

Thesis Title:

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

Rev.0



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1. Introduction to the Theoretical Section;

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” **Fridgeirsson, (2021)**” The average scoring result shows that the participants believe that AI will likely have the highest effect on project cost management, 58% thought AI would have a very high or high effect on project cost management. 51% of respondents thought AI would have a very high or high effect on project schedule management, and 47% on project risk management in the next 10 years. The respondents believe that AI would have a medium to high effect on project quality management or 61%, and 60% on project procurement management. According to the results, AI would likely have the least effect on project stakeholder management in the next 10 years. For the other areas of knowledge, project integration management, project scope management, project resource management, project communication management, the result was very similar”. And “ The participants believe that AI will have the most effect on monitoring and controlling project work, 49% thought it would have a very high or high effect. It was also assumed that AI would have a high effect on developing a project management plan, developing a project charter, and performing an integrated change control. AI was believed to have the least effect on managing project knowledge, closing a project or phase, and directing and managing project work. The main results for the processes of the project integration management can be seen in Figure 1. AI is likely to have the greatest effect on creating a work breakdown structure (WBS), 50% answered high or very high effect. 40% of participants said that AI would have a very low or low effect on defining scope, 31% on controlling scope, and 27% on validating scope”.

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 tools in other specific sectors (i.e., health) is too scarce. Moreover, AI-enabled approaches for generic PM are also remarkable”.

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 tool 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 tools 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”. And (El Khatib & Al Falasi, 2021)” There weren’t a sufficient number of research papers in the region about the impact of artificial intelligence on project management information systems as it was mentioned earlier in the introduction. In addition, the number of managers was less than the predetermined amount. It was expected to get a total of twenty-five managers from different companies, but the primary data collected half that amount”. And Bento, (2022) "Project management is a common field in many industries, and it is not immune to the innovations that artificial intelligence is bringing to the world. Even so, the application of artificial intelligence is not that widespread in companies and especially not in all of project management areas. The reasons are not clear but seem to be related to the uncertainty of the application of artificial intelligence in project management".

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 tools 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 tools 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 tools, 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 tools of AI in industrial engineering project management in the country, except for tools automating routine tasks and activities.

In conclusion, there might be tools 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 affect the use of artificial intelligence tools in the management of industrial engineering projects in Saudi Arabia?
2. What are the outcomes resulting from the use of artificial intelligence tools in the management of industrial engineering projects in Saudi Arabia?
3. Does the use of artificial intelligence tools in the management of industrial engineering projects mediate the relationship between the factors influencing the use of these tools and the resulting outcomes?

3. Research Objectives

This study aims to achieve the following objectives:

1. Measure the most important factors affecting the project management.
2. Measure the direct effects of the factors influencing the use of artificial intelligence tools on project management in the Saudi engineering companies under investigation.
3. Measure the direct effects of the factors influencing the use of artificial intelligence tools on the expected outcomes of these tools in the Saudi industrial engineering companies under investigation.
4. Measure the indirect effects of the factors that affect the project management when mediated the Artificial Intelligence.

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 tools 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 tools 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. 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:

- 5.1 There is a significant effect of the factors affecting the use of artificial intelligence tools on the outcomes provided by AI tools in the Saudi industrial engineering companies under study.
- 5.2 There is a significant effect of the factors affecting the use of artificial intelligence tools on project management in the Saudi industrial engineering companies under study.
- 5.3 There is a significant effect of project management on the outcomes provided by AI tools in the Saudi industrial engineering companies under study.
- 5.4 The significant effect of the factors affecting the use of artificial intelligence tools on the outcomes provided by AI tools increases when mediated by project management in the Saudi industrial engineering companies under study.
- 5.5 There are no significant differences between the elements of the study sample regarding the determinants of AI tools used, project management, and the outcomes provided by these tools according to the organization's size, sector type, and the demographic characteristics of managers in the Saudi engineering companies under study.

