Impact of Artificial Intelligence Technologies on Engineering (Construction) Project Management: An Applied Study on Construction Project Workers in Diyala Governorate

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Abstract:
This research aims to study the impact of artificial intelligence (AI) technologies on the management of engineering (construction) projects through an applied study on construction workers in Diyala Governorate. The study highlights the most prominent AI technologies used in this field, such as smart scheduling models, big data analysis, predictive systems, and risk management, and their role in improving project management performance.
The research adopted a descriptive analytical approach, and data was collected using questionnaires distributed to a sample of workers in the construction sector, in addition to conducting interviews with engineers and field supervisors. The study's results showed that the application of AI technologies in construction projects in Diyala is still in its early stages. However, there is a growing awareness among workers about the importance of these technologies in enhancing work efficiency, reducing costs, and improving execution quality.
The data were analyzed using SPSS version 26, the result show the F-value of favorability reached 37.755, which is higher than the tabular value of 4.412 at two degrees of freedom (1, 48) with a significance level of 0.05. The P-value is 0.000, which is less than 0.05, and the R2 value is 0.553, indicating that artificial intelligence accounts for 43.7% of the changes occurring in

engineering project management. Additionally, the coefficient of determination value reached 0.760, meaning that an increase of one standard deviation in the engineering project management variable will result in a 76% increase in artificial intelligence by one standard deviation.
Key Word: Artificial Intelligence, Engineering Construction Projects, Project Management.

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الخلاصة:
يهدف البحث الى دراسة تأثير تقنيات الذكاء الاصطناعي على ادارة المشاريع الهندسية الانشائية من خلال دراسة تطبيقية على العمال في مجمع راسان السكني في محافظة ديالى .يسلط البحث الضوء على ابرز تقنيات الذكاء الاصطناعي المستخدمة في هذا المجال مثل نماذج الجدولة الذكية ,تحليل البيانات الضخمة ,الانظمة التنبؤية و ادارة المخاطر و دورها في تحسين ادارة المشاريع.
اعتمد البحث على المنهج التحليلي الوصفي ,وتم جمع البيانات باستخدام استبيانات تم توزيعها على عينة من العمال في قطاع البناء ,بالاضافة الى اجراء مقابلات مع المهندسين والمشرفين والميدانيين.اظهرت نتائج الدراسة ان تطبيق تقنيات الذكاء الاصطناعي في مشاريع البناء في محافظة ديالى مازال في مراحله الاولى .ومع ذلك هناك وعي متزايد بين العمال باهمية هذه التقنيات في تعزيز كفاءة العمل ,وتقليل التكاليف ,وتحسين جودة التنفيذ.
تم تحليل هذه البيانات باستخدام برنامج (**SPSS**)الاصدار(**26**) واظهرت النتائج ان قيمة **(F)**الافضلية بلغت **(37.75)**وهي اعلى من القيمة الجدولية (**4.412**)عند درجتين من الحرية **(48.1)**بمستوى دلالة **,(0.05)**وكانت قيمة**(P)**هي**(0.000)** اقل من**(0.05)** بينما بلغت قيمة **R2 (0.553)**مما يشير الى ان الذكاء الاصطناعي يمثل **(43.7%)** من التغيرات الحاصلة في ادارة المشاريع الهندسية . بالاضافة الى ذلك ,بلغت قيمة معامل التحديد**(0.760)**, ممايعني انه مع زيادة انحراف معياري واحد في متغير ادارة المشاريع الهندسية سيؤدي ذلك الى زيادة بنسبة**(76%)** في الذكاء الاصطناعي بزيادة انحراف معياري واحد.
الكلمات المفتاحية :الذكاء الاصطناعي، مشاريع البناء، إدارة المشاريع الهندسية .

