

A Study of the Impact of Artificial Intelligence on the Human Resource Development Framework Past – Future

Mousavi Sayyed Najmuddin¹, Haider Wahid Ali Al-Buwaihi², Nazarpouri, Amirehshah³, Vahdati, Hujjatullah⁴

^{1,2,3,4}Lorestan University, Iran



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ABSTRACT

Objective: This article focused on developing a causal model of the causes and effects relating to the impact of artificial intelligence on human resource development in public hospitals in Iraq, with the aim of identifying and prioritising the key influencing factors and outcomes associated with this technology, and analysing them. **Method:** This study is considered applied research in terms of its purpose and employed a mixed-methods approach (qualitative-quantitative). In the qualitative phase, the fuzzy Delphi method was used, involving 11 experts, including senior managers, human resource specialists and information technology specialists from public hospitals in Iraq, over three iterative rounds. The cause-and-effect factors of AI's impact were identified through a systematic review of the literature and expert opinions. Data were analysed using fuzzy triangular means (a, b, c), non-fuzzy numerical values, and Kendall's coefficient to assess consensus among experts and determine the final priority of factors. **Results:** The results revealed that, among the antecedent factors, 'technological infrastructure and integration', 'human factors and readiness (organisational acceptance)' and 'organisational structure and operational factors' ranked highest. With regard to the subsequent factors, 'Reduction in HR costs and financial results', 'Process automation' and 'Improvement of the employee experience and reduction of discrimination' occupied the top three positions. Other factors, such as 'performance evaluation', 'improved productivity', 'staff retention' and 'improved management' ranked in the mid-range. The study concluded that the use of artificial intelligence for human resource development in public hospitals in Iraq requires a two-pronged approach: Firstly, ensuring that technological and organisational requirements are in place, including suitable infrastructure, integration of technologies and workforce readiness; and secondly, managing the outcomes of AI implementation, particularly in reducing costs, automating processes and enhancing the employee experience. **Novelty:** This study is considered applied research in terms of its purpose and employed a mixed-methods approach (qualitative-quantitative). In the qualitative phase, the fuzzy Delphi method was used, involving 11 experts over three iterative rounds, and the cause-and-effect factors of AI's impact were identified through a systematic review of the literature and expert opinions.

INTRODUCTION

In the era of Industry 4.0, the human resources function plays a vital role in bridging the gap between technology and human resources. Although technology is taking over most of the tasks traditionally performed by HR, there is still a growing need for flexible HR functions to address the challenges of people management [1], [2]. The rapid advancement of technology, particularly the implementation of artificial intelligence in HR, has brought about significant changes in HR processes and practices. As organisations increasingly move towards digitising their HR operations, it is crucial to understand the impacts of AI on various aspects of HR, such as employee productivity, training and learning, health and safety, payroll processing, employee well-being, and

real-time feedback [3], [4], [5]. The emergence of artificial intelligence and automation has ushered in a new era of challenges and opportunities, reshaping many industries, including the field of human resources development [6], [7]. These technologies can identify the individual needs of employees and design and deliver training programmes tailored to each person's requirements. Furthermore, artificial intelligence plays a vital role in creating dynamic and interactive educational content, as well as in continuously assessing and improving learning processes [8], [9], [10]. The integration of artificial intelligence and automation in human resource development is an evolving field. The advent of the internet in the 1990s led to e-learning, thereby providing a more flexible and convenient platform for employees to engage in learning and development. AI algorithms analyse employee feedback using natural language processing and machine learning, thereby revealing actionable insights into employee skill gaps and learning needs [11], [12]. Therefore, The adoption of AI in HR development facilitates highly personalised learning experiences and informs the identification of skill gaps through analytics, ensuring that each employee receives training that is most relevant and effective for them [13], [14]. AI-driven predictive analytics also aids workforce planning, assisting HR development professionals in managing talent and development strategies. Similarly, automation transforms the operational aspects of HR development, fostering a culture of continuous improvement and streamlining HR development processes across the organization [15], [16]. This streamlining frees up valuable time for HR development professionals, allowing them to focus more on the strategic aspects of training and development rather than on administrative tasks. The integration of AI and automation into HR development is not without its challenges. Issues such as data privacy, the ethical use of AI, and the potential for job displacement require careful consideration [17], [18]. Overall, these technologies have transformed HR development processes, making them more efficient and impactful, with the potential to further change the field in profound ways [19], [20], [21]. As human resource development continues to evolve, the integration of artificial intelligence and automation technologies is not only transforming specific training areas but also reshaping the strategic landscape of HRD [22], [23]. Addressing the various dimensions of human resource development and examining and analysing the outcomes of investment, workforce planning, training, and assessing future personnel requirements became increasingly common, particularly in developed countries. In this regard, the efforts of scholars and experts in this field provided a valuable guide for the managers and administrators of various organisations. Large service organisations, including hospitals, although they joined this endeavour much later, began to adopt the prevailing methods of human resource development used in other organisations. However, issues such as the large-scale investment required for expensive medical technology, the continuous rise in hospital costs, and the very high proportion of expenditure on human resources necessitate that the best possible use is made of the workforce through the application of modern scientific and practical methods. Therefore, given the limited scientific attention paid to the development of human resources using artificial intelligence in Iraq's healthcare sector, particularly

concerning state hospitals, the researcher has undertaken to provide a brief overview of the role of artificial intelligence in human resource development and its dimensions, including planning and training, and the connection between these two matters and human resource development in Iraq's state hospitals, namely Al-Rafidain and Al-Rashidi.

Artificial intelligence and its role in human resource development are essential for running hospitals; therefore, the main question is: what are the benefits of artificial intelligence in hospital development, and by relying on which advantages can hospital management emphasise the effective role of artificial intelligence in hospitals? Moreover, since human resource development has been identified as one of the most important functions of human resource management, the field of health and treatment is one of the most significant and emphasised areas in the comprehensive scientific roadmap. Therefore, there is no doubt that the use of artificial intelligence in human resource development can play an effective role in achieving the strategic objectives of hospitals and can prove fruitful in implementing the vision document. In the theories and approaches of human resource development, there are numerous benefits, each of which has considered multiple dimensions and components. However, this research attempts to develop a model of the benefits by studying the views and approaches of relevant specialists, as primarily reflected in their research. This model will emphasise the role of artificial intelligence in human resource development, whilst also addressing the specific benefits of artificial intelligence in human resource development within Iraqi hospitals and presenting them in a comprehensive framework [24], [25].

