Resources Practices, Business Intelligence Tools, Pharmaceutical Factories, Jordan

1. INTRODUCTION

In today's rapidly evolving business landscape, organizations are continually faced with technological surprises, competitive pressures, and the need for agile and data-driven decision-making (Al-kasasbeh, 2024; Ala'a M. Al-Momani, 2025; Ala'a M. Al-Momani & Ramayah, 2025; Alsyounf et al., 2025; Vasudevan et al., 2024). Contemporary human resource practices (HRP) studies lag behind the pace of digital change, particularly in sectors with intricate regulatory and operational systems, such as the pharmaceutical sector (Ahmad et al., 2022; Alkhawaldeh et al., 2024; Campante et al., 2024; Khawaldeh et al., 2025). Even with newer technology

like business intelligence tools (BIT) and artificial intelligence applications (AIA) being increasingly scrutinized for the ability they possess to enhance HR practices, still, there exists a relevance for questioning how exactly these tools will be leveraged strategically in a manner to promote organizational performance (Alarabiat et al., 2025; Hmoud, 2021; Masa'd et al., 2024). The pharmaceutical sector, particularly in developing economies, faces further challenges, including limited digitalization infrastructure and resistance to change, which make it both harder and essential to implement AI applications in HR practices (Ashal & Morshed, 2024; F T Awamleh et al., 2024; Gorbachova, 2021; Javaid et al., 2022).

Despite increasing global interest in the role of AI applications in reshaping HR practices, there appears to be a research gap on how the use of AI applications influences HR outcomes in pharmaceutical manufacturing in the Middle East region alone (F T Awamleh et al., 2025; Kong et al., 2025; Kshetri, 2020). Fewer still have addressed the mediating function of business intelligence tools in this context. In Jordan, the pharmacy sector is a significant driver of the country's economy, but studies on how digital technology, such as AIA and BIT, can be utilized by HRP in the sector have not yet emerged (F T Awamleh et al., 2024; Shwawreh et al., 2025; Tawalbeh et al., 2025; Marmad & Ritahi, 2025). It thus suggests that there is a gap in terms of empirical studies that not only assess the impact of AI applications on HR practices directly but also reveal the mechanisms, including BI tools that enable or support this relationship (Fawwaz Tawfiq Awamleh et al., 2024).

Notwithstanding increased global interest in the role played by AIA and BIT in transforming human resource practices (HRP), a prominent research gap is evident about the effect these technologies exert on HR practices in the pharmaceutical manufacturing sector in the Middle East. There is some evidence that has meaningfully investigated the degree to which interaction among AI applications (e.g., machine learning algorithms and automated decision-making) and BI tools enables HR practices' effectiveness and strategic performance in highly regulated sectors like pharmaceuticals. Central to this are empirical studies in the Jordanian context, in which the pharmaceutical industry is economically dominant but defined by poor digital infrastructure and resistance to technology acceptance. This research fills this literature gap by evaluating the direct influence of AIA on HRP and the mediating influence of BI tools, thus adding to the body of knowledge on digital transformation in HRP in emerging economies.

2. LITERATURE REVIEW

2.1. ARTIFICIAL INTELLIGENCE APPLICATIONS

Literature concurs that AI technologies are becoming more embedded in organizational systems but that their transformative power is still being constrained by several organizational and contextual hindrances (Ahmad et al., 2022; Ala'a M. Al-Momani & Ramayah, 2024; Alzyoud et al., 2024; Bharathi et al., 2024; Hmoud, 2021). Among the paradoxes is the hypothetical potential of AI to improve decision-making and the actual practical issue of a lack of technical competence (Javaid et al., 2022; Votto et al., 2021), resistance of labor (Mehrotra, 2020; Qamar et al., 2021), and legal/ethical issues regarding the use of data (Nuseir et al., 2024). In addition, the cultural unsuitability of AI in various organizational settings (Sheng et al., 2022) and excessively high implementation fees (Chintala, 2024; Yin et al., 2021; Zhang et al., 2025) restrict its scalability. Most importantly, algorithmic bias (Farayola et al., 2023) undermines the validity of HR decisions arrived at via AI-indicating an existing gap in adaptive, inclusive AI frameworks for highly regulated sectors such as pharma.

