

Research Proposal Title:

**Influencing Factors over Project Management Via
Using Artificial Intelligence in Industrial Engineering
Projects**

For Ph.D. Registration_ Rev.0

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1. Introduction

In light of scientific advancements and rapid technological changes in many scientific fields such as medicine, engineering, pharmacy, laboratories, astronomy, and earth sciences, as well as in industry and production, it has become imperative for specialists in project management to take advantage of available technologies. Foremost among these is the use of artificial intelligence (AI) technologies in project management processes and research into technologies, particularly smart technologies, that can impact project management. With the Vision 2030 of the Kingdom, AI cannot be ignored in Saudi Arabia, as AI is one of the key pillars upon which the vision relies to achieve its desired goals.

Weng. (2023) “Artificial intelligence has increasingly become an essential component of project management, as it can help streamline workflows, optimize resource allocation, and improve decision-making. By automating repetitive tasks, AI allows project managers to focus on higher-level strategic activities, while, also reducing the likelihood of human error. Furthermore, AI-powered tools can analyze large volumes of data, enabling teams to make data-driven decisions and identify trends and patterns that may not be immediately apparent”.

(Caniels & Bakens, 2011). “With the help of AI it becomes more possible to predict possible outcomes of resource allocation, alert project managers to upcoming issues, aid in prioritizing projects and providing project managers with the necessary information to carry out decisions that best fit the projects’ overall progress”

El Khatib & Al Falasi, (2021) “A recent study was done at Mashreq Bank which had used AI to increase productivity by automating transactions and reducing the time per transactions. They had observed more than 150,000 error-free transactions in a single day. Using AI to automate this process has allowed Mashreq bank to have a higher number of transactions while eliminating data bias and providing a pool of data with higher integrity that could be accessed, analyzed and have conclusions drawn upon it in order to carry out future decisions more effectively”.

AI can be utilized in many aspects of project management, but Taboada et al. (2023) concluded “We found that almost half of the selected works focus on construction PM whereas, the use of AI in IT projects is also pronounced (nearly 22%), while its application in other specific sectors (i.e., health) is too scarce. Moreover, AI-enabled approaches for generic PM are also remarkable”.

1.1 Key Words;

AI Tools – Project management – Industrial engineering projects.

2. Research Problem

Through reading and reviewing published research, the researcher believes that the field of artificial intelligence is still in its early stages and lacks much clarity and vision, particularly at the application level. Most research includes findings that are either not implemented or difficult to apply at this moment. This may be due to the factors affecting the application of artificial intelligence in project management, resulting in a lack of clear practical outcomes in the real world.

Taboada et al. (2023), confirmed the researcher's notice “Although AI-enabled PM seems encouraging, its design, standardization, and implementation in project-based firms are still a challenge. Thus, AI adoption in PM is yet to be noted”.

Ruiz. (2020), “The slow progress of AI in the field of project management is largely due to the lack of investment from private companies, which means progress is only has been made in the universities and the public research organizations”.

To confirm the problem from a practical perspective, the researcher conducted an exploratory study with a convenience sample of experts in the field of engineering project management to understand their perceptions and opinions on the factors and outcomes of using artificial intelligence in project management. The findings were as follows:

1. A large percentage indicated that there is no practical application of artificial intelligence in project management within the companies they have worked for or are currently working for.
2. A small percentage agreed that there had been attempts to use artificial intelligence, but these attempts were not completed due to reasons such as the applications not being compatible with the existing company infrastructure, insufficient training, and lack of adequate support from senior management for these initiatives.
3. A fair percentage agreed that there are AI-supported applications, which were found to be limited to automating some routine tasks.

As the researcher is also a practitioner of engineering project management in Saudi Arabia, he did not find any practical application of AI in industrial engineering project management in the country, except for applications automating routine tasks and activities.

In conclusion, there might be applications of AI in some companies that are not publicly documented. The researcher aims to confirm this throughout his research journey.