Research Background

Artificial Intelligence

Artificial intelligence is a branch of computer science whose main goal is to create intelligent machines capable of performing tasks that require human intelligence. Artificial intelligence is, in fact, a form of human intelligence simulation for computers, and by artificial intelligence, we mean a machine programmed in such a way that it thinks like a human and is capable of imitating human behaviour. This definition can be applied to all machines that operate in a manner similar to the human mind and are capable of performing tasks such as problem-solving and learning [26].

Human Resource Development

Human Resource Development is the collection of organisational activities that aims to create desirable behavioural changes in employees. It plays a constructive role in the process of recruitment, nurturing, retention, promotion, and evaluation of applied scientific training by employing approaches such as formal training, assessment, work experiences, and interpersonal communication [27]. Human resource development refers to systematic learning experiences offered by an organisation with the aim of enhancing employee performance and personal growth [28]

The Benefits of Artificial Intelligence in Human Resource Development

In a rapidly changing economy, organisations are investing in electronic human resource systems that support the personal development of employees and are therefore

changing their approach to learning [29]. However, one of the critical areas is the implementation of appropriate learning strategies for employees [30]. Yazdani and Hakimnia conducted a study entitled "Identifying the Challenges and Opportunities of Applying Artificial Intelligence in Human Resource Management with a Meta-combination Approach". This research was carried out using a qualitative, meta-combination methodology. The data analysis method is open coding. The research findings were identified from 44 primary studies or benchmarks, selected from a total of 950 relevant articles and theses. The derived propositions comprise 64 codes, 18 concepts, 4 sub-categories, and 2 main categories. The results showed that the challenges of implementing artificial intelligence in human resource management are as follows: Technical/informational challenge, human challenge, ethical/legal challenge, organisational challenge. Furthermore, the opportunities for applying artificial intelligence include: improving the employee user experience, enhancing human resources processes, reducing human resources management costs, developing strategies, aligning with digital transformation, catering to the millennial generation, and advancing management. Rahdarpour conducted a study entitled "A Model for the Adoption of Artificial Intelligence in Private Organisations with the Mediation of Human Resource Management: Predictors and Consequences". This research was carried out using a qualitative method and a thematic analysis approach with the MAXQDA software. In the quantitative section, 252 questionnaires were distributed among the HR managers of private companies in Tehran. The data analysis for the quantitative section was conducted using PLS software. The results showed that the antecedents of AI adoption in HRM include organisational strategy and vision, organisational culture, and resources and infrastructure, and its consequences include improved recruitment processes, training development, reduced errors, increased accuracy, and the creation of a competitive advantage. Hosseini conducted a study entitled 'The Role of Artificial Intelligence on Human Resource Management in the Sports Industry'. This qualitative research was carried out using a semi-structured interview with 12 individuals, including sports management professors, managers of sports clubs, and directors and deputy directors of the sports and youth affairs offices in West Azerbaijan Province. The data were analysed using the constant comparative method and open and axial coding. The results revealed 28 main themes across two sections on the implications of AI for HR management, including: 1- Market analysis, 2- Diversity management, 3- Employee satisfaction, 4- Attendance data analysis, 5- Process automation, 6- Predicting HR needs, 7- Time management optimisation, 8- Reducing discrimination, 9- Burnout, 10- Enhancing the employee experience, 11- Fan engagement, 12- Performance management, 13- Employee development and training, 14- Improving recruitment and selection and the factors affecting AI on HR management include: 1- Laws and regulations, 2- Ability to analyse and interpret organisational results, 3- Skills training and development, 4- Change management, 5- Specific needs of the sports industry, 6- Organisational adoption, 7- Implementation and maintenance costs, 8- Collaboration between technology and HR management, 9- Skills and training gaps, 10- Adoption and uptake

by HR professionals, 11- Transparency and trust, 12- Ethical considerations and bias, 13- Technology infrastructure and integration, and 14- Data quality and access were identified. Natarpour and Zakari conducted a study entitled 'Artificial Intelligence and its Impact on Strategies and Solutions for Human Resource Training and Development in Projects'. This research examined the role and effectiveness of artificial intelligence in enhancing the quality of human resource training and development by reviewing successful experiences of its use in the process of human resource training and development in civil engineering projects. The results showed that the use of artificial intelligence in human resources training and development in civil engineering projects can lead to improved quality, reduced costs, and increased productivity and speed of work. Ultimately, the use of artificial intelligence in human resources training and development in civil engineering projects can lead to improved project performance, increased productivity, and reduced costs [31], [32], [33], [34].

Akbari Emami et al. conducted a study entitled "Designing a Framework for the Application of Artificial Intelligence in Human Resource Management: An Exploratory Approach". This research is qualitative in terms of data collection methods and has an exploratory approach, which was used to extract components from open-ended and in-depth interviews with experts. The results showed that the drivers for the adoption of AI in HRM were categorised as technological, competitive environment, and organisational drivers. The second aspect of the model, titled 'Processes', includes talent selection and recruitment, training and development, performance appraisal, compensation, and employee retention. Ultimately, the consequences of applying artificial intelligence in human resource management include financial, internal process, individual, and growth and learning outcomes [35].

Rajabi Fejad and Atapur conducted a study entitled 'The Impact of E-HRM and AI on Talent Management at the Iranian Space Research Institute'. This research was carried out using a stratified random sampling method, with 251 questionnaires distributed among all employees of the Iranian Space Research Institute. The results showed that e-HRM has an impact on talent management, as do the various dimensions of e-HRM and AI on the talent management of the Iranian Space Research Institute (including the dimensions of talent attraction, talent discovery, development and enhancement, and talent retention and maintenance). Sarvestani conducted a study entitled "Identifying the prerequisites for utilising artificial intelligence in human resource management." This research was carried out using a qualitative method, of the exploratory and applied types, with an inductive approach. The sampling method was purposive and snowball, conducted through interviews with 10 experts and specialists in human resources, digital transformation, human resources analytics, and artificial intelligence. This research identified 6 main themes and 13 sub-themes. The main themes include individual, organisational, data, digital ethics and privacy, hardware and software, and policymaking prerequisites [29], [36].