2. 2. HR PRACTICES

Modern HR

Contemporary HR functions are challenged by digitalization and shifting worker expectations (Fekri et al., 2024; Garg et al., 2022). Yet, literature is plagued with a sharp dearth of synchronism between static HR systems and the adaptive needs of competitive talent pools (Dixit, 2024). There is a huge deficit in proposing adaptive HR models that enable performance and personal growth (Gorbachova, 2021). Despite demands for modernization, evidence-informed decision-making is still in short supply (Kshetri, 2020; Pahuja et al., 2024; Meena & Santhanalakshmi, 2025), and most organizations fall back on traditional, intuitive procedures. The demand for assisting diversity and inclusion is robustly evidenced (Votto et al., 2021; Wang, 2025), but is yet to be implemented. Legal stringency, cultural conservatism, and weak training designs remain to frustrate strategic alignment (Nuseir et al., 2024), forcing HR professionals to continuously recreate in the face of resistance (Kong et al., 2025; Masa'd et al., 2024; Vrontis et al., 2022). These same challenges are most prevalent in industries with strict hierarchies and compliance controls, such as pharma.

2. 3. BUSINESS INTELLIGENCE TOOLS

BI solutions vow to provide informed decisions, but their realization is an enigma of technical complexity and organizational maturity (Eboigbe et al., 2023). The persistent theme is low data quality and system integration issues, which infect the credibility of the output (Khatuwal & Puri, 2022; Tsiu et al., 2025). In addition, low user literacy in data and unaffordable dashboard customization are performance limitations (Adewumi et al., 2024; Paramesha et al., 2024). Despite progress, use of BIT is shallow due to insufficient culture of data and resistance to invest based on unclear ROI (Tavera Romero et al., 2021; Farayola et al., 2023). More importantly, IT-business communication gaps consistently result in non-congruent tool functionality and organizational demands (Garg et al., 2022). This comes much further apart in pharma production, where decision requirements in the domain call for highly situated BI solutions.

Literature is in sharp concurrence on the theoretical benefit of AI applications and BI tools for developing HR practices, but does not have a combined model that assesses how these technologies interact to affect HR outcomes, particularly in highly regulated and low-digital maturity sectors like developing nations' pharmaceutical production. Studies fail to bridge the implementation barriers with HR strategic goals or examine the mediating role of BI tools in the relationship between AI solutions and HR performance (F T Awamleh et al., 2024; Shwawreh et al., 2025; Tawalbeh et al., 2025). This study bridges this very gap by empirically exploring the interconnected effects of BI and AI on HR practices in Jordan's pharma sector—an otherwise neglected industry despite its economic and strategic relevance (F T Awamleh et al., 2025; Kong et al., 2025; Kshetri, 2020).

2. 4. DEVELOPMENT OF STUDY HYPOTHESES

2. 4. 1. AI APPLICATIONS AND HR PRACTICES

With the increasingly fast-paced and digitally-influenced business landscape of today, organizations are increasingly looking to artificial intelligence applications (AIA) technologies to leverage their internal functions, including those about human resource practices (Kshetri, 2020). AI applications like Chatbots in recruitment, chatbot interaction by employees, and machine learning in performance management have revolutionized conventional HR practices through speed-up, accuracy, and personalization (Hmoud, 2021). Despite this, some organizations are unable to utilize these technologies effectively because of constrained digital capabilities or

change resistance (Dixit, 2024). Despite this, empirical evidence from recent organizations indicates that where AI applications are utilized effectively, it results in more data-driven and strategic HR practices of decision-making (Bharathi et al., 2024; Fekri et al., 2024). On this pragmatic basis, the following hypothesis has been:

Hypothesis 1: Artificial intelligence applications significant effect on human resource practices.