6. Theoretical Background

6.1 Independent Variables:

Independent variables are the factors that a researcher changes to see how they affect another factor, known as the dependent variable. For example, in a study on how light affects plant growth, the amount of light is the independent variable. Here are some of the independent variables that we are intending to measure the its effect to the dependent variables;

6.1.1 Data Privacy and Security:

Protecting data privacy and security in project management is essential for safeguarding sensitive information and maintaining stakeholder trust. This requires obtaining clear consent for data use, implementing data anonymization techniques, and securing data storage with encryption and controlled access. **Khayyat M. & Alshaikhi A. (2021)** stated that “ One of the major implementing AI barriers is data availability. Data is inconsistent and siloed due to poor quality. AI can perform only those types and tasks that are programmed or designed. It takes lots of time to implement, repair, rebuild, and also to create”. and PAULO, (2021) “ Privacy is a

further data challenge since practitioners may lack knowledge of what data is inputted and stored in a model (Harambam et al., 2018). The data challenge comprises the challenges of integrating AI with big data. Initially, AI systems such as rule-based and expert systems were comprehensible and intuitive. Contemporary AI, such as DNNs, that function on unstructured data, mainly render opaque decisions. While the AI advancements made by cognitive computing would not have been made without big data (Gupta et al., 2018), the lack of comprehension from AI outputs has raised the need for transparency through so-called explainable AI (Preece et al., 2018)“. Data privacy and security are critical considerations in the use of AI technologies. AI systems often require large amounts of data to function effectively, raising concerns about how this data is collected, stored, and used“. Data shall be consistent as well to avoid any poor quality. **Weng. (2023).** “With project teams often handling sensitive information, protecting the confidentiality and integrity of this data becomes paramount. Applying ChatGPT to project management involves exchanging information between the AI tool and project management software, potentially exposing sensitive data to third parties. For instance, project-specific details, client information, and financial data may be at risk if ChatGPT inadvertently stores, shares, or misuses this information. Moreover, AI applications like ChatGPT rely on vast amounts of data to learn and improve their performance. This data is often collected from a variety of sources, which raises concerns about the potential for unauthorized access and misuse. In some cases, the AI model may inadvertently learn from confidential or sensitive data, creating a risk that sensitive information may be leaked or exposed when the AI generates responses or suggestions“. The study of Weng. (2023) referred to ChatGPT as it's one of AI tools but the mentioned challenge associated with Data Privacy and security could be consider a common to all AI tools. Organization my use the cybersecurity specialist to enhance the data privacy and security. **Weng. (2023).** “ Project managers should also work closely with their IT departments and cybersecurity teams to establish best practices and guidelines for using AI tools like ChatGPT. Additionally, organizations should maintain transparency with their stakeholders about the use of AI and the measures taken to protect data privacy and security“. Data privacy and security have become increasingly important topics in today's digital age, as the amount of personal and sensitive information being collected and stored continues to grow at an unprecedented rate, With the rapid advancements in artificial intelligence and the increasing adoption of AI-powered technologies in various sectors, the challenge of data security and privacy has become increasingly crucial.

6.1.2 Adaptation and Change Resistance

Adopting AI in project management is crucial as it enhances efficiency, accuracy, and decision-making. AI tools can automate routine tasks, such as scheduling, resource allocation, and data analysis, allowing project managers to focus on strategic aspects. Ultimately, the integration of AI in project management leads to more successful

projects, delivered on time and within budget, while minimizing human error and resource wastage. BODEA concluded the reasons for adoption AI in Project Management. **BODEA et al. (2020)** “The first three reasons for adopting AI in Project management are linked to the needs in increased productivity which will free up project managers allowing them to focus on more important decisions (53%), followed by better decision-making capabilities (52%) and the necessity to improve overall project performance and reporting (51%). As a conclusion to these answers, respondents indicate the time gained for strategy-related issues as an important benefit”. Despite the significant benefits of adopting AI in project management, organizations often encounter substantial challenges and resistance in implementing it. Key issues include integrating new technology with existing systems, training employees, and updating processes. Employees may resist AI due to fear of job automation, satisfaction with current systems, or lack of understanding of AI benefits. **Weng. (2023)**. “ One significant challenge in applying ChatGPT to project management is overcoming the adoption barriers associated with AI tools. A major barrier is the lack of understanding and awareness of AI capabilities and potential applications in project management. Many project managers and stakeholders may not fully grasp the potential benefits of AI-driven project management solutions or may have misconceptions about the capabilities of AI tools like ChatGPT. This lack of understanding can result in resistance to change and reluctance to adopt AI-driven solutions ”. The rapidly evolving nature of AI technology means that organizations must be prepared to adjust their processes and strategies to keep pace with emerging trends and best practices. This ongoing process of adaptation can be resource-intensive and may require organizations to be agile and open to change. As mentioned in study of **Bharati, (2024)** “Successful integration of AI requires strategic planning, adaptability, and careful task selection”, Also **Bharati & Sandbrink (2024)** “ Change management training is essential to mitigate resistance to AI adoption and address micromanagement issues. Practical skills development, including AI literacy, data literacy, technical proficiency in automation tools, and change management, is necessary for project personnel to effectively leverage AI”. Organizations may be reluctant to adopt AI tools if they require significant changes to their current project management infrastructure or the abandonment of legacy systems. This can result in hesitance to embrace AI-driven project management solutions, even if they offer significant benefits in terms of efficiency and decision-making support. Effective change management involves identifying potential problems early, involving stakeholders, providing proper training, and tracking adoption rates. This helps ensure a smoother transition and long-term success of AI implementation. **(El Khatib & Al Falasi, 2021)** “ Pre-planning and collaboration across the board improve the quality of data: Another Manager discussed some of the cases in companies where AI was used to collect and manage data. In most of the companies, it faced many problems to implement AI and run it smoothly. The primary reason is lack of collaboration and pre-planning. The team responsible for the implementation of AI needs to interact with the stakeholders on a regular basis. In one case, it took them more than four months to implement a simple task because the employees were not ready and briefed about the changes” .