Akuma conducted a study entitled 'Artificial Intelligence and Automation in Human Resource Development: A Systematic Review'. This research was established

through a comprehensive search of academic databases, HRD journals, and conference proceedings to identify relevant studies on AI and automation in HRD. Databases such as Semantic Scholar, Google Scholar, Scopus, and Web of Science were searched using keywords related to artificial intelligence, automation, and human resource development. The search terms included: (artificial intelligence or AI or machine learning or automation) and (human resource development or talent management or workforce upskilling or staff development or workforce development or knowledge management or workforce planning or learning and development). The search focused on the titles, abstracts, and keywords of articles and other academic sources published between 1997 and the first quarter of 2023. The results showed that the use of AI is applicable in the areas of talent development, training and development, performance management, workforce planning, and knowledge management [21].

Nwaz et al. conducted a study titled 'Adoption of Artificial Intelligence in Human Resource Management Practices'. The study was carried out using a simple random sampling method, distributing 274 questionnaires to Information Technology employees in Chennai, India. The results showed that variables such as accuracy, computational power and capacity, and personalisation significantly impact time savings and cost reduction, whereas automation and real-time experience had no effect. By focusing on key variables such as accuracy, automation, computational power and capacity, real-time experience, personalisation, and time and cost savings, this research provides a comprehensive understanding of the expected outcomes when implementing artificial intelligence in human resource management [9].

Ilyas and Qadir conducted a study titled 'An Examination of the Impact of Artificial Intelligence on Human Resource Management'. Through a comprehensive systematic literature review and analysis, the research examined 60 articles published across 30 leading international journals over a 25-year period. The findings indicated that AI is most effective in recruitment, training and development, and human resource performance appraisal [30].

Agarwal conducted a study titled "Adoption of Artificial Intelligence by Human Resource Management: A Study on its Predictors and Impact on HR System Effectiveness". This research was carried out using a convenience sampling method, distributing 210 questionnaires to HR employees (only senior officers or specialist HR positions) in Delhi-based IT companies. The results showed that among the factors influencing the adoption of AI are organisational readiness, perceived benefits, and technological readiness, which in turn can make the HR system more effective.

Ghomi and Ebrahimi conducted a study entitled 'Identifying Artificial Intelligence Indicators in Human Resource Development'. This research was carried out using a qualitative, meta-synthetic method, involving an in-depth analysis of sources from the period 2000 to 2023. It followed the seven stages of Sandelowski and Barros (2007) and utilised open coding. The results showed that the AI indicators in HRD include three categories (HR intelligence, digital HR management, and HR architecture) and nine concepts (advancement and promotion of intelligent HR, smartisation). strategic human

resource planning, cultural development of human resources aligned with artificial intelligence, training and empowerment of human resources aligned with artificial intelligence, use of artificial intelligence tools in performance appraisal, core technology, organisational learning, smart knowledge management, digital talent management) and 45 codes were extracted [34].

Yoo et al conducted a study entitled 'Predictors and Consequences of AI Adoption and Use in the Workplace: A Social-Technical Systems Theory Perspective'. This research was carried out using a qualitative, text-analytical approach. The results showed that the antecedents of AI adoption and implementation include the human resource subsystem (including human resource characteristics and readiness), the technical subsystem (infrastructure, technology, technical tools), the organisational structure subsystem (organisation structure, management structures, operational structures), and environmental factors (external conditions, policies, laws, and existing technologies in the work environment). are: the antecedents of AI adoption and implementation include the human resource subsystem (comprising employee characteristics and readiness), the technical subsystem (infrastructure, technology, technical tools), the organisational structure subsystem (organisation structure, management structures, operational structures), and environmental factors (external conditions, policies, laws, and existing technologies in the work environment). The consequences of AI adoption and implementation include individual outcomes (increased personal productivity, skills, job satisfaction), organisational outcomes (improved efficiency, cost reduction, enhanced organisational processes), and employment-related outcomes (changes in jobs, workforce structure, employee interactions) [36].

RESEARCH METHOD

The present study is developmental in its objective, descriptive in its nature, and qualitative in its data type. In this research, after identifying and outlining the main topic, the research problem was conceptualised and framed through a study and review of literature and theoretical foundations, comparative studies, and a review of the research's domestic and international background. The present study utilised qualitative, latent, and inductive content analysis, through which the antecedents and consequences of the impact of artificial intelligence on human resource development were identified. The statistical population of the present study comprised senior managers, human resources specialists, and information technology specialists from public sector hospitals in Iraq. The researcher initially extracted meaningful concepts and categories from the data through qualitative analysis, taking a step towards theory construction. Initially, scientific literature was reviewed using databases, and the research instrument was a fuzzy Delphi questionnaire, which was distributed to 11 experts. Qualitative research methods were used to validate the instrument's validity and reliability. In the present study, information was gathered from experts and specialists, and the sampling method was purposive. The criteria for selecting the experts were theoretical mastery (review of relevant research), practical experience (relevant work history), willingness and ability to

participate in the research, and accessibility. A noteworthy point in determining the number of experts is ensuring the comprehensiveness of various perspectives in the research. At this stage, 11 experts were selected. The sampling method in the present study was purposive. The experts participated in three consecutive rounds. The antecedent and consequent factors influencing artificial intelligence were identified through a systematic review of the literature and expert opinion. The data were then analysed using fuzzy triple mean (a, b, c), fuzzy crisp numbers, and Kendall's coefficient of correlation to assess the degree of agreement among the experts and to determine the final prioritisation of the factors. The experts' profiles are presented in Table 1.