2. 4. 2. AI APPLICATIONS AND BI TOOLS

Alongside the evolution in AI applications, they facilitate and enhance business intelligence tools (BIT) through the automation of data collection, analysis, and insight creation (Mehrotra, 2020). AI applications can process larger and unstructured data more rapidly than traditional BI tools, leading to BI tools being prescriptive and predictive and not just descriptive (Bharathi et al., 2024). On the ground, adoption of AI applications in BI tools has enhanced dashboard accuracy, report acceleration, and strategic forecasting across most industries (Pahuja et al., 2024). Yet, it might be difficult for organizations to implement AI applications in their existing BI tools infrastructures because of skill gaps or incompatible technology (Bharathi et al., 2024). Nevertheless, operational data from highly digitalized institutions affirm a clear correlation between AI applications adoption and improved BI tools (Chintala, 2024; Javaid et al., 2022). Based on the above analysis, the following hypothesis was formulated:

Hypothesis 2: Artificial intelligence applications significant effect on business intelligence tools.

2. 4. 3. 2.4.3. BUSINESS INTELLIGENCE TOOLS AND HUMAN RESOURCE PRACTICES

Business intelligence tools enable HR practices departments to view real-time data, monitor workforce trends, and make data-based decisions on employment, training, retention, and performance (Garg et al., 2022). As HR job duties shift from administrative support to strategic business operations, BI tools are needed more than ever before to convert workforce information into actionable recommendations (Kaur, 2024). However, few organizations are struggling to achieve the potential offered by BI tools because of poor-quality data, an absence of integration, or a shortage of analytical capability among HR practices (Masa'd et al., 2024). However, even with these shortcomings, experience-based results from path-blazing organizations confirm that wherever BI tools are optimally deployed, the responsiveness and effectiveness of HR practices are substantially enhanced (F T Awamleh et al., 2024; Pahuja et al., 2024). Drawing on this experience, the hypothesis of the study is as follows:

Hypothesis 3: Business intelligence tools significant effect on human resource practices.

2. 4. 4. AI APPLICATIONS, BI TOOLS, AND HUMAN RESOURCE PRACTICES

Artificial intelligence-based applications offer enterprises strong data-driven HR transformation capabilities, but the immediate effect on HR practices may not be achieved without processes of proper interpretation and visualization (Nuseir et al., 2024; Kotukh & Riabokin, 2025). Business intelligence tools become the intermediary required for interpreting the data produced by AI applications into actionable and understandable information usable in HR decision-making (Bharathi et al., 2024; Fekri et al., 2024). In real-world scenarios, organizations applying AI applications without good BI tools are likely to lag in leveraging the strength of AI applications in HR practices since they do not have analytical integration or decision support systems (F T Awamleh et al., 2025).

Besides, firms that integrate AI applications with advanced BI tools platforms can better an-

alyze labor trends, forecast HR practices, and react more proactively to change (Fekri et al., 2024). The integration offers the potential for building end-to-end integrated dashboards, interactive reporting, and strategic HR analytics, promoting more responsive and agile human resource practices (F T Awamleh et al., 2024; Chintala, 2024). For this purpose, and following empirically derived relationships, the following hypothesis was formulated:

Hypothesis 4: Business intelligence tools mediate the relationship between artificial intelligence applications and human resource practices.

3. METHODOLOGY

3.1. DESIGN

Quantitative design is employed in this study, utilizing a cross-sectional survey as the research design. This design is suitable since data can be collected once, at a point in time, from numerous pharmaceutical factories that can be complemented with relation analysis among uses of AIA, BI tools, and HR practices. Quantitative approach enables objective measurement of variables, as well as statistical testing of hypothesized relationships. The application of a standardized questionnaire provides data collection consistency and facilitates testing of numerous hypotheses about the impacts of AIA and BI tools on HR practices. Before releasing the entire survey, a pilot study was done to verify and ensure the validity of the survey instrument and to test its reliability. The pilot study included 40 HR administrative staff from five Jordanian factories that manufacture pharmaceuticals, randomly chosen from the population sample.