Building on the previous discussion and addressing the identified research gap, this study seeks to answer the following question:

1. What are the factors that influence the use of artificial intelligence applications in the management of industrial engineering projects in Saudi Arabia?
2. What are the outcomes resulting from the use of artificial intelligence applications in the management of industrial engineering projects in Saudi Arabia?
3. Does the use of artificial intelligence applications in the management of industrial engineering projects mediate the relationship between the factors influencing the use of these applications and the resulting outcomes?

3. Research Objectives

This study aims to achieve the following objectives:

1. Determine the nature and direction of the relationship between the study variables in the Saudi industrial engineering companies under investigation.
2. Measure the direct effects of the factors influencing the use of artificial intelligence applications on project management in the Saudi engineering companies under investigation.
3. Measure the direct effects of the factors influencing the use of artificial intelligence applications on the expected outcomes of these applications in the Saudi industrial engineering companies under investigation.
4. Measure the indirect effects of the factors influencing the use of artificial intelligence applications on the expected outcomes when mediated by project management in the engineering companies under investigation.
5. Identify whether there are significant differences between the study sample elements regarding factors and outcomes according to organization size, sector type, and the demographic characteristics of managers in the Saudi engineering companies under investigation.
6. Develop a set of recommendations based on the findings that will help project managers in the companies under investigation maximize the benefits of artificial intelligence applications in their field.

4. Research Importance

4.1 Scientific Importance:

This study differs from others in that it seeks to identify the influencing factors and measure their impact on the use of artificial intelligence in project management. Given the scarcity of studies on the application of artificial intelligence in project management, this study will contribute to enriching the scientific and research literature in academic libraries.

Many studies predicted the evolution of AI in project management e.g. Ruiz. (2020) P.61, "Looking to the future 25 years from now, it is likely that there will exist an AI

capable of managing the entire project, albeit with some form of human supervision. Hence little is known about the quantitative impact of the moderating AI tools in project management, in this study we will quantify the effect of applying AI in project management and measure the effect on each variable.

This could provide a detailed investigation of the influencing factors affecting project management via utilizing AI in industrial engineering projects.

4.2 Practical Importance:

Companies increasingly need to achieve strategic objectives and enhance project value. Thus, the practical importance of using artificial intelligence in project management becomes a priority for these companies to adapt to the latest technology. Therefore, companies need to understand the factors influencing the successful and sustainable use of artificial intelligence in project management.

5. Theoretical Background

5.1 Artificial Intelligence and Project Management:

Project management is a strategic competency that involves the application of knowledge, skills, tools, and techniques to project activities to meet the project requirements effectively and efficiently. This discipline is guided by the process groups and knowledge areas defined in the Project Management Body of Knowledge (PMBOK) Guide, developed by the Project Management Institute (PMI). It emphasizes a systematic approach to achieving project objectives through careful planning, execution, monitoring, controlling, and closure.

The PMBOK Guide structures project management around five process groups: Initiating, Planning, Executing, Monitoring and Controlling, and Closing. Each of these groups comprises a series of activities and steps that are critical for moving a project from inception to successful completion. These processes ensure that projects are aligned with the strategic goals of the organization, and delivered within scope, on time, and within budget, while meeting or exceeding stakeholders' expectations.

Furthermore, the PMBOK Guide delineates ten knowledge areas integral to project management: Integration, Scope, Schedule, Cost, Quality, Resource, Communication, Risk, Procurement, and Stakeholder Management. These areas encompass the competencies project managers must possess to manage projects effectively, covering everything from resource allocation and schedule management to stakeholder communication and risk mitigation.

By adhering to the standards and practices prescribed in the PMBOK Guide, project managers and their teams are better equipped to navigate the complexities of modern projects, ensuring not only the success of individual projects but also contributing to the strategic success and competitiveness of their organizations. In essence, effective project management, as guided by the PMBOK, is indispensable for transforming strategic vision into reality and for ensuring that projects deliver value and drive organizational success. PMBOK® (2021).

Project management using artificial intelligence applications faces several challenges, including data security, resistance to change, balancing AI with human expertise, training and adoption, lack of experienced human resources, ethical considerations, adoption barriers and change management, and the cost associated with implementing AI. On the other hand, AI applications have provided a range of opportunities that have become critical in project management, such as streamlining workflows, improving resource allocation, and enhancing decision-making processes. Weng (2023) & Costa et al. (2022).