Table 1. Demographic Characteristics of Experts (N=11)

Feature	Category	Frequency	Percentage
Gender	Male	7	63.6%
	Female	4	36.4%
Age	Less than 30 years	1	9.1%
	31-40 years	3	27.3%
	41-50 years	5	45.5%
	Over 50 years	2	18.2%
Education	Bachelor's	2	18.2%
	Master's	6	54.5%
	Doctorate	3	27.3%
Work Experience	Less than 5 years	1	9.1%
	6-10 years	3	27.3%
	11-15 years	4	36.4%
	Over 15 years	3	27.3%

RESULTS AND DISCUSSION

Result

In this study, a comprehensive review of research literature and sources related to the impact of artificial intelligence on human resource development was first conducted to identify a set of antecedent and consequent factors. These factors comprised 24 antecedent and 24 consequent components, which were extracted based on theoretical foundations and the findings of previous studies. Following the categorisation of the factors, a Delphi questionnaire was designed based on this classification, containing 24 statements for each factor. After the questionnaire was validated by academics, the Delphi rounds were conducted. The Fuzzy Delphi Technique is a combination of the Delphi method and fuzzy logic that accounts for uncertainty and expert disagreement in the analysis. Using fuzzy triangular numbers, fuzzy mean, and defuzzification, the prioritisation of antecedent factors is carried out. For the Fuzzy Delphi analysis, each expert response was converted into a fuzzy triangular number, which consists of three values:

- a: Lower bound
- b: Most likely value

c: Upper bound

For the fuzzy Delphi analysis, each expert response was converted into a fuzzy triangular number, which consists of three values:

$$\delta = (b - b) / (c - a)$$

$$b - b = a$$

$$\delta + b = c$$

The value of δ was determined based on the standard deviation of each factor:

$$\delta = \text{"Average"}$$

$$b - b = a$$

$$\delta + b = c$$

The value of δ was determined based on the standard deviation of each factor:

$$SD=0 \rightarrow \delta=0.2$$

$$SD>0 \rightarrow \delta=SD$$

Then, the fuzzy crisp value of each factor was calculated using the centre of gravity method:

$$(a+b+c)/"3" = \text{Crisp value}$$

Note: The fuzzy rank is determined by the fuzzy crisp value, and a higher crisp value indicates a greater impact of the factor.

Based on Table 2, it can be stated:

High priority: Infrastructure and human preparedness have the greatest impact, so they should be given high priority in operational planning.

Medium priority: Factors such as organisation, training, change management, and other factors with a crisp value close to 4 are in the second and third priority.

Lowest priority: external factors with lower fuzzy numbers (e.g., 25/3) have less impact but should not be ignored in policy design. Table 2 shows the results of the first-round fuzzy Delphi for the antecedent factors.

إليك الجدول رقم 2 من الملف، مع إعادة بنائه باللغة الإنجليزية وترتيب الأعمدة من اليسار إلى اليمين كما طلبت:

Table 2. Fuzzy Delphi Results for Antecedent Factors (Round 1)

Factor Group	Influencing Factor Name	Mean (a)	Mean (b)	Mean (c)	Crisp Value	Rank
Technical & Data Factors	Infrastructure & Tech Integration	4.8	4.99	5.0	4.93	1
	Info & Comm Quality	4.1	4.25	4.4	4.25	-
	Data Mining	3.96	4.1	4.22	4.09	-
	Intelligence Requirements	3.7	3.9	4.1	3.97	11
	Functional Requirements	3.8	3.9	4.0	3.9	12
Human & Org. Factors	Human Factors & Readiness	4.8	4.99	5.0	4.93	2

Factor Group	Influencing Factor Name	Mean (a)	Mean (b)	Mean (c)	Crisp Value	Rank
Managerial & Process	Training & Skill Development	3.8	4.0	4.2	4.0	10
	Change Management	3.9	4.1	4.3	4.0	11
	Organizational Culture	3.7	3.8	3.9	3.9	11
	Results Interpretation	3.8	3.9	4.0	3.9	11
	Ability Personal Innovation	3.8	4.0	4.2	4.0	11
	Strategy & Org. Vision	3.7	3.9	4.1	3.9	11
	Process & Organization Methods	4.1	4.29	4.4	4.26	1
	Management Structures	3.8	3.9	4.1	3.9	12
	Operational Structures	3.8	4.0	4.1	4.0	-
	IT & HRM Collaboration	3.8	4.0	4.2	4.0	11
Environmental/Industrial	External Conditions	3.1	3.3	3.5	3.3	12
	Competitive Environment	3.8	4.0	4.2	4.0	11
	Industry-Specific Needs	3.8	4.0	4.2	3.9	12
	Social Media Influence	3.8	4.1	4.26	4.0	-
	Technological Awareness	3.8	4.0	4.2	4.0	11
Legal & Ethical	Ethics, Transparency & Trust	3.8	3.9	4.0	3.9	11
	Resources & Infrastructure	3.8	4.0	4.2	3.9	11
	Perceived Benefits	3.8	3.9	4.0	3.9	12

The Kendall's coefficient in the first round was reported as 0.38, which indicates that the experts have not yet reached a full consensus and that there is a significant disagreement.

Given the relatively low Kendall's coefficient, it is advisable to conduct another fuzzy Delphi round (a supplementary round) in order to:

1. Reduce disagreements
2. Stabilise the rankings
3. Increase confidence in the results

In the second round, the Kendall's coefficient of 0.557 indicates a moderate consensus, meaning the experts' opinions are somewhat close but not complete. Some factors have similar rankings, but a slight disagreement remains among the experts. Example: 'Human factors and their readiness' is ranked 7th, whereas 'Infrastructure and technology integration' is ranked 1st; this rank difference has reduced the Kendall's coefficient. This value indicates that the data still exhibit some dispersion and that sufficient consensus for a definitive ranking of all factors has not been achieved. To reach $W \geq 0.7$ (high consensus), a supplementary round can be conducted and expert feedback collected to allow the rankings to converge.

The means (a, b, c) for most factors are between 3.96 and 5.0, indicating the relatively high importance of most factors from the experts' perspective. The fuzzy crisp value is in most cases close to 4, but the first two factors (technology infrastructure and human factors) are clearly higher than the others:

1. Technology Infrastructure and Integration: 969/4 $\rightarrow$ Rank 1
2. Human Factors and Organisational Readiness: 965/4 $\rightarrow$ Rank 2
3. Top ranks (1 to 3):
4. Technology Infrastructure and Integration (Rank 1)
5. Human Factors and its Readiness (2nd rank)
6. Organisation and Process Factors (3rd rank)

These three factors have the greatest role in the success of the project or case study.