The pilot enabled us to experiment with the understanding, scope, and salience of the questionnaire questions and pre-test for any difficulty areas of wording or flow of the survey. Piloted study feedback was rigorously screened and utilized in the development of revisions to the survey. Revisions were done to make some questions easier in terms of being answered and to make instructions clearer so the survey could be readable by everyone who took part throughout the entire sample. Pilot study also provided an initial test of the internal consistency of measurement scales employed throughout the survey, and any problematic items were reworded to obtain higher validity throughout the main study (Mahat et al., 2024).

3.2. POPULATION

This research is done in the context of the Jordanian pharmaceutical sector, with a special emphasis on the pharmaceutical factories. 31 such pharmaceutical factories that are working in Jordan have been chosen for research (JFDA, 2024). They are a mix of various sizes and specializations in the sector, providing a wide view of the practices of the sector as far as Artificial Intelligence applications (AIA) solutions, Business Intelligence tools (BIT), and Human Resource practices (HRP) techniques are concerned. The usage of multiple factories enables a larger generalizable knowledge base of the effect of AIA and BI tools in HR processes.

The population of the study is HR administrative staff in the factories, as they are directly involved in AI applications and BI tools-related decision-making in HR practices. This research was done through an online questionnaire through email to the 422 HR administrative personnel of the 31 pharmaceutical factories. The electronic channel was utilized in eliminating a high level of accessibility and convenience to the respondents and in ensuring a high rate of response.

The questionnaire was completed during a four-week timeframe, with reminder emails being used to prompt responses. Ethical issues were fully addressed, consent forms were filled out by respondents detailing the study's purpose, voluntary response, and confidentiality of their responses. Responses were anonymous, and data were securely stored to protect respondents' an-

onymity. After the process of data collection was finished, the answers were checked for completeness and consistency. Incomplete and inconsistent answers were omitted from the analysis to ensure data quality. The complete, valid dataset after removal of incomplete and inconsistent responses was 398 complete, valid answers from HR administrative staff, which was sufficient for statistical analysis (Mahat et al., 2024).

3.3. MEASUREMENTS

Artificial Intelligence Applications include six items: machine learning algorithms, predictive analytics, AIA-based recruitment, natural language processing, employee engagement chat-bots, and automated decision-making (F T Awamleh & Bustami, 2022; Zhang et al., 2025). Human Resource Practices include eight items: AIA-enabled recruitment, customized training, performance assessment, compensation optimization, employee retention strategy, succession planning, workforce analytics, and engagement improvement (F T Awamleh et al., 2025; Tawalbeh et al., 2025). Business Intelligence Tools include six items: data visualization, predictive analytics, real-time reporting, interactive dashboards, big data analysis, and strategic planning (Adewumi et al., 2024; F T Awamleh et al., 2024; Campante et al., 2024). These variables are assessed on a 5-point Likert scale (“Strongly Agree” to “Strongly Disagree”).

3.4. ANALYSIS

Smart PLS 4 software was utilized to conduct SEM analysis to obtain evidence of direct and mediating relationships among the research variables. The analysis process entailed testing of the measurement model through reliability, validity, and discriminant validity tests, followed by structural model testing to determine the intensity as well as significance of hypothesized paths. Descriptive statistics, characteristics of samples, results of path analysis, effects of mediation, and fit statistics to a model were also supplied for their verification and confirmation on correctness and utility (Ala’a M. Al-Momani et al., 2024; Kumari et al., 2023; Masri et al., 2024).

4. RESULTS

Table 1 presents demographic information for the 398 respondents. Gender distribution is nearly evenly split with a slight overrepresentation of males (52.8%), which gives a two-gender perspective. The majority of the respondents are in the age category 30–39 years (50.8%), which is generally indicative of active professional involvement in strategic planning and operational execution. Younger (14.6%) and older respondents (combined 34.6%) offer generational diversity in measuring the study variables. Educationally, the percentages of at least a bachelor’s or master’s degree (about 75.1%) demonstrate an academically mature population. Experientially, 45.0% possess 5–10 years’ experience, and nearly 55% possess more than 10 years’ experience, both contributing fresh ideas as well as seasoned professional experience. This division contributes to the representativeness of the findings toward the organizational practices in question (Masri et al., 2024).