Introduction:

A construction project is an achievement resulting from a specific effort, bound by a specific period and precise criteria that govern its success. Each construction project has its own unique characteristics and features. Building a school differs from building a hospital in terms of planning, resources, equipment, supplies, and implementation phases. It is important to note here that the completion of a construction project is bound by a specific time period and an appropriate budget is allocated for it. The size of the project is usually measured by the degree of complexity is measured by the number of activities required and the degree of overlap between them. It can also be inferred by listing the entities involved in construction projects and the activities performed by different entities. This study seeks to identify the impact of artificial intelligence on engineering project management in Diyala Governorate, reveal the various factors required for the success of engineering projects, and highlight scientific methods for engineering project management in Diyala Governorate. This study aims to develop methods that help control these projects in a positive and highly effective manner, contributing to achieving the desired goals. At the forefront of modern scientific methods is the adoption of artificial intelligence and its software, based on the application of engineering project management processes. This concept focuses on managing various types of information that can be clearly and explicitly stated.

Large and complex engineering projects require precise coordination and clear planning to ensure success within the specified time and budget. With the advancements in science and technology, it has become essential to use and apply advanced and modern techniques to improve and ensure the success of managing such projects. Among these technologies is artificial intelligence, which is considered one of the latest innovations and most significant advancements contributing to a revolution in many fields, including the engineering sector. This technology focuses on simulating the organized human decision-making process based on a set of rules and specialized

knowledge. Therefore, it becomes an effective tool in enhancing the accuracy of complex decisions, finding smart solutions in real time, and achieving the best results in engineering projects.

This study aims to explore the importance of using artificial intelligence for expert systems in managing engineering projects and its impact on improving processes and decision-making within engineering environments. Consequently, it seeks to bridge the gap between theoretical capabilities and practical implementation.

Research Problem:

What is the impact of using artificial intelligence technology on engineering project management in Diyala Governorate?

Research Hypotheses:

First Main Hypothesis: There is a correlation between the use of artificial intelligence technology and engineering project management.

Second Main Hypothesis: There is a statistically significant effect between the use of artificial intelligence technology and engineering project management.

Significance of the Study:

The importance of the study stems from the importance of the topic and its focus on the role of artificial intelligence in engineering project management to expedite the completion of construction projects. These challenges are often addressed in terms of time, cost, quality, and other conditions for the success of construction projects in the governorate. Since the prosperity and development of infrastructure in Iraq's governorates, the government has been striving to invest in and develop construction projects to serve the interests of the state and the individual, especially after the implementation of a series of engineering and architectural projects in 2024 and 2025. Therefore, it is working to incorporate and implement all that is modern and contemporary to help advance all its achievements. Contribution can also be made through the results and

recommendations that will lead to improved performance in construction companies by identifying the main obstacles facing engineering project management, identifying their causes, and working to address them.

Study Objectives:

To study and analyze the obstacles facing engineering project management in various regions of the governorate that prevents projects from achieving their objectives.

To identify the impact of applying artificial intelligence technology in engineering project management.

To identify areas of deficiency in the completion of engineering projects and determine the causes of these shortcomings. - Identify the role of engineering projects in economic and social development in the governorate, given the recent developments in engineering projects.

Study Methodology:

The study relies on a descriptive-analytical approach, as well as a deductive approach, examining the impact of artificial intelligence technology on engineering project management from the perspective of construction project workers in Diyala Governorate. The practical part of the study was carried out on a random sample of workers. The research also aims to highlight the various advantages of the statistical findings and connect them to the different factors and influences that contributed to the current outcomes. The SPSS statistical software was used to analyze and process the data and to test the validity of the hypotheses.

Study Limits:

- Spatial Limits: Construction project workshops in Diyala Governorate were selected.
- Temporal Limits: The study period was between February 1, 2025, and April 1, 2025.
- Human Limits: A sample of engineering project workers.