Middle ranks (4 to 12):

Organisational culture, perceived benefits, data mining, technological awareness, competitive environment, resources and infrastructure, industry-specific needs, ethical factors and transparency have a medium importance and a complementary impact.

Lower-ranked factors (from 20th place):

1. Change management (Rank 20)
2. Functional Requirements (Rank 21)
3. Operational Structures (Rank 22)
4. Organisational Strategy and Vision (Rank 23)
5. External Conditions (Rank 24)

These factors had the lowest consensus and impact in this round.

Furthermore, the Kendall's coefficient of 0.64 indicates good, though not perfect, agreement among the experts. This represents an increase of 0.09 from the previous round (Kendall's coefficient of 0.55), indicating a significant improvement in consensus. At present, it can be said that the key factors have been identified and the main direction of the experts is aligned. Given this ranking, organisations can focus their strategic efforts on three key factors: technological infrastructure, human readiness, and process

organisation. Table 3 presents the results of the third Delphi round for the antecedent factors.

Table 3. Fuzzy Delphi Results for Antecedent Factors (Round 3)

Category	Factor Name	Mean (a)	Mean (b)	Mean (c)	Crisp Value
Technical & Data Factors	Infrastructure & Tech	4.933	4.973	5	4.969
	Integration				
	Information & Communication Quality	3.96	4.04	4.12	4.04
	Data Mining	3.96	4.04	4.12	4.04
	Intelligence Requirements	3.96	4.04	4.12	4.04
Human & Org. Factors	Functional Requirements	3.96	4.04	4.12	4.04
	Human Factors & Readiness	4.927	4.967	5	4.965
	Training & Skill Development	3.96	4.04	4.12	4.04
	Change Management	3.96	4.04	4.12	4.04
	Organizational Culture	3.96	4.04	4.12	4.04
Managerial & Process	Results Interpretation Ability	3.96	4.04	4.12	4.04
	Personal Innovation	3.96	4.04	4.12	4.04
	Strategy & Organizational Vision	3.959	3.999	4.039	3.999
	Process & Organization Methods	4.06	4.1	4.14	4.1
	Management Structures	3.96	4.04	4.12	4.04
Environmental/I ndustrial	Operational Structures	3.96	4.04	4.12	4.04
	IT & HRM Collaboration	3.96	4.04	4.12	4.04
	External Conditions	3.24	3.28	3.32	3.28
	Competitive Environment	3.96	4.04	4.12	4.04
	Industry-Specific Needs	3.96	4.04	4.12	4.04
Legal & Ethical	Social Media Influence	3.96	4.04	4.12	4.04
	Technological Awareness	3.97	4.041	4.112	4.041
	Ethics, Transparency & Trust	3.96	4.04	4.12	4.04
	Resources & Infrastructure	3.96	4.04	4.12	4.04
	Perceived Benefits	3.96	4.04	4.12	4.04

Table 4 shows the value of the fuzzy definite number and the ranking of the post-impact factors of using artificial intelligence on human resource development. Each influential factor is specified by the three fuzzy means (a, b, c) and the fuzzy definite number, which form the basis for the final ranking.

Priority Ranking: Based on the fuzzy definite number, the factor 'Reducing HR Costs and Financial Implications' with a definite value of 973/4 holds the highest importance and is ranked first. Following this, 'Process Automation' with a value of 965.4

and 'Improving Employee Experience and Reducing Discrimination' with a value of 1.4 have been ranked second and third, respectively. This indicates that the impact of AI on financial optimisation, processes, and employee experience is highly significant for the experts.

Factors with moderate importance: Factors such as 'improving operations, processes and attendance', 'performance evaluation and increasing productivity', 'management level advancement', and 'employee retention' are ranked in the middle. This indicates that the impact of AI on employee performance and productivity, and on human resources management, is important to the experts, but it is prioritised lower than cost reduction and automation.

1. Less important factors: Factors such as 'Personalisation', with a fuzzy definite number of 328/3 and a rank of 24 at the bottom of the list, were considered relatively unimportant.
2. Expert Focus and Consensus: It is observed that most factors have a fuzzy definite number close to 4, which indicates a relative consensus among the 11 experts in the study, although there are differences in the rankings.

A Kendall's coefficient of 0.74 indicates that the agreement among the 11 experts in the study is relatively high. In other words, over 74 per cent of the rankings or preferences for the factors influencing the development of human resources with artificial intelligence were aligned among the experts.

1. Kendall's values between 0.6 and 0.8 typically indicate moderate to good agreement.
2. Values above 0.8 indicate very good and near-perfect agreement.

Therefore, Kendall's 0.74 indicates an acceptable and reasonable consensus among the experts, suggesting that the collected data are reliable for the final analysis and ranking. It can therefore be concluded that most experts agree on the relative importance of the influencing factors, and there is no need to conduct additional rounds to increase agreement.

Table 4. Results for Consequent Factors (Final Ranking)

Category	Factor Name	Crisp Value	Rank
Performance & Productivity	Reducing HR Costs & Financial Impacts	4.973	1
	Reducing Errors & Increasing Accuracy	4.04	8
	Improving Operations & Attendance	4.04	4
	Data-Driven Decision Making	4.04	22
	Performance Evaluation & Productivity	4.04	5
Automation	Process Automation	4.965	2
	Time Optimization & Speed	4.04	10
Employee Development	Training & Development	4.04	17

Category	Factor Name	Crisp Value	Rank
Experience & Motivation	Recruitment & Selection	4.04	17
	HR Planning & Strategy	4.04	10
	Skills Enhancement	4.04	17
	Job Design & Task Optimization	3.999	23
	Employee Experience & Reducing Bias	4.1	3
	Employee Participation	4.04	17
	Motivation & Satisfaction	4.04	10
	Job Autonomy & Trust	4.04	17
Innovation & KM	Personalization	3.28	24
	Innovation	4.04	8
	Knowledge Management	4.04	15
	Support & Guidance	4.04	10
Org. Structure	Management Level Advancement	4.04	6
	Employee Interactions	4.04	15
	Employee Retention	4.04	6
	Compensation & Welfare	4.04	10