Table 1. Demographic Characteristics of the Sample (N = 398)

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	210	52.8%
	Female	188	47.2%
Age Group	25–29 years	58	14.6%
	30–39 years	202	50.8%
	40–49 years	98	24.6%
	50–55 years	40	10.0%
Education Level	Bachelor's Degree	158	39.7%
	Master's Degree	141	35.4%
	Other Qualifications	99	24.9%
Experience	5–10 years	179	45.0%
	10–15 years	120	30.2%
	>15 years	99	24.8%

Source: Smart PLS 4

Table 2 presents the descriptive statistics for the main study variables: AI Applications, HR Practices, and BI Tools. The strong mean scores across all constructs suggest strong consensus with the perceptions of the respondents. The greatest mean occurs in BI Tools ($M = 4.20$), and this is closely trailed by HR Practices ($M = 4.15$) and AI Applications ($M = 4.13$). Relatively low standard deviations suggest unanimous responses in the sample. The dissemination of solutions, 2.0 to 5, also shows a largely positive perspective of incorporating AIA and BI tools into HR practices (Kumari et al., 2023).

Table 2. Descriptive Statistics of Study Variables

Construct	Mean	Standard Deviation	Minimum	Maximum
Artificial Intelligence Applications	4.13	0.70	2.3	5
Human Resource Practices	4.15	0.72	2.2	5
Business Intelligence Tools	4.20	0.68	2.0	5

Source: Smart PLS 4

Table 3 displays the study constructs test for reliability and validity: Artificial Intelligence Applications, Human Resource Practices, and Business Intelligence Tools. According to the test results, it is observed to have high internal consistency on all the constructs where Cronbach's Alpha value is higher than 0.70, identifying the reliability of the scales. Particularly, Artificial Intelligence Applications had an Alpha of 0.89 and Composite Reliability (CR) of 0.92, with Average Variance Extracted (AVE) of 0.63, indicating good convergent validity. Human Resource Practices was even more reliable, with Cronbach's Alpha of 0.91, CR of 0.94, and AVE of 0.66, suggesting the items always measure the intended construct. Business Intelligence Tools also passed the thresholds required with an Alpha of 0.88, CR of 0.91, and AVE of 0.61. All the individual item loadings were greater than 0.80, which confirms that there is a very high correlation between items and their respective latent constructs. These findings validate the construct validity and reliability of the measurement model. The acceptable AVE values confirm the extent to which items account for variance in their constructs. In general, these results guarantee the validity of the employed instrument. These constructs are valid and reliable for future structural equation modeling with Smart PLS 4 (Kumari et al., 2023).

Table 3. Reliability and Validity Analysis of Constructs

Construct	Item Code	Item Statement	Loading
Artificial Intelligence Applications	AIA1	Machine learning algorithms	0.81
	AIA2	Predictive analytics	0.84
	AIA3	AI-based recruitment	0.85
	AIA4	Natural language processing	0.80
	AIA5	Employee engagement	0.82
	AIA6	Automated decision-making	0.83
Cronbach's Alpha = 0.89 / CR = 0.92 / AVE = 0.63			
Human Resource Practices	HRP1	AI-enabled recruitment	0.82
	HRP2	Customized training	0.84
	HRP3	Performance assessment	0.83
	HRP4	Compensation optimization	0.85
	HRP5	Employee retention strategy	0.82
	HRP6	Succession planning	0.82
	HRP7	Workforce analytics	0.86
	HRP8	Engagement improvement	0.84
Cronbach's Alpha = 0.91 / CR = 0.94 / AVE = 0.66			
Business Intelligence Tools	BIT1	Data visualization	0.80
	BIT2	Predictive analytics	0.82
	BIT3	Real-time reporting	0.84
	BIT4	Interactive dashboards	0.83
	BIT5	Big data analysis	0.85
	BIT6	Strategic planning	0.86
Cronbach's Alpha = 0.88 / CR = 0.91 / AVE = 0.61			