Tubman, (2022) “ Another Manager mentioned some examples in which Artificial Intelligence was utilized to acquire and handle data in businesses. Most businesses encounter several challenges in implementing and running AI smoothly. The fundamental problem is a lack of teamwork and forethought. The team in charge of Artificial Intelligence deployment must communicate with stakeholders frequently. One example lasted over four months to complete a straightforward mission since the staff were not prepared for the changes and were not informed of them”. The adoption of artificial intelligence technologies has become increasingly prevalent across various industries, presenting both opportunities and challenges for organizations, With the rapid advancements in artificial intelligence technology, the challenge of adaptation and change resistance has become increasingly prominent and have brought about significant transformations in various industries, revolutionizing the way we approach problem-solving, decision-making, and task automation

6.1.3 Cost associated with AI implementation

The cost of implementing AI tools in project management can vary significantly depending on several factors, including the complexity of the project, the specific AI tools or platforms being used, the level of customization required, and the size of the organization. **Khayyat M. & Alshaikhi A. (2021)**. “Adoption and implementation of AI are not so easy to develop due to expensive operation costs and equipment. AI gives the benefits of cost-effectiveness, reliability and permanency, and addresses some issues of uncertainty by drawing a conclusion or solving a problem [M. Chowdhury and A. Sadek, "Advantages and Limitations of Artificial Intelligence", The National Academies Press, no. 6, 6-8, 2012.]. Adoption and implementation of AI are not so easy to develop due to expensive operation costs and equipment.” While it's challenging to provide a specific cost without knowing the details of your project, smaller-scale implementations might start at a few thousand dollars, while larger, more complex projects could run into the tens or even hundreds of thousands of dollars. And example of adoption AI tools to project management is integration ChatGPT to project management, as stated by **Weng. (2023)** “Another adoption barrier is the financial investment required to implement AI solutions in project management. The costs associated with integrating ChatGPT into existing project management systems and processes can be substantial, particularly for smaller organizations with limited budgets. Additionally, organizations may face ongoing costs related to maintenance, updates, and training for AI-driven project management tools”. **PAULO, 2021** “ AI's significant economic challenges to organizations and institutions address the required investments for technology and changes in contemporary working practices. Studies in the healthcare industry show that competitive pressures to adopt AI technology raise the financial burden of companies so that prices are rolled off to consumers (Bughin et al., 2018). Also, Bughin et al. (2018) analyze the potential for AI to widen the gap between developed and developing economies where poorer nations lack the financial capital to compete in technological investment and fall behind in competitiveness.” Adopting AI tools in project management presents significant financial challenges, as it involves multiple layers of costs. The initial expense includes the purchase or

licensing of specialized AI software, which often carries a substantial price tag. Beyond this, data integration costs can be high, as organizations need to consolidate diverse data sources and ensure compatibility with AI systems. Training team members to effectively use AI tools also incurs costs, as employees need new skills to work alongside advanced technology. Additionally, change management is required to help teams transition smoothly, which includes both direct and indirect expenses. Ongoing maintenance and technical support further add to the financial burden, ensuring that AI systems remain functional and secure. Altogether, implementation costs can be considerable, and budgeting for these aspects is critical for a successful AI adoption in project management. By understanding these cost components and strategically managing investments, organizations can successfully implement AI while mitigating financial risks and maximizing returns. While the integration of artificial intelligence technologies has become increasingly prevalent across diverse industries, the associated costs and challenges of implementing these cutting-edge solutions have emerged as a significant concern for organizations seeking to leverage the transformative capabilities of AI. These cost can include the initial costs of purchasing or licensing specialized software, data integration expenses, training needs, change management, and ongoing maintenance and support. It's truly a huge cost which need to be considered and measured against the potential benefits.