Discussion

After the final model of the antecedent and consequent factors influencing artificial intelligence in human resource development in Iraqi public hospitals was confirmed, and their dimensions were identified, it was time to examine the importance and prioritise these factors. Following the valuable measures undertaken to gather data through expert interviews to identify the dimensions and components of entrepreneurial opportunities in the tourism industry of the city of Tabbad, the researcher then proceeded to quantify the prioritisation of antecedent and consequent factors by distributing a fuzzy Delphi questionnaire among experts. Data were collected from 11 experts via the fuzzy Delphi questionnaire. Each expert indicated their level of importance or agreement for each antecedent and consequent factor of artificial intelligence in human resource development using fuzzy numbers (triangular numbers on a 5-point Likert scale). The experts' responses, which were provided as opinions and importance ratings, were converted into triangular or rectangular fuzzy numbers to allow for mathematical analysis and to account for the uncertainty and ambiguity of the experts' opinions. For each factor, the average of the fuzzy numbers from the experts' responses was calculated to create a composite fuzzy number representing the group opinion of the experts. A fuzzy consensus threshold was determined for each factor. Factors whose fuzzy mean exceeded this threshold were selected as factors with high and valid consensus. In the next stage, the factors were sorted and prioritised using the defuzzified values to determine which factors have the greatest impact. Factors with sufficient consensus and high priority were identified as important antecedent and consequent dimensions of the impact of artificial intelligence on human resource development and were included in the final research model.

Discussion and Review of the Quantitative Section of Predictive Factors

The ranking of the predictive factors in Chapter Four indicates the relative importance of each factor in the impact of artificial intelligence on the development of human resources. These factors have been evaluated using the fuzzy definitive number and fuzzy trinomial means (a, b, c) and have formed the basis for the final ranking.

The following factors have the highest value of the fuzzy definitive number (greater than 4) and are ranked highest in importance:

1. Infrastructure and Technology Integration (technical, data, hardware, and software factors) – Rank 1: This factor indicates that the ability of hospitals to establish suitable infrastructure and integrate various technologies is a critical prerequisite for the success of artificial intelligence in human resource development. In Iraqi public hospitals, the lack of integrated infrastructure, system connectivity, and access to accurate data can hinder the full utilisation of AI. Therefore, experts have considered this factor to be the highest priority, as technology will not have a significant impact without the appropriate infrastructure.
2. Human factors and their readiness (Organisational Adoption) – Rank 2: The adoption of AI by staff and management is one of the main challenges in hospital settings. This factor indicates that human readiness and organisational willingness to embrace technological changes are determining factors in the successful implementation of AI. In Iraq's public hospitals, past experiences have shown that staff resistance or a lack of trust in the technology can cause AI projects to fail.
3. Organisational Structure and Process Factors – Rank 3: The way hospitals are organised and their internal processes directly affect the ability to integrate AI into human resources systems. Inefficient organisation or opaque processes can reduce the effectiveness of intelligent tools. This factor's third-place ranking highlights the importance of aligning processes with new technologies in public sector hospitals.
4. Technological Awareness – Rank 4: The knowledge and understanding of AI technology's capabilities and limitations by staff and managers is a key factor in the successful implementation of the technology. This factor indicates that the level of technological knowledge and awareness can play a decisive role in the effective adoption and use of artificial intelligence.

The following factors have a fuzzy definitive number of 4 and are of significant importance, but less so than the top four factors:

Factors such as information and communication factors, intelligence requirements, functional requirements, training and skills development, change management, the ability to interpret and analyse results, personal innovation, managerial and operational structures, collaboration between technology and human resources management, the competitive environment, specific industry needs, social media

influence, ethical and legal factors, and resources and infrastructure are included in this category.

This ranking indicates that AI in human resource development requires a set of organisational and technical prerequisites, organisational culture, and human skills. In Iraqi public hospitals, these factors are important, but the experts' initial focus has been on infrastructure, human readiness, and processes.

Organisational strategy and vision – ranked 6th, and external conditions – ranked 7th, with an average score of less than 4, indicate a lower relative importance. This may be because Iraqi public hospitals focus more on operational, financial, and procedural matters, and in comparison to infrastructure, staff readiness, and internal processes, the overarching strategy and environmental conditions are a secondary or tertiary priority.

The ranking of the antecedent factors reflects the realities and operational constraints of Iraqi public hospitals:

1. The focus on infrastructure, technology, human adoption, and processes is paramount due to financial constraints, a shortage of specialised staff, and the need for immediate productivity.
2. The mid-tier factors indicate that while the success of AI requires technical, informational, skill-based, and ethical alignment, its implementation demands sustainable resources and organisational culture.
3. Less significant factors, such as strategy and external conditions, are less tangible in the short term and do not have an immediate impact on the daily work of staff, which is why they are ranked lower.

Overall, this ranking indicates that experts in Iraqi public hospitals focus first on infrastructure, human readiness, and process organisation when implementing artificial intelligence, before attending to supplementary and environmental factors.

Discussion and Review of the Quantitative Section of the Post-implementation Factors

In the data analysis section, each influential factor has been identified using the three fuzzy means (a, b, c) and the fuzzy definite number, which has formed the basis for the final ranking. Based on the fuzzy definite number, the factor 'Reducing Human Resource Costs and Financial Implications' holds the greatest importance with a value of 973.4, ranking first. This indicates that the experts consider the impact of artificial intelligence in optimising costs and enhancing the financial efficiency of Iraq's public hospitals to be crucial. Given the financial and budgetary constraints in these hospitals, cost reduction and optimal human resource management are considered a strategic necessity. Following this, the factor 'Process Automation' with a fuzzy definite number of 965.4 and 'Improving Employee Experience and Reducing Discrimination' with a number of 1.4 have been ranked second and third, respectively. The importance of process automation indicates that artificial intelligence can reduce staff workload, increase the accuracy and speed of task execution, and prevent rework. Furthermore, the focus on employee experience and reducing discrimination demonstrates the experts' sensitivity to job satisfaction and maintaining fairness in the workplace, which is of great importance in government hospitals with large staff populations and diverse roles.