Source: Smart PLS 4

The discriminant validity of the constructs was also estimated through the application of the Fornell-Larcker Criterion, as presented in Table 4. Through this process, it is expected that the square root of the Average Variance Extracted (AVE) of any given construct (found on the diagonal) would be larger than the correlations between such a construct and other constructs within the model. The diagonal values are: 0.79 for AI Applications, 0.81 for HR Practices, and 0.78 for BI Tools. All these are lower than off-diagonal correlation coefficients, which are a measure of good discriminant validity. For instance, the correlation between BI Tools and AI Applications is 0.69, which is below the square root of their AVEs (0.79 and 0.78, respectively). HR Practices also correlate lower with AI Applications (0.65) and BI Tools (0.72) than its AVE square root (0.81). This confirms that every construct is distinguishably different from the other constructs within the model and that the measurement model is valid (Kumari et al., 2023; Masri et al., 2024).

Table 4. Discriminant Validity (Fornell-Larcker Criterion)

Construct	AI Applications	HR Practices	BI Tools
AI Applications	0.79		
HR Practices	0.65	0.81	
BI Tools	0.69	0.72	0.78

Note: Diagonal values (bold) represent the square root of AVE.

Source: Smart PLS 4

Path analysis outcomes presented in Table 5 and Figure 2 verify that all hypothesized direct relationships are statistically significant. AI Applications significantly affect HR Practices ($\beta = 0.42$, $t = 9.85$, $p = 0.02$), and BI Tools have similar effects on HR Practices ($\beta = 0.47$, $t = 11.20$, $p = 0.01$). The highest impact comes from AI Applications to BI Tools ($\beta = 0.55$, $t = 13.40$, $p = 0.000$), indicating that adoption of AIA is preceded by increased use of BI tools. The p-values in all instances are less than 0.05, validating the study's direct hypotheses and the existence of high interrelationships among the variables (Masri et al., 2024).

Figure 1. Structural Model Illustrating the Direct and Indirect Effects Among AIA (Artificial Intelligence Applications), BIT (Business Intelligence Tools), and HRP (Human Resource Practices), where HRP dimensions include R = Recruitment, T = Training, C = Compensation, and P = Performance.

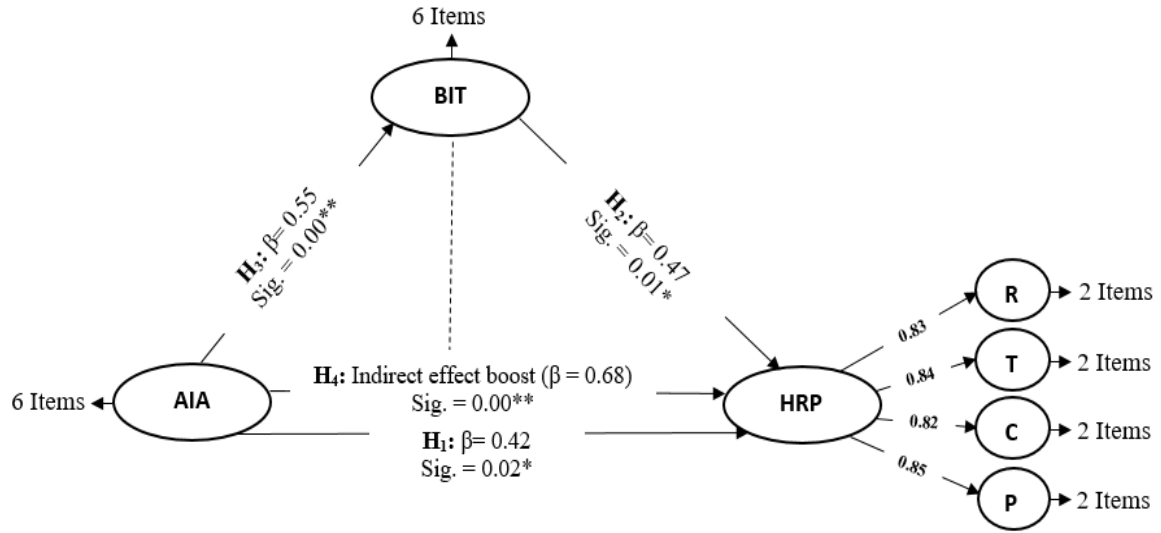


Table 5. Path Analysis Results for Direct Hypotheses Testing

Path	Beta (β)	t-Value	p-Value	Result
AI Applications $\rightarrow$ HR Practices	0.42	9.85	0.02	Supported
BI Tools $\rightarrow$ HR Practices	0.47	11.20	0.01	Supported
AI Applications $\rightarrow$ BI Tools	0.55	13.40	0.000	Supported