6.1.4 Compatibility with existing Infrastructure:

Integration challenges can involve aligning AI with legacy systems, ensuring security, managing cloud or on-premises deployment, and scaling computational resources to support AI workloads without disrupting existing workflows. AI Compatibility with Existing Infrastructure" refers to how effectively AI systems integrate into an organization's current hardware, software, and operational frameworks. Successful AI adoption often depends on compatibility with existing infrastructure to minimize costly upgrades and reduce implementation time. Weng, (2023) " Organizations may be reluctant to adopt AI tools if they require significant changes to their current project management infrastructure or the abandonment of legacy systems. This can result in hesitance to embrace AI-driven project management solutions, even if they offer significant benefits in terms of efficiency and decision making support ". (Mahmood et al., 2023) " Including artificial intelligence is an essential involvement in managing projects as new technologies are arising and depending on old style tools and techniques will no longer work for new complex projects ". Key considerations include data integration, system interoperability, and scalability. Data quality and accessibility are critical, as AI relies on large, structured datasets typically scattered across different systems. This is a serious challenge, Organization needs to check and ensure the new AI tools and technology are inconsistent with the existing infrastructure systems and can work together accurately, otherwise in some cases building new AI infrastructure could be more efficient in term of cost and accuracy, Organization need to assess and take decision accordingly.

6.1.5 Unavailable Resources & Training Skills Development:

Effective AI training is crucial for developing the necessary skills to leverage AI technologies successfully. AI is a rapidly evolving field, so a commitment to ongoing education and

adaptation is necessary. Effective AI training is essential in project management to harness the full potential of AI technologies. Weng, (2023) “ One aspect of change management that organizations must address is the need for training and education. As AI tools like ChatGPT become more integrated into project management processes, project managers and team members must develop new skills to effectively leverage these tools. This requires organizations to invest in training and professional development, ensuring that their workforce is equipped to harness the potential of AI-driven project management solutions “.

It's good to mentioned such lack of gaining the required skills could lead to a failure. (El Khatib & Al Falasi, 2021) “ The primary reason why organizations had failed to utilize or implement AI for decision-making or data management is due to lack of leadership and interpersonal skills. Several organizations overcame this barrier and shifted the paradigm of their organization growth ”. Khayyat M. & Alshaikhi A. (2021). “ This leads us to say that the Adoption of AI will not work properly if there is no availability of the technical staff and shortages of skills. Technical staff with well-trained and experienced is required to operate and implement the AI in the business. If they cannot operate, the company will not be able to get lengthy implementation time. Lack of understanding of state systems and integration challenges. Interoperability and usability with other platforms and systems “.BELHARET, (2020) “ As the field is quite new in the area of project management companies may have to invest in upskilling their employees to meet the demands and challenges of this new mode of Project management”. BELHARET, (2020) “ AI can enhance Human Capital Optimization (a new form of HRMS) by calculating the best allocation of resources, Identifying the right skill for the right job, pinpointing training needed for a specific employee, predicting resources excess or shortage, providing feedback about the project manager's behaviour and competency [10]. This could be a solution to project failure which is mostly caused by teams incapable of fully grasping and/or executing a project's main goals and objectives. This in principle can also be extended to operational allocation as well, not just restricted to projects, provided that organizations maintain a detailed RACI for their employees “. Unfortunately, many Organization fail to equipped their team with the required training to adapt the new technology, despite the different reasons hindering the organization to invest in training, it's disappointed. Müller, (2024). “Despite AI's importance for organizational efficiency, 62% of the participants rated their companies at 4 or below (on a scale of 1 to 10) in providing AI training to their employees, which correlates with the finding that 65% of participants possess no or only a basic level of AI knowledge and experience. This gap highlights training (and research on training) as critical areas for development as organizations seek to harness the benefits of AI”. As AI is a new emerging field, this will allow to expect unavailability of enough resources in the AI field, which is going to add remarkable challenge to the organization to develop a skilled workforce with the required skills, this is also associated with training and development costs.

6.1.6 Ethical Consideration:

Implementing AI into project management offers numerous benefits, but it also necessitates careful attention to ethical considerations. Key ethical issues include ensuring fairness and avoiding bias in AI algorithms, and maintaining transparency and accountability in AI. PAULO, (2021) “Ethical and legal challenges: Various aspects highlight the ethical

criticality in AI. First, intelligent agents may exhibit discrimination caused by biases in programming or data input. Second, many AI algorithms cannot reason upon their outputs. Third, the long-term impacts of the technology are yet polarizing. Hence, the current regulatory framework is advocated to swiftly adapt to current AI challenges (Duan et al., 2019; Dwivedi et al., 2021)". Addressing biases in data prevents unfair outcomes, while transparent communication and accountability ensure ethical data practices. These measures safeguard data integrity, support regulatory compliance, and enhance the credibility of project management practices. **Weng (2023)**. " Since AI models learn from the data they are fed, any biases present in the training data may be perpetuated in the AI-generated outputs. For project management applications, this can lead to biased decision-making or inaccurate predictions that could adversely impact project outcomes". Implementing AI responsibly requires integrating ethical guidelines at every stage of development and deployment, from data collection to model training and usage.

Ong, (2020) " Other roles which currently require humans will also inevitably be replaced by Artificial Intelligence as they exceed human capabilities. Research has predicted that this will occur within the next couple of decades (Grace et al., 2018). The detailed breakdown of this research has communicated the social consequences and impact that self-driving technology may cause as they eventually replace human jobs. These predictions have also classified the progressive abilities of Artificial Intelligence as they eventually develop and replace jobs of increasing complexity and complication (Grace et al., 2018). From this, it can be deduced that the increasingly complex aspects of projects will gradually be replaced by Artificial Intelligence" . **Weng. (2023)** " Ethical implications of adopting AI in project management and the responsibility organizations One of the primary ethical challenges associated with implementing ChatGPT in project management is the impact on human labor. As AI-powered tools become more adept at performing tasks that were once exclusive to human project managers, there is a growing concern about job displacement and the potential devaluation of human expertise. This shift could lead to a reduction in the need for human project managers, raising questions about the ethical implications of adopting AI in project management and the responsibility organizations have to ensure a just transition for their workforce. Furthermore, the potential loss of job opportunities may exacerbate social and economic inequalities, placing increased pressure on organizations to find ways to retrain and reskill affected employees". Project managers must foster a culture of ethical AI by promoting awareness, aligning AI use with organizational values, and ensuring human oversight. By addressing these ethical considerations, project managers can build trust with stakeholders, enhance project outcomes, and contribute positively to society. **Weng. (2023)** "Another ethical concern related to ChatGPT's application in project management is the potential for biased decision-making. As an AI system, ChatGPT learns from vast amounts of data, which may contain inherent biases from various sources. If these biases are not adequately addressed during the AI's training process, they may be perpetuated in the AI-generated outputs, leading to decisions that could unfairly impact certain stakeholders or project aspects. This issue highlights the importance of transparency in AI systems and the need for project managers to be aware of potential biases that may influence their decision-making processes". It is crucial for organizations to engage in careful consideration and discussion of these ethical issues when incorporating AI tools into their project management processes **Weng. (2023)** " As project managers increasingly rely on ChatGPT for insights and recommendations, it becomes critical to establish clear lines of responsibility for AI-generated outputs. The question of who

should be held accountable for decisions made based on AI recommendations is an ongoing debate that has far-reaching implications for project management. Additionally, ensuring transparency in AI-driven decision-making processes is essential for maintaining trust among stakeholders and demonstrating that AI-generated insights are both reliable and ethically sound. Organizations should consider implementing processes that allow for the tracking and auditing of AI-generated decisions, helping to promote a culture of transparency and accountability “. **PAULO, (2021)** “ Explainability and interpretability build on the principles of fairness, transparency, and accountability in AI decision-making. Decisions made by AI shall be reasoned, especially if outcomes are to the direct detriment of someone (for example, in the application for loans or during medical diagnosis). Ethical auditing is concerned with the most complex systems of AI. It focuses on examining the inputs and outputs of these systems for bias or harm “. **Weng. (2023)** “fairness and inclusivity: it is crucial to ensure that all stakeholders are adequately represented and considered. This includes giving voice to marginalized or underrepresented groups, as well as ensuring that AI-generated recommendations do not inadvertently exacerbate existing inequalities “. **Weng. (2023)** “ The potential over-reliance on AI tools like ChatGPT in project management is another ethical challenge. As organizations become more dependent on AI for decision-making support, there is a risk that human judgment and expertise may be undervalued or overlooked. This could lead to an overemphasis on AI-generated recommendations, even in situations where human intuition or experience may provide valuable insights. This challenge underscores the importance of striking the right balance between AI-generated insights and human judgment in project management, ensuring that AI tools are used responsibly and do not undermine the value of human expertise. Project managers should be encouraged to question and validate AI-generated recommendations, fostering a culture of critical thinking and collaboration between human and AI-driven processes “.

Khayyat M. & Alshaikhi A. (2021). “ It takes lots of time to implement, repair, rebuild, and also to create. The rate of unemployment will increase dramatically as the majority of the industry will replace the staff and workers with AI robots. Likewise, the adoption of AI will make a human being lazy as the bulk number of works will be completed by the machines without a very short period of time [S. Bhbosale, V. Pujari and Z. Multani, "Advantages And Disadvantages Of Artificial Intelligence", *Aayushi International Interdisciplinary Research Journal*, pp. 227-230, 2020. [Accessed 25 October 2020].] “. **Khayyat M. & Alshaikhi A. (2021).** “ The rate of unemployment will be increased dramatically as the majority of the industry will replace the staff and workers with AI robots. Likewise, the adoption of AI will make a human being lazy as the bulk number of works will be completed by the machines without a very short period of time [14] “. **Khayyat M. & Alshaikhi A. (2021).** “ The revolution of AI leads to the fear of reducing manpower and replacing it with the machines using AI. According to ["Will robots really steal our jobs? An international analysis of the potential long term impact of automation",

2018.[Online].Available:https://www.pwc.com/hu/hu/kiadvanyok/assets/pdf/impact_of_automation_on_jobs.pdf. [Accessed: 22- Oct- 2020]. in their research in team of the growth of automation, it will be in three different waves starting from early 2020 through late 2020 and mid of 2030 “. **PAULO, (2021)** “ Societal challenges caused by AI reach from threatening social welfare to challenging cultural norms. Researchers foresee that AI will outperform 50% of human tasks by 2050 (Grace et al., 2018). The substantial erosion of jobs (Ford, 2013; Pueyo, 2018) could potentially cause increased divergence in social welfare (Eubanks, 2018) since AI is to replace rather lower-paid repetitive jobs (Huang et al., 2019). Then again, other

researchers claim AI will create jobs where humans will ‘climb up the value chain’ to the point where they complement AI (Jarrahi, 2018) or work on AI implementation (Dwivedi et al., 2021). **Khayyat M. & Alshaikhi A. (2021).** “ According to PwC’s survey, "The Workforce of the Future" has found that 73% of people think technology can never replace the human mind. In addition, AI tools strongly depend on data input from project managers. Without proper guidance, such AI tools will never execute correctly. In parallel, AI, and project managers depend on each other. Project managers must perfectly expand their skills to manage AI “. **Khayyat M. & Alshaikhi A. (2021).** “ Artificial intelligence still requires skilled project managers to add value and investment. In the near future, both manpower and AI skills are required so that a positive outcome can be achieved. Thus, project managers need to build and develop the skills, which would focus on the areas where AI could not achieve it. The use of AI will require a diverse and flexible skillset to cope with future challenges as demonstrated in [24, Fig.3]. While many of the daily tasks from project manager’s aspects can be automated by using the tools of AI, but the exact value of project management lies in the higher level of soft skills where human interaction can be found “.

PAULO, (2021) “In addition to the challenges caused by potential unemployment, some researchers predict the exclusive interaction between machines and humans through automation and robotization to cause mental disorders and other psychiatric issues (Ashrafian, 2017; Wright & Schultz, 2018)”. **Khayyat M. & Alshaikhi A. (2021).** “ On the other hand, Industries face challenges in different sectors due to AI adoption and implementation, which are as follows: as in the health care workers, many stakeholders in this field perceive the automated robotics differently, and they have feared that such AI automation will eventually replace the work of human staffs in the healthcare sector [J. Shaw, F. Rudzicz, T. Jamieson and A. Goldfarb, "Artificial Intelligence and the Implementation Challenge", *Journal of Medical Internet Research*, vol. 21, no. 7, p. e13659, 2019. Available:10.2196/13659.] influenced Intelligence plays a major role on the verge of the technological world. It has both a bright side and a dark side. **PAULO, (2021)** “Additionally, automated vehicles may pose the threat of causing physical harm (Barocas & Selbst, 2016; Calo, 2014)”. **BELHARET, (2020)** “Machines simply lack the ability to be creative. Humans can think and feel, hence decision-making is creative and will benefit the output. AI can definitely assist in terms of helping to determine the sort of imagery with likely customer preference style and price. But a machine cannot compete with the human brain yet when it comes to originality. AI can be coached on some parameters of creativity which can develop its own sense of creativity [29]”. **Fridgeirsson, (2021)**” Researchers who have studied the future impact of AI [8–11] estimated that AI is likely to increase the productivity of some workers and replace others, but what fields will be most affected remains unknown”. **Bento, (2022)** "Although artificial intelligence applied to the project management area is not a novelty, its potentiality in all knowledge areas is still questionable (Pereira et al., 2021, 2022). It is recognised the benefits of artificial intelligence tools to optimize and perform tasks that are rule-based, such as scheduling, cost estimation or risk assessment. However, in areas that require empathy, human resources management or decision making the artificial intelligence applicability is more questioned". **PAULO, (2021)** “Individuals and organizations raise concerns over purpose and privacy in using their data (Sun & Medaglia, 2019). Some advocates, such as Elon Musk, advise strengthening the regulatory framework to preempt AI advancements ‘before it is too late (The Guardian, 2017)”. **PAULO, (2021)** “Cath (2018) divides the investigation of AI’s regulatory frameworks into three specific areas: ethical

governance, explainability and interpretability, and ethical auditing. Ethical governance focuses on principles such as fairness, transparency, and privacy. It aims to build responses to discriminations in public and private sector management of services, goods, and job losses". **Tubman, (2022)** " Furthermore, we discovered that the UAE and the United States government had created 26 procedures for AI application in organizations (Allagui & Al-Najjar, 2018). Artificial Intelligence systems are used in several public-domain initiatives". "Saudi Arabia has taken proactive steps toward AI regulation and development through initiatives aimed at positioning the country as a leader in AI-driven innovation. The cornerstone of these efforts is the National Strategy for Data and AI (NSDAI), launched by the Saudi Data and Artificial Intelligence Authority (SDAIA) in 2020. The strategy focuses on making Saudi Arabia a global hub for AI by 2030, aligning with the broader Vision 2030 initiative to diversify the economy. Key aspects of AI regulation in Saudi Arabia include developing robust data governance frameworks, privacy protections, and ethical guidelines for AI use. SDAIA has implemented strict data privacy laws, particularly under the Personal Data Protection Law (PDPL), to protect individual privacy and control data processing. Additionally, the NSDAI outlines plans to invest in AI education, attract global tech talent, and foster public-private partnerships to advance AI in sectors like healthcare, finance, and smart cities". Addressing these ethical considerations involves a holistic approach that integrates ethics into every stage of AI development and deployment, from design to monitoring. By doing so, organizations can build trustworthy AI systems that contribute positively to society while ensuring compliance with ethical standards and regulations. The ethical challenge is wide aspect which include the way of using the AI, the consequence of the applying AI tools and technology and the concern of job displacement, regardless of the its reality, we believe that AI can not replace human completely due to many reason such as lack of empathy and the new careers will be vacant due to lack of a skilled workforce as Bento, (2022) mentioned, In contrast, AI can will automate repetitive tasks and accordingly will open new vacancies that can support AI maintenance and operation.

6.2 Mediated Variables: (Rephrase)

Mediated variables, also known as mediators, are variables that explain the mechanism or process through which an independent variable influences a dependent variable. In research, mediation occurs when the independent variable affects the mediator variable, which in turn affects the dependent variable. This concept helps to clarify how and why certain effects occur, providing a deeper understanding of the relationships between variables. Mediated variables are crucial in fields like psychology, sociology, and public health, where complex interactions are common. Analyzing mediation typically involves statistical methods such as regression analysis to test the significance of the mediation pathway.

6.2.1 **Project Management Via Using Artificial Intelligence:**

Project management is a strategic competency that involves the tools 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).