The Theoretical Aspect

The Concept of Artificial Intelligence

Human cognition is a complex class of phenomena that artificial intelligence systems interact with in two distinct ways. Proponents of what is known as strong AI are interested in building systems that behave at a level indistinguishable from humans. Success in strong AI will lead to the production of computer minds located in independent physical objects, such as robots, or perhaps in virtual worlds, such as the information space created by the Internet.[1]

An alternative approach to strong AI is to examine human cognition and explore ways to support them in difficult or complex situations. For example, a fighter pilot might need the assistance of intelligent systems to help navigate a highly complex aircraft that they cannot operate alone. These simple methods are not intended to be autonomous, but rather a form of cognitive enhancement to support humans in multiple tasks. In the field of medicine, artificial intelligence systems are used to support healthcare workers in performing their duties, specifically in tasks that rely on data and knowledge. An AI system might operate within an electronic medical system, for example, and alert a clinician when it detects indicators that contradict the treatment plan. It might also alert a physician when patterns are detected in the data that indicate significant changes in a patient's condition.[2][3]

Human experts possess a vast amount of specialized knowledge in their fields of expertise, so expert systems are typically based on knowledge bases that contain a vast number of databases containing this knowledge. Expert systems emerged as a branch of artificial intelligence. The beginning of the emergence of this field dates back to the fifties of the twentieth century, when a group of scientists adopted a new approach to producing intelligent machines based on recent discoveries in neuroscience, using new mathematical theories of information and relying on the invention of devices built on the essence of mathematical logic. The first recorded event in the field of artificial intelligence was the publication of a scientific paper

"Computing Machinery and Intelligence" by the British mathematician Alan Turing, in which he invented a test that, if passed, classifies the machine as intelligent. This test consists of questions asked by a person known as the judge and directed to another person and a computer simultaneously. If the judge is unable to distinguish between the person and the machine, then the machine passes the intelligence test and is described as an intelligent machine.[4][5]

There are several perspectives on defining artificial intelligence. Some of these perspectives rely on important aspects of the classification and definition of intelligence, such as rationality, thinking, actions, decision-making, and others. These are linked based on a cognitive perspective. Artificial intelligence can be defined as intelligence manifested in a non-natural, artificial entity (human-made). Artificial intelligence is a branch of informatics that studies the development of intelligent algorithms and technologies for application in computers and robots, enabling them to behave intelligently in performing tasks or solving problems. When artificial intelligence is integrated into the work environment, interacts with it, and learns from it, it is known as an intelligent agent. Artificial intelligence is also viewed as the study of intellectual abilities through the use of accounting models, which focuses on how to simulate human thinking. The central goal of the artificial intelligence model is that both the human and the model make predictions about a particular phenomenon through signs, signals, or certain clues. A more comprehensive definition can be defined as the ability to think and make good decisions using a non-human mind.[12][13][15]

Engineering Project Management

The process of planning, organizing, directing, and controlling resources (human, material, and financial) to achieve the objectives of a specific engineering project within a specific timeframe, budget, and with high quality. This management encompasses a set of skills, tools, and standards to ensure the success of complex engineering projects, such as bridge

construction, building construction, infrastructure development, or industrial system design.[7][8]

Project management has a long-standing historical foundation and has progressively developed throughout the centuries. Its earliest manifestations can be observed in ancient times, exemplified by large-scale constructions like the Egyptian pyramids and the Great Wall of China. A significant advancement in modern project management was the introduction of the Gantt Chart by Henry L. Gantt in 1917 (Pacagnella and da Silva 2023). During the 1950s and 1960s, influential thinkers such as Peter Drucker and Frederick Taylor contributed to shaping theories focused on organizing and managing production processes (Winkler-Schwartz et al. 2019) .[9][11].[14].

The Importance of Engineering Project Management [16][19]

1. Ensuring on-time delivery: Avoiding delays that can increase costs.
2. Controlling costs: Preventing budget overruns through careful financial planning.
3. Achieving the required quality: Adhering to technical specifications and standards.
4. Risk management: Identifying potential threats and developing mitigation plans.
5. Improving communication between teams: Coordinating work between engineers, contractors, and clients.