5.2 Artificial Intelligence and Project Management:

Studies have varied in defining artificial intelligence, but many agree that artificial intelligence is training a machine to mimic human thinking and behavior, and thus the machine's ability to imitate human movements and actions. This includes the ability to solve mathematical operations, collect and analyze data, and make decisions. Sahadevan (2022), الغامدي & ضرمان (2023)

Artificial intelligence began with robots that had the ability to perform simple tasks such as lifting and moving, which was the earliest form of machine intelligence. Later, in the early 1980s, machine learning became the common form of artificial intelligence, which was more advanced than robotic processes. Graphic Processing Units (GPUs) were used, paving the way for the next stage: deep learning. Deep learning is a more advanced machine learning technique that gained prominence in 2012. It is used in image recognition systems, recommendation systems, and all financial fraud detection systems. AI's goal is to learn from information generated around a specific task to maximize machine performance. Sahadevan (2022), & الغامدي & ضرمان (2023).

6. Literature Review & Hypotheses Development

6.1 Literature Review:

In the study by Al-Shahri et al. (2023) titled "The Reality of Artificial Intelligence in Project Management in the Government Sector in Saudi Arabia," the research aimed to understand the current state of AI usage in government project management in Saudi Arabia at that time and to propose suggestions that could improve the efficiency

and effectiveness of project management. The study sought to enhance the ability to make accurate decisions, strategic planning, and forecasting potential challenges and dilemmas. The study concluded that artificial intelligence can play a significant role in project management within the government sector in Saudi Arabia, significantly contributing to the development and improvement of projects, continuous improvement, and providing the relevant authorities with the necessary technological capabilities to achieve this. It also emphasized the importance of having specialized managers to handle AI-related technologies. The current study differs from this one in its research objectives but aligns with it in its research methodology.

In the study by Weng (2023) titled "Putting Intellectual Robots to Work Implementing Generative AI Tools in Project Management," the goal was to provide a comprehensive guide for project managers on the effective use of ChatGPT in their project management practices. The study highlights the benefits and challenges of integrating ChatGPT into project management processes, focusing on data privacy and security, ethical considerations, adoption barriers, and change management. The study identified several key areas for future development and improvement in ChatGPT's capabilities, including integration with other project management methodologies (e.g., Agile, Kanban), customized development capabilities, and providing training and support for non-technical staff. The current study differs from Weng's study in its objectives, proposed model, spatial boundaries, and methodology.

In the study by Sahadevan (2023) titled "Project Management in the Era of Artificial Intelligence," the research aimed to help project managers understand how integrating artificial intelligence (AI) can benefit project management while acknowledging some challenges. The study concluded that AI can significantly enhance project management processes. AI-based solutions can support project managers in making better decisions, fostering teamwork, reducing project risks, and improving project efficiency and quality. The current study differs from Sahadevan's study in its objectives, proposed model, spatial boundaries, and methodology.

In the study by Taboada et al. (2023) titled "Artificial Intelligence Enabled Project Management: A Systematic Literature Review," the research aimed to provide a comprehensive understanding of emerging AI applications in project management and categorize them by project management areas to discover solutions for the digital transformation towards Industry 5.0. The findings reveal that the number of impactful publications on AI-supported project management has significantly increased over the past decade. The results indicate that AI, particularly machine learning, can be highly beneficial in managing construction and IT projects. This is especially encouraging for enhancing planning performance, measurement, and uncertainty through promising predictive and decision-making capabilities. The current study differs from Taboada et al.'s study in the methodology and scope of AI applications. While Taboada et al.'s research focuses on a comprehensive understanding of the literature and categorizes it by project management areas, our study emphasizes integrating AI into project management and examining the influencing factors.