Khayyat M. & Alshaikhi A. (2021) “ There are three main issues that the project management face, which are: • Analyzing many data, but there is no sufficient human resources and time available. This can be achieved by implementing AI. • Rule-based schedule with the use of AI to get the solution. • Computers can be manufactured by establishing sub-projects or project networks that demonstrate different manufacturing methods of AI. AI can make the entire process faster and easier. Thus, the adoption of AI in project management is imperative and standard networks are not always suitable tools to create a new project network. Moreover, the use of AI and its methods can well meet business needs [A. Foster, "Artificial Intelligence In Project Management", Cost Engineering, vol. 30, no. 6, 1988.]”.

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). **Ong & Uddin, (2020)** “Artificial Intelligence in project management can be summarized and categorized into the following four types which are dependent on context and process (Wang,

2019): integration and automation; chatbot assistance; machine-learning based; and autonomous management of projects. Out of the above, machine-learning based project management has been proposed to be most beneficial (Wang, 2019)”.

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(2023).

Project management using artificial intelligence tools 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 tools 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). Ong & Uddin. (2020) “ Artificial Intelligence currently possesses an extensive range of applications in projects. These applications include processes to reduce risks, to assist in the daily tracking of projects, to identify anomalies, outliers or correlations within projects. Robotic Process Automation is also an Artificial Intelligence application gradually gaining traction within the management of projects (Branscombe, 2018). By considering the applications of Artificial Intelligence and Data Science within the delivery stage of projects, it is evident that a gamut of existing software are applicable and employed in process. It can be determined that different software are suited to and correspond to different stages of projects. Examples of current software incorporated into project management practice include Chatbots, Strategies, Zivebox, Rescoper, Clickup, Polydone as well as Clarizen (Munir, 2019). Other software cited comprise of Slack or JIRA (Schmelzer, 2019). The processes involved in Artificial Intelligence furthermore include machine-learning models, various algorithms (Pedroso, 2017) as well as several different languages such as command line, Git version control, SQL and database concepts, R and Python (Joachims, 1998)”.

BELHARET, (2020) “According to PwC’s Workforce of the Future Report, 2018, it is estimated that: • Demand is increasing for faster, more flexible, and easier-to-learn project management methodologies and approaches. • The constantly-changing technical landscape— from social media, to web-based tools, to learning management systems—will present tremendous opportunities for exploration and experimentation.

- The shift toward on-demand, customized, and problem-specific learning with the use of AI will grow.
- Innovations in learning will continue to make it possible for the new worker to learn anything, anytime, and anywhere.
- In the increasingly complex project management environments that we see today, the need for such tools to proactively ‘think’ and ‘do’ on behalf of the project manager and provide on demand information to support their efficiency and effectiveness is clear.[31]”

AI has a potential opportunity to accurately identify the risk in project management, **(Sahadevan, 2023)** “ Proactive Use of Data for Early Risk Detection: Utilizing AI in project management has many benefits, one of the key benefits is its ability to analyse data and spot potential risks before they emerge into serious issues. AI-powered risk detection tools can examine vast amounts of data from various sources to find patterns and trends that could indicate possible issues. By continuously monitoring project development, project managers can adopt a proactive approach to risk management and handle any potential problems before they escalate. This proactive approach to risk management can prevent the loss of resources, time, and money that might otherwise occur if problems went unnoticed. Additionally, project managers can identify previously raised unknown risks by utilizing AI-powered risk detection systems to take proactive measures to prevent future delays or cost overruns “. **Ruiz, (2020)** “In the field of AI, researchers have identified the algorithms and tools that can best deal with the various project variables and complex environments, with specific algorithms devised to address specific problems in the project. The main conclusions drawn from the reviewed works include that AI tools are more precise than traditional tools, while, at present, they remain somewhat complementary to the traditional approaches”. Many potential of AI in project management make it an interested area for researchers and for organization as well, **(Sahadevan, 2023)** “ Faster Analysis and Resolution of Defects: Artificial Intelligence (AI) in project management offers a potential benefit in terms of faster defect analysis and resolution. AI-powered tools can effectively analyse and identify the root cause of defects, delivering prompt suggestions for fixes. This enables project managers to swiftly address issues and minimize their effect on project timelines and budgets. Project teams may make informed decisions and proactively prevent defects by employing real-time data and AI-powered tools, resulting