Previous study

In 2017, Luger G, described the complexity of artificial intelligence in a way that no theory can fully define it. Therefore, researchers have created a hierarchical framework consisting of theories, networks, and algorithms that have helped adapt and interact with various environments that require the use of any form of intelligent and advanced activities.

In 2014, a study by Aziz and other researchers highlighted that planning, scheduling, and controlling large building projects

require significant methods and procedures, which form the foundation of the project life cycle. The study demonstrated the benefits of using the Critical Path Method (CPM) for scheduling and optimizing massive projects, as well as the Genetic Algorithm (GA). The study aimed to provide support for planners of large construction projects to reduce project duration and costs while improving quality under the name (SCPMS).

In 2016, this study outlined the principles followed in managing portfolios and programs within an organization, which involve translating the business strategy into groups of activities that deliver the desired benefits and outcomes that individual efforts cannot provide, in terms of project cost estimates and pricing. The organization's strategic vision is achieved through controlling program management in terms of program initiation, managing program risks, managing benefits, and controlling the program through the benefits achieved and the techniques used for managing programs and projects.

. In 2018, Jeams conducted a study showing that the capabilities developed by artificial intelligence have enabled businesses to reach higher levels, improving both the value and efficiency of operations, as well as execution speed. This has attracted widespread interest and engagement due to the rapid advancement and development of tools and software.

A technical and field study was conducted. From a technical perspective, artificial intelligence has become a leader in two scientific fields: behavioral and neural sciences, and informatics, which includes algorithms in all their theoretical and practical applications. This theory enabled prediction and decision-making that adapts to the environment, replacing human decision-making.

The self-evolution, automatic behavior, learning, and the depiction of the horizon of smart technology are features of artificial intelligence that have granted machines complete freedom in decision-making.

In 2021, the study clarified that the effectiveness and success of artificial intelligence technology have created an exceptional digital environment for researching, processing, and storing

information across various fields, such as industry, transportation systems, communications, and others.

After the advancements in expert systems, they have become an effective tool for developing distance learning, enabling the potential for virtual education in the future, especially if future data is considered. This makes the coming stages a phase of convergence and integration between the biological and technological realms.

In 2022, this study clarified the impact of artificial intelligence technologies in enhancing and improving the quality of governance and the potential for linking these technologies, based on information and communication technology, with political science.

In 2022, this study identified the importance and role of artificial intelligence in achieving the Saudi Arabia Vision 2030 development goals, and clarified the impact of artificial intelligence on supporting sustainable development from economic, social, and environmental perspectives in both the private and public sectors. This was done through applying a descriptive analysis approach to describe and interpret phenomena by utilizing historical sources, information, and statistical data.

In 2023, due to the widespread use of Artificial Intelligence (AI) and Machine Learning (ML) in various fields such as business, it has become possible to transform traditional work methods and support project managers in their daily tasks. This means that projects can be managed through AI applications, allowing project managers to establish foundations for work that contribute to improving and developing projects. It is crucial to increase awareness and knowledge about how to automate processes between stakeholders and organizations. As a result, risks can be reduced, excessive costs can be avoided, and employee efficiency can be enhanced, leading to greater satisfaction.

Research Sample and Data Collection Method:

The researchers used a simple random sampling method to distribute the questionnaires to a sample of workers at the Rasan Housing Complex in Diyala Governorate, assuming a homogeneous population. An appropriate sample was then drawn, with 80 questionnaires distributed to a sample of workers at the complex. 75 valid questionnaires were returned for analysis, representing a response rate of 90%.

Statistical Indicators:

The researchers conducted their statistical analysis using data gathered through a five-point Likert scale. They applied key statistical measures via the SPSS software package (version 26), ensuring consistency with the study's hypotheses and specific research questions. The primary indicators utilized include the following:

A. Frequencies and percentages are used to identify the number and proportion of respondents within the research sample.

B. The weighted arithmetic mean is used to assess the level of agreement of the research sample with the questionnaire items

C- Standard Deviation: Used to measure the extent of variation or dispersion in the research sample's responses concerning the level of agreement.