In the study by Wang (2023) titled "Intelligent Decision Support System for Building Project Management Based on Artificial Intelligence," the article proposes using a Deep Belief Network (DBN) as a theoretical research framework for creating a decision support system for construction projects. It uses examples to illustrate

specific application problems. This study examines the architecture of a construction project decision support system based on a data warehouse. Specific examples include the creation of engineering project data warehouses, online analytical processing, and the application of data mining in project decision support. The article explains the supporting principles of the system and its significance in project management. The results show that the proposed method has high accuracy. The current study differs from Wang's study in both methodology and objectives. While Wang's research focuses on developing a decision support system using DBN and evaluating its practical application, the current study aims to integrate AI into project management and examine the influencing factors.

In the study by Waqar (2023) titled "Evaluation of Success Factors of Utilizing AI in Digital Transformation of Health and Safety Management Systems in Modern Construction Projects," the research aims to address the gap related to the key factors for successful implementation by thoroughly analyzing the critical elements that contribute to the successful integration of artificial intelligence in the digital transformation of health and safety management systems within modern construction projects. The study's findings emphasize the paramount importance of six critical constructs in determining the success of AI implementation in construction health and safety management systems: adaptability, operability, management, reliability, integration, and knowledge. These results provide valuable insights for enhancing safety measures in the construction industry through AI-driven solutions. The current study differs from Waqar's study in the methodology and scope of AI applications. While Waqar's research focuses on integrating AI into health and safety management systems, the current study focuses on integrating AI into project management and examining the influencing factors.

In the study by Savio & Ali (2023) titled "Artificial Intelligence in Project Management & Its Future," the research explores the current applications of artificial intelligence in project management and its future prospects. The researchers identified a set of opportunities and challenges for the evolution of AI in project management through a review of relevant databases. Additionally, various successful cases of AI integration with project management were evaluated. The current study differs from this one in its research objectives and methodology. While Savio & Ali's study focuses on exploring current applications and future opportunities and challenges of AI in project management, the current study aims to integrate AI into project management and examine the influencing factors.

In the study by Vikingur et al. (2023) titled "A Qualitative Study on Artificial Intelligence and Its Impact on the Project Schedule, Cost, and Risk Management Knowledge Areas as Presented in PMBOK," the paper aims to examine the key areas where AI will impact project management concerning cost, risk, and scheduling. The study found that AI has the potential to significantly influence project management by automating tasks, improving resource allocation, and providing data-driven insights. AI can enhance decision-making processes, risk analysis, and project forecasting, ultimately leading to increased efficiency, reduced costs, and improved project outcomes. Additionally, AI can analyze historical project data to predict future project outcomes, aiding in resource allocation and risk management. The current study differs from Vikingur et al.'s study in both methodology and the scope of AI application. While Vikingur et al.'s research focuses on the impact of AI on cost,

schedule, and risk management in project management, the current study aims to integrate AI into project management more broadly and examines the influencing factors.

In the study by Bento (2022) titled "Artificial Intelligence in Project Management: Systematic Literature Review," the aim was to recognize the potential and challenges of AI in project management by conducting a systematic review of the literature. The research findings suggest that organizations can derive practical implications from this work by referring to studies that support their needs. They can find relevant studies within the scope of this review, providing them with insights on how to leverage AI in project management. The study believes that organizations will gain critical guidelines regarding the advantages, challenges, areas of application, and technologies to aid their research on implementing AI in project management. The current study differs from Bento's in its objectives, proposed model, geographical scope, and methodology. While Bento's study focuses on providing a comprehensive literature review to highlight the potential and challenges of AI in project management, the current study aims to integrate AI into project management and examine the influencing factors specifically within the context of engineering companies in Saudi Arabia.

In the study by Sheoraj and Sungku (2022) titled "Using AI to Develop a Framework to Prevent Employees from Missing Project Deadlines in Software Projects - Case Study of a Global Human Capital Management (HCM) Software Company," the research aims to eliminate issues related to missed deadlines faced by employees in their projects through the use of artificial intelligence (AI). The research objective is to identify the problems employees encounter in meeting project deadlines and propose a framework that provides solutions to these issues, enabling employees to meet their project deadlines more effectively. The proposed AI framework was evaluated by 72.7% of participants as effective, and they advocated for the integration of AI in their workplace to facilitate a smoother task transition. The current study differs from Sheoraj and Sungku's in both methodology and the scope of AI applications. While their study focuses on the challenges faced by a global software company and developing an AI framework to address these issues, the current study aims to integrate AI into project management within engineering companies in Saudi Arabia and examines the influencing factors.