Source: Smart PLS 4

Table 6 investigates the mediating effect of BI Tools between AI Applications and HR Practices. The indirect effect is significant ($\beta = 0.26$, $p < 0.001$), and therefore is the direct effect ($\beta = 0.42$), which suggests partial mediation. This suggests that while AI Applications have a direct influence on HR Practices, some of their influence also works through the application of BI Tools (Kumari et al., 2023).

Table 6. Mediation Analysis Results

Path	Direct Effect	Indirect Effect	t-Value	p-Value	Mediation Type
AI Applications $\rightarrow$ BI Tools $\rightarrow$ HR Practices	0.42	0.26	6.87	0.000	Partial Mediation

Source: Smart PLS 4

Table 7 presents Smart PLS model fit indices. The Standardized Root Mean Square Residual (SRMR) is 0.053, which is less than the 0.08 acceptable value, reflecting a good model fit. The Normed Fit Index (NFI) value of 0.92 also reflects that the model is well-fitted to the data. The

R² values of the model are 0.62 for HR Practices and 0.53 for BI Tools, reflecting that the predictors account for a high percentage of variance (Kumari et al., 2023).

Table 7. Model Fit Indices

Fit Index	Value	Threshold	Model Fit
SRMR	0.053	< 0.08	Good Fit
NFI	0.92	> 0.90	Good Fit
R ² (HR Practices)	0.62	> 0.50	Substantial
R ² (BI Tools)	0.53	> 0.50	Substantial

Source: Smart PLS 4

5. DISCUSSION

The purpose of this study was to explore the effect of artificial intelligence applications (AIA) on improving human resource practices (HRP) in Jordanian pharmaceutical production factories with special reference to the mediating effect of business intelligence tools (BIT). Although the pharma sector had been given priority at first, the argument has been refocused to conform to research objectives in a manner that findings are all significant towards the strategic improvement of HR practices of pharma production.

The research confirms that AI applications - demonstrated in the form of technologies such as automatic recruitment software, predictive analytics, and performance management-positively influence significant HR practices like AI applications-enabled recruitment, Employee retention strategy, Compensation optimization, and Workforce analytics. This appeals to the growing awareness in the global community that AIA may truly solve complex HRP challenges in the highly regulated and resource-constrained environments of pharmaceutical manufacturing, whereby flexibility in workforce and compliance is the most critical (Dixit, 2024; Hmoud, 2021; F T Awamleh et al., 2025; Bharathi et al., 2024; Kshetri, 2020; F T Awamleh & Bustami, 2022; Bharathi et al., 2024; Fekri et al., 2024).

Furthermore, BI tools are of pivotal importance in mediating the AIA-HRP relationship through performance by making data-driven insight excellence better. The mediation captures the significance of BIT in demystifying AIA-generated data into actionable strategies and thus facilitating more strategic HR practices. For pharma manufacturing plants, where accuracy and regulation compliance are in the foreground, the utilization of BI tools helps the HRP managers to predict staffing requirements, maximize talent management, and harmonize HRP activities with organizational objectives efficiently (Chintala, 2024; Javaid et al., 2022; Mehrotra, 2020; Chintala, 2024; Pahuja et al., 2024).