C-Pearson Correlation Coefficient: It is used to measure the strength and direction of the association between research variables, indicating whether the relationship is direct (positive) or inverse (negative).

C- F-Test:It is used to determine whether the independent variables in the research have an effect on the dependent variable.

H-Regression analysis is used to assess the degree to which the independent variable affects the dependent variable.

Description of the Research Sample:

The research sample included a group of individuals surveyed in the Rasan complex in Diyala Governorate. Table (1) shows the characteristics of the individuals in terms of gender, degree, experience, and job title.

Table No. (1) Frequencies and percentages of demographic variables of the research

Information	Category	Number	Percentage
Gender	Male	55	73.0
	Female	20	27.0
Total		75	100.0
Education	Intermediate or lower	22	29.0
	Preparatory education	18	24.3
	Bachelor's degree	35	46.7
Total		75	100.0
Experience	less than 5 years	7	9.0
	6-10 Years	11	15.0
	11- 15 Years	27	36.0
	16 years and above	30	40.0
Total		75	100.0
Job	Lawyer	9	12,00
	Accountant	4	5,00
	Engineer	16	21,00
	Accounts Manager	8	11,00
	Driver	9	12,00
	Two-Craft	17	23,00
	Department Manager	2	3,00
	Service Worker	10	13,00
Total		75	100.0

Source: Prepared by the researcher based on calculator results.

From Table (1), the results are as follows

• The gender variable showed that the number of males was 55, representing 73% of the total sample, which is higher than the percentage of females.

• The degree variable showed that those with a bachelor's degree had a value of 35, representing 46.7% of the total sample, which is higher than other degree holders.
• The experience variable showed that employees with 16 years of experience or more had a numerical value of 30, representing 40% of the total sample, which is higher than the number of experienced employees.
• The job variable showed that the two letters had a value of 17, representing 23% of the total sample, which is higher than the other occupations.

Description and diagnosis of research variables:

This section presents the description and analysis of the main research variables: artificial intelligence, considered the independent variable, and engineering project management, considered the dependent variable. To accomplish this, appropriate statistical analyses were employed to calculate the arithmetic means and standard deviations of the participants' responses concerning both artificial intelligence and engineering project management. Table (2) displays the description and analysis of the artificial intelligence variable.

Table No. (2) below describes the research variables related to artificial intelligence.

Variables	Strongly agree		Agree		Neutral		Disagree		Strongly disagree		Mean	Standard deviation
	Nom	%	Nom	%	Nom	%	Nom	%	Nom	%		
X1	15	20	30	40	27	36	8	11	0	0	3.9800	0.98242
X2	7	9	26	35	18	24	14	18	0	0	3.5400	0.95384
X3	8	11	20	27	15	30	21	28	0	0	3.5900	0.75928
X4	3	4	28	37	8	16	6	12	4	8	3.3800	1.11098
X5	17	23	24	32	10	20	6	12	0	0	3.7800	0.97646
X6	19	25	25	33	9	18	4	8	0	0	3.8200	0.80026
General average											3.8800	0.92660

Source: Prepared by researchers based on calculator results

The results presented in Table (2) show that artificial intelligence obtained an overall mean score of 3.88 with a standard deviation of 0.92660, indicating a high degree of consistency in the participants' responses. At the item level,

item (1) in this domain (X1) exhibited the highest level of response consistency, with a mean score of 3.98 and a standard deviation of 0.98242. The response trend for this item was "agree," which aligns with the overall trend for the artificial intelligence variable, also categorized as "agree." Table (3) displays the means and standard deviations of the participants' responses related to employee performance.