In the study by El Khatib and Al Falasi (2021) titled "Effects of Artificial Intelligence on Decision Making in Project Management," the researchers explored the impact of artificial intelligence (AI) on decision-making processes within project management. Specifically, the paper examines the quality, integrity, and volume of data collected by AI systems, which is then presented to project managers to inform their decisions. The conclusion drawn was that the application of AI enhances data quality and integrity, thereby improving the speed and effectiveness of the decision-making process in both single and multiple project environments. The current study differs from El Khatib and Al Falasi's research in its objectives, proposed model, and methodology. While their study focuses on the impact of AI on decision-making by improving data quality and integrity, the current study aims to integrate AI into project management in engineering companies in Saudi Arabia, examining the factors that influence this integration and its outcomes.

In the study (Ruiz, 2020) titled "The Application of Artificial Intelligence in Project Management Research; A Review," the aim of this study was to review emerging new proposals in the field of artificial intelligence across various domains and to identify the technologies that could be most effective in ensuring project success. The study concludes that artificial intelligence tools are highly beneficial for project managers in terms of project control and monitoring. However, many of the reviewed models exhibit weaknesses and limitations, indicating that project managers should continue to rely on their expertise when conducting evaluations based on the findings. The current study differs from this study in terms of its objective, proposed model, and methodology.

In the study (Jean, 2007) titled "Global Project Management Communication Collaboration and Management across Borders," the research discusses the key characteristics of global projects and programs. It presents a framework aimed at guiding multinational corporations to achieve maturity in global project management. This is done by assisting global program and project managers in leveraging the advantages of international teams operating in different countries and addressing challenges related to cross-cultural communication and virtual collaboration through innovative solutions. The global project management framework is constructed based on organizational change and organizational theories, enabling consistent implementation of best practices and adoption by members of global project teams. The framework categorizes information into five classes: global teams, global communications, global organizations, collaborative tools, and cooperative technologies. Through a review and analysis of previous literature, the researcher was able to formulate the study's problem and hypotheses, as well as understand the concept of artificial intelligence in project management and the challenges and opportunities identified in that literature. This approach aimed to identify various factors and variables discussed, and leverage recommendations highlighted in previous studies.

6.2 Study Hypotheses:

Based on the research problem and the objectives we aim to achieve, this study is built on testing the validity of the following hypotheses:

6.3 Study Hypotheses:

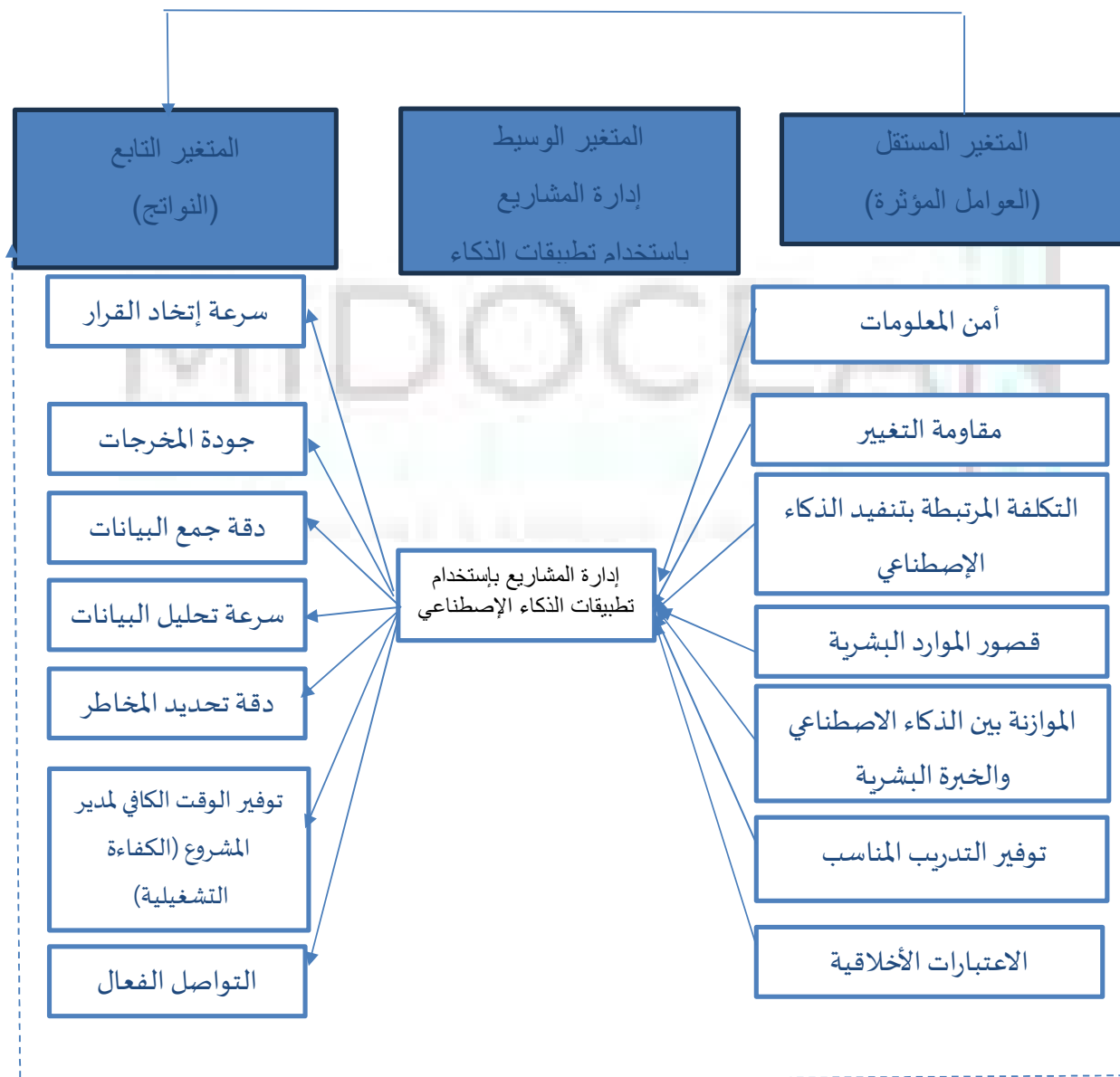
- 6.3.1 There is a significant effect of the factors influencing the use of artificial intelligence applications on the outcomes provided by AI applications in the Saudi industrial engineering companies under study.
- 6.3.2 There is a significant effect of the factors influencing the use of artificial intelligence applications on project management in the Saudi industrial engineering companies under study.
- 6.3.3 There is a significant effect of project management on the outcomes provided by AI applications in the Saudi industrial engineering companies under study.
- 6.3.4 The significant effect of the factors influencing the use of artificial intelligence applications on the outcomes provided by AI applications

increases when mediated by project management in the Saudi industrial engineering companies under study.

- 6.3.5 There are no significant differences between the elements of the study sample regarding the determinants of AI application use, project management, and the outcomes provided by these applications according to the organization's size, sector type, and the demographic characteristics of managers in the Saudi engineering companies under study.

7. Proposed Conceptual Framework

The following figure illustrates the proposed model, which provides a conceptualization of the expected relationships between the included variables.



8. Research Methodology

We will rely on the descriptive-analytical method. The descriptive method will be used to describe artificial intelligence and its related aspects, as well as project management and the influencing factors, and to summarize the findings of researchers in these fields. Additionally, the data collected from companies through interviews and questionnaires will be analyzed.

8.1 Variables:

8.1.1 Independent Variables:

The main independent variable is "Challenges of Using AI Applications," which may include some sub-independent variables such as:

1. Data security issues
2. Resistance to change
3. Financial costs of AI implementation
4. Lack of support from senior management
5. Compatibility with existing infrastructure
6. Insufficient training and skill development
7. Ethical considerations
8. Availability of experienced human resources
9. Adoption barriers and change management

8.1.2 Dependent Variables:

The main dependent variable is "Opportunities of Using AI Applications," which may also include the following sub-dependent variables:

1. Enhancing decision-making processes
2. Improving project outcomes and success rates
3. Accuracy of data collection
4. Enhancing data analysis and insights
5. Accuracy in risk identification
6. Providing sufficient time for project managers (operational efficiency)
7. Enhancing collaboration and communication

And the list may continue to include but not limited to the following; Streamlining workflows, Improving resource allocation, Increasing productivity and efficiency, Reducing operational costs, Automating routine tasks, and Facilitating innovation and creativity in projects.

8.2 Population and Sampling:

8.2.1 Study Population:

The large industrial engineering companies in Saudi Arabia, in total 1,123 companies according to the statistics of the Saudi Council of Engineers as of April 2024.

8.2.2 Study Sample:

The sample size was calculated using the formula by Steven K. Thompson (2012), as follows:

$$n = \frac{N \times p(1-p)}{\left[\frac{N-1}{d^2} \times \left(\frac{1}{z^2} \right) + p(1-p) \right]}$$

where:

- n = required sample size
- N = population size (1,123)
- p = expected proportion of the characteristic present (e.g., 0.5 to maximize the sample size)
- d = acceptable margin of error (e.g., 0.05)

Assuming an expected proportion **p = 0.5** and a margin of error **d = 0.05**, the sample size is calculated as follows:

$$n = \frac{1123 \cdot 0.5 \cdot (1-0.5)}{(1123-1) \cdot 0.05^2 + 0.5 \cdot (1-0.5)}$$

Let's compute the sample size using these values:

$$n = \frac{1123 \cdot 0.5 \cdot 0.5}{1122 \cdot 0.0025 + 0.25}$$

$$n = \frac{280.75}{2.805 + 0.25}$$

$$n = \frac{280.75}{3.055}$$

$$n \approx 91.86$$

To ensure accurate data, the sample size can be rounded to **92** companies.

If it is necessary to ensure good representation and avoid potential errors, the sample size may be increased based on the study's needs and potential data collection challenges.

8.3 Data Collection Methods:

- **Questionnaires:** Questionnaires will be distributed to gather data and gain a broad understanding of the impact of artificial intelligence on project management within

companies. They will also explore the challenges and opportunities companies face when using AI in project management.

- **Structured Interviews:** Structured interviews will be conducted with company owners or representatives, experienced project managers, and specialists in this field according to the questionnaire questions. These individuals have used AI tools or have previous experiences and are currently researching and gaining knowledge. Interviews will be conducted face-to-face or via audio-visual programs.

Questionnaire Design: The questions will be designed to collect data related to the following variables:

1. What are the influencing factors that companies face in using AI applications in project management in Saudi Arabia?
2. What are the outcomes that companies can achieve as a result of using AI applications in project management in Saudi Arabia?

8.4 Data Sources:

- **Primary Sources:** The study will primarily rely on primary sources such as questionnaires to collect data.
- **Secondary Sources:** Secondary sources such as previous studies will also be utilized. The collected data will be analyzed using statistical software like SPSS.

8.5 Timeframe and Geographical and Boundaries:

- **Timeframe Boundaries:** The study will be limited to companies within Saudi Arabia.
- **Geographical Boundaries:** The study will include all publications from 2020 to 2024.

8.6 Statistical Methods Used:

To test the validity of the study hypotheses, various statistical methods will be used:

- **Cronbach's Alpha:** To calculate the reliability of the questionnaire dimensions and its overall score.
- **Mean and Standard Deviation:** To measure the degree of dispersion and differences between the opinions of the study sample.
- **Pearson Correlation Coefficient:** To measure the strength and direction of the relationship between the study variables.
- **Structural Equation Modeling (SEM):** To measure the direct and indirect relationships between the study variables.

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2. Appendices