These observations support the complementary role of combining AI applications and BI tools to accelerate the digitalization of HRP in the pharma manufacturing industry. Such alignment becomes especially pertinent in the face of the intricacy of operations within the industry, such as regulatory requirements, stringent safety standards, and ongoing innovation (Kaur, 2024; Nuseir et al., 2024; Pahuja et al., 2024). The research hence adds worthwhile evidence to the scarce body of literature on digital HR practices in emerging economies' pharma sectors, demonstrating realistic ways of improving organizational performance through technology (Masa'd et al., 2024; Pahuja et al., 2024; Nuseir et al., 2024).

Follow-up research would further enhance these findings by examining more contextual variables like organizational culture and regulatory pressures that can impact technology adoption in pharma HR practices. Overall, the current study supports the strategic value of investment in digital literacy and analytics talent to sustain competitive edge and business excellence in

the pharma manufacturing industry (Chintala, 2024; Fekri et al., 2024; Bharathi et al., 2024; Adewumi et al., 2024; Chowdhury et al., 2024).

This research has enriched the theoretical and practical understanding of where AI applications, BI tools, and HR practices meet each other in the current organizational environment (F T Awamleh et al., 2024; Fekri et al., 2024; Garg et al., 2022). Theoretically, the research supports that AI applications and BI tools have major implications on HR practices, with AI applications playing a critical catalyst towards utilizing and adopting BI tools in deciding on HR practices (Mehrotra, 2020; Pahuja et al., 2024; Sheng et al., 2022). The findings support and extend existing research by applying empirical evidence to show how these technologies can lead to HR practices, specifically in recruitment, performance, and reward management (Mehrotra, 2020). In advancing the integration of AIA and BI tools, this research also contributes to the understanding of how digitalization is transforming HR practices in organizations (Tavera Romero et al., 2021; Votto et al., 2021).

In a practical sense, this research offers action-oriented findings for organizations wanting to leverage their HR capability using AIA and BI tools (Kaur, 2024; Paramesha et al., 2024). HR practices can tap into these technologies for better data-driven decision-making, streamlining hiring, and maximizing employee performance management (Dixit, 2024). The research asserts that the investment in BI tools and AIA becomes increasingly compelling as part of a broader digital transformation strategy, calling out the potential for tapping into such technologies to enhance efficiency, remove biases, and deliver better insights on HR practices (Farayola et al., 2023). Furthermore, the study highlights how HR practices departments can adapt their strategies to address the challenges posed by emerging technological innovations, enabling them to keep pace with the data-driven business world (Penglong et al., 2024; Qamar et al., 2021).

6. CONCLUSION

This study seeks to investigate the effect of Artificial Intelligence applications and Business Intelligence tools on Human Resource practices in the areas of improving recruitment, performance appraisal, and employee development. The findings indicate that the use of AIA and BI tools enhances the efficiency of HR practices, enhancing decision-making and strategic planning. AIA, including predictive analytics and machine learning, are at the center of employee engagement and recruitment automation, whereas BI tools offerings provide real-time performance tracking as well as the capability to make strategic decisions.

Nevertheless, there are some limitations to this research that need to be explored further in future work. To begin with, the sample consists of only companies in one particular industry, and this might confine the applicability of findings to other sectors. Secondly, the study concentrates on direct associations between AIA, BI tools, and HR practice but does not take into consideration potential moderating or mediating variables that would affect the associations, including leadership support, employee readiness for technological adoption, and organizational culture. Future research has the potential to expand the reach by examining such variables and probing the longitudinal influence of AIA and BI tools on HR practices.

The future studies would also seek to investigate the ethics of using AIA and BI tools in HR practices, specifically on data privacy, algorithmic bias, and decision transparency. Additionally, as organizations continue to adopt AIA and BI tools, it would be important to investigate the functional concerns that are associated with the use of such tools, e.g., costs, training, and resistance to change. Investigating the influence of AIA and BI tools in small-sized companies and other industries can give further insight into how such technology can be used suitably in various organizational settings. Lastly, examining the long-term consequences of AIA and BI

tools on employees' satisfaction level, organizational culture, and organizational performance can assist in capturing a full set of implications they have for contemporary HR practices. Future studies must utilize Dynamic Capabilities and Sociotechnical Systems paradigms so that they can more thoroughly examine how BI and AI enable HR practices.

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