Factors such as 'improving operations, processes and attendance', 'performance evaluation and increasing productivity', 'upgrading the management level', and 'staff retention' were ranked in the middle. This indicates that AI can improve management processes and employee performance, thereby increasing the organisation's overall productivity, but it is a lower priority compared to cost reduction and automation. In Iraqi public hospitals, due to the high workload and limited resources, experts' primary priority is financial and operational effectiveness, followed by improving management and human productivity. Factors such as 'Personalisation', with a fuzzy definite number of 328.3 and a rank of 24, are at the bottom of the list. This indicates that the experts consider the effect of personalisation on human resource development through artificial intelligence to be a lower priority. The reason for this could be the scarcity of resources, the focus on collective goals, and the formal structures of Iraqi public hospitals, which have less opportunity or need for individualised and personalised programmes. It is observed that most of the fuzzy definite number factors are close to 4, which indicates a relative consensus among the experts. The Kendall's coefficient of 0.74 indicates that the agreement among the 11 experts is relatively high and acceptable. In other words, more than 74 per cent of the rankings or preferences of the influential factors were aligned among the experts. Kendall's coefficients between 0.6 and 0.8 typically indicate moderate to good agreement. Therefore, the coefficient of 0.74 indicates a reasonable and reliable consensus, and the collected data are trustworthy for the final analysis and ranking. Furthermore, this level of agreement suggests that conducting additional Delphi rounds to increase consensus is not necessary. The final ranking indicates that the experts' focus is on financial and operational optimisation, process automation, and improving the employee experience, as these three areas have the greatest impact on organisational efficiency, employee satisfaction, and human resource sustainability. In contrast, factors such as personalisation or certain welfare activities, whilst beneficial, are lower priorities given the resource constraints and high volume of services in Iraqi public hospitals. This prioritisation trend reflects the operational realities and critical needs of public healthcare organisations in Iraq, indicating that AI offers the greatest value in strategic and operational areas.

Research Proposals

Based on the analysis of the antecedent and consequent factors of the effect of artificial intelligence on human resource development, the following practical recommendations can help to improve performance, reduce costs, and increase staff satisfaction and productivity in Iraqi public hospitals:

1. Strengthening Infrastructure and Technology Integration
 - a. Establishing integrated internal networks and shared databases for storing and accessing staff information and hospital processes.
 - b. Developing reliable hardware and software systems that enable rapid data processing and support artificial intelligence algorithms.
 - c. Utilising cloud-based platforms and SaaS solutions to reduce maintenance costs and enhance technological scalability.

- d. Recommending the integration of existing HR, attendance, and financial management systems with AI to facilitate process automation.
2. Strengthening Human Readiness and Organisational Adoption
 - a. Designing training and upskilling programmes for staff and managers in the field of artificial intelligence and related technologies.
 - b. Organising awareness-raising workshops and consultation sessions to explain the benefits of artificial intelligence and to reduce staff fear or resistance.
 - c. Establishing internal feedback channels to identify staff concerns and suggestions, thereby increasing their sense of involvement and trust in the technology.
 - d. Developing incentive policies for innovative and tech-adoptive staff to foster motivation and job satisfaction.
3. Optimising Organisation and Processes
 - a. Reviewing administrative and nursing processes to reduce complexity and increase efficiency, particularly in attendance, performance appraisal, and staffing allocation.
 - b. Automating repetitive and time-consuming processes, such as data entry, shift scheduling, and performance reporting.
 - c. Establishing transparent and measurable processes for monitoring employee performance and evaluating organisational performance.
4. Improving the employee experience and reducing discrimination
 - a. Implementing intelligent employee experience management systems that collect and analyse employee feedback, complaints, and suggestions.
 - b. Using artificial intelligence to identify patterns of discrimination or inequality in task allocation, promotions, and remuneration.
 - c. Designing policies to maintain fairness and transparency in decision-making, which increases employee trust and motivation.
5. Enhancing productivity, performance appraisal, and financial management
 - a. Utilising artificial intelligence algorithms to analyse employee performance data and provide accurate reports for data-driven management decisions.
 - b. Predicting staffing needs based on past patterns and hospital service volumes.
 - c. Identifying areas for reducing unnecessary costs and optimising financial and human resources.
6. Skills Development and Continuous Training
 - a. Providing technical skills and data analysis training programmes for key staff and HR managers.
 - b. Developing remote and blended learning courses for staff with varying shifts, particularly nurses and doctors.
 - c. Creating intelligent learning systems that provide staff with immediate and personalised feedback.

7. Strengthening Change Management and Organisational Strategy
 - a. Establishing change management teams to lead AI projects and mitigate organisational resistance.
 - b. Developing a clear organisational vision and strategy for implementing AI in HR, aligned with operational priorities and financial constraints.
 - c. Clarifying the role of AI in the hospital's long-term strategies, including resource management, service quality, and staff retention.
8. Fostering Innovation and Personalisation
 - a. Encouraging individual and team innovation to propose process improvements and creative uses of AI.
 - b. Enabling the personalisation of AI tools and dashboards for different managers and staff, making decisions more precise and relevant to job requirements.
9. Knowledge Management and Data Analysis
 - a. Creating a data hub and intelligent knowledge base for collecting, analysing, and sharing HR information.
 - b. Using AI to interpret data and provide actionable recommendations to managers and staff.
 - c. Combining existing knowledge with new data for predictive and evidence-based decision-making.
10. Strengthening working relationships and collaboration between technology and HR management
 - a. Holding regular coordination meetings between IT and HR management teams to ensure systems align with operational needs.
 - b. Creating joint projects and interdisciplinary teams that integrate employee experience with technological data.
11. Focusing on employee well-being, retention, and longevity
 - a. Using artificial intelligence to predict the risk of employee turnover and provide preventative solutions.
 - b. Designing performance- and data-driven reward and compensation systems.
 - c. Identifying key personnel and developing support and welfare programmes to increase satisfaction and reduce burnout.
12. Addressing environmental factors and external conditions
 - a. Monitoring the competitive landscape and new technologies to identify opportunities and threats related to AI.
 - b. Utilising social media and the media to enhance awareness among staff and the public about hospital smart projects.

Overall, this set of recommendations suggests that artificial intelligence is not just a technology but a comprehensive management and strategic tool for human resource development in Iraqi public hospitals. Adhering to these recommendations can lead to reduced costs, improved staff productivity and performance, increased staff satisfaction

and motivation, enhanced decision-making quality, and increased staff retention and loyalty.

Research Suggestions

In light of the findings from the analysis of the antecedent and consequent factors of the impact of artificial intelligence on human resource development in Iraqi public hospitals, the following research suggestions can specify and enrich the path for future studies:

1. Development of practical AI models in human resources
2. Future research can design specific operational and algorithmic models to optimise human resources processes in hospitals.
3. Focusing on predictive AI for performance management, attendance, and staff retention can lead to practical, data-driven tools.
4. Examine the long-term effects of AI on employee productivity and satisfaction.
5. Study the effects of AI on employee job satisfaction, motivation, and well-being over extended periods.
6. Analyse how process automation and intelligent performance evaluation impact the reduction of bias and improve the employee experience.
7. Comparative analysis across different organisations and industries.
8. Future research could compare public and private hospitals, or different healthcare sectors, to determine which areas derive the greatest benefits from AI.
9. International studies comparing the experience of Iraqi hospitals with those in other countries in the region could provide practical recommendations for improving infrastructure and technology adoption.
10. Focus on human and cultural factors.
11. Future research can analyse cultural and human approaches to AI technology adoption and quantify indicators of organisational acceptance and employee resistance.
12. Examining the role of staff training, skills development, and personal innovation in facilitating AI implementation.
13. Examining technical and informational factors in greater detail.
14. Future studies could focus on improving infrastructure, data quality, information security, and system integration.
15. Analysing the effect of AI on the quality of decision-making and the reduction of human error, and comparing it with traditional HR management methods.
16. Studying organisational and strategic effects.
17. Future research could examine the impact of organisational strategy and vision, management and operational structures, and change management on the success of AI in HR.

18. Analysing the role of collaboration between technology and HR management and how to improve coordination between departments.
19. Utilising mixed-methods research and novel technologies.
20. It is suggested that future research employs integrative qualitative and quantitative methods such as fuzzy Delphi, social network analysis, simulation, and data-driven modelling.
21. Examine the use of machine learning algorithms and predictive analytics for human resource management and strategic decision-making.
22. Consider the external environment and conditions.
23. Future research could analyse the effects of the competitive environment, social media, and legal and ethical requirements on the implementation of AI in hospitals.
24. Analyse the specific industry needs and constraints of financial and human resources to design suitable AI models.
25. Identify success metrics.
26. Future research can determine the quantitative and qualitative indicators for measuring the success of AI in HR, including cost reduction, increased productivity, employee satisfaction, and staff retention.
27. Examine the alignment of smart tools with employee productivity and performance indicators to establish standard benchmarks.
28. Develop policy-based research.
29. Future studies can analyse the strategies and policies of the Iraqi government and the Ministry of Health to support the implementation of artificial intelligence in hospitals.
30. Provide practical, policy-oriented guidance for hospital managers on the effective use of smart technologies and the development of human resources.

CONCLUSION

Fundamental Finding: The present study, despite presenting valuable findings in the field of the effect of artificial intelligence on human resource development in Iraqi public hospitals, has faced limitations that are essential to consider for the interpretation of the results and for future research. **Implication:** Overall, these limitations indicate that the research findings are interpretable given the current conditions and expert perspectives. **Limitation:** The study's statistical population comprised hospital managers, informatics and information technology specialists, and university professors in the field of human resources, with their number limited to 11. This may affect the generalisability of the results and the applicability of the findings to other hospitals or healthcare centres. The limited sample size meant that data was collected primarily based on the perspectives of specific experts and their personal experiences, with the views of other staff and patients being less represented. Although the use of the fuzzy Delphi method facilitates expert consensus, the limited number of rounds and experts may have

meant that not all dimensions of experience and diverse opinions were considered on a broader scale. The research focused more on fuzzy quantitative analysis and the ranking of factors, and some hidden relationships or interactions between antecedent and consequent factors may not have been fully identified. The semi-structured interviews and questionnaires, whilst providing both qualitative and quantitative information, may have been influenced by the experts' personal interpretation and response bias. The research was limited to Iraqi public hospitals and a specific time frame, and the results may differ in other temporal or geographical settings. The non-inclusion of private hospitals or other sectors means that the identified patterns and priorities may change in different environments with different constraints. Limited access to operational data and internal hospital systems meant that some analyses were based more on the experts' knowledge and experience than on actual, historical data. Limitations in the quality, integrity, and accuracy of the data may have reduced the precision of the ranking of antecedent and consequent factors. Cultural and organisational factors in the adoption of AI in Iraqi public hospitals may have influenced the experts' perceptions and prioritisation. Some factors, such as personalisation and personal innovation, which received lower rankings, may be more significant in environments with a different organisational culture; therefore, the results cannot be fully generalised to other cultures and countries. Artificial intelligence is rapidly changing and developing, and new tools, algorithms, and applications may influence the prioritisation and impact of antecedent and consequent factors. The present study addressed the current applications of artificial intelligence in human resources, and it is possible that with new technologies in the future, some factors will become more significant. **Future Research:** Future research could provide more accurate and comprehensive results by expanding the statistical population, examining diverse environments, analysing real-world data, and integrating quantitative and qualitative methods.

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* Mousavi Sayyed Najmuddin (Corresponding Author)

Lorestan University, Iran

Email: mousavi.na@lu.ac.ir

Haider Wahid Ali Al-Buwaihi

Lorestan University, Iran

Email: aassxxzzaa66@gmail.com

Nazarpouri, Amirehshah

Lorestan University, Iran

Email: nazarpouri.a@lu.ac.ir

Vahdati, Hujjatullah

Lorestan University, Iran

Email: vahdati.ho@gmail.com