Table No. (3) Description of Engineering Project Management

Variables	Strongly agree		Agree		Neutral		Disagree		Strongly disagree		Mean	Standard deviation
	Nom	%	Nom	%	Nom	%	Nom	%	Nom	%		
X1	27	36	25	50	23	30	5	6	0	0	4.4500	0.60238
X2	1	1	29	58	7	14	21	30	0	0	3.7800	0.86402
X3	2	3	26	52	9	18	1	2	0	0	4.4900	0.73983
X4	20	27	27	54	14	28	2	4	0	0	4.7800	0.75551
X5	30	40	30	60	10	20	3	6	1	2	3.7400	0.82833
X6	11	15	25	50	13	26	2	4	0	0	3.8600	0.78272
General average											3.8256	0.89125

Source: Prepared by researchers based on calculator results

The results in Table No. (3) show that the Engineering Project Management variable achieved an overall mean score of 3.8256 with a standard deviation of 0.89215, indicating consistency in the sample responses regarding the average value. At the item level, Item No. (4) under this variable (X4) demonstrated the highest consistency, with a mean of 4.7800 and a standard deviation of 0.75551. The response trend for this item was "Agree," and the overall trend for the Engineering Project Management variable was also "Agree."

Hypothesis Testing:

The analysis of the correlation between artificial intelligence and engineering project management at the residential complex site under study serves as a test of the first main hypothesis, which posits a significant relationship between the two. The data presented in Table (4) demonstrate a strong correlation, with a coefficient of (**0.680) and a significance value (sig.) of 0.001—well below the 0.01 threshold, confirming the result with 99% confidence. These findings highlight the strength and statistical significance of the relationship, leading to the

rejection of the null hypothesis and the acceptance of the alternative hypothesis.

Table (4) represents the correlation between artificial intelligence and engineering project management.

Correlations		
		Engineering Project Management.
Artificial Intelligence	**Pearson Correlation**	****0.680**
	Sig. (2-tailed)	**0.000**
	N	**75**
****. Correlation is significant at the 0.01 level (2-tailed).**		

Source: Prepared by the researchers based on the results of the ready-made SPSS software, N = sample size.

Analysis of the impact of the relationship between artificial intelligence and engineering project management at the construction site of the residential complex under study :

The content of this analysis tests the second main research hypothesis, which posits a significant impact between artificial intelligence and engineering project management. Table (5) demonstrates that a significant impact exists between artificial intelligence and engineering project management, as the F-value of favorability reached 37.755, which is higher than the tabular value of 4.412 at two degrees of freedom (1, 48) with a significance level of 0.05. The P-value is 0.000, which is less than 0.05, and the R2 value is 0.553, indicating that artificial intelligence accounts for 43.7% of the changes occurring in engineering project management. Additionally, the coefficient of determination value reached 0.760, meaning that an increase of one standard deviation in the engineering project management variable will result in a 76% increase in artificial intelligence by one standard deviation. This implies the rejection of the null hypothesis and acceptance of the alternative hypothesis, confirming that there is an impact between artificial intelligence and engineering project management. In other words, engineering project management in engineering projects

in Diyala Governorate, under study, relies on artificial intelligence.

Table (5) Impact between artificial intelligence and engineering project management

Independent variable / Dependent Variable	Engineering Project Management		R^2	F	
	B_o	B_1		Calculation	Tabular
Artificial intelligence	0.660	0.760 (5.624)	0.553	37.755	4.412

Source: Prepared by the researchers based on the results of the electronic calculator (spss). The calculated t value indicates df (1,48) N=50 P < 0.05.

Research Conclusions

These conclusions were reached through a discussion of the study results, which included a set of key points through which the impact of artificial intelligence technology in engineering project management can be understood. The most prominent of these are:

- The acceptance and awareness of the use of artificial intelligence technology in engineering project management among employees who expressed their opinions on the concept of artificial intelligence.
- Increased knowledge and preparedness to use artificial intelligence technology in engineering project management among engineering project workers in Diyala Governorate.
- Developing training courses and workshops specifically for the use of artificial intelligence technologies in engineering project management, which will enhance knowledge in this field.
- Reducing engineering plan defects and delays in project completion, further improving project performance, and avoiding errors and delays in completion.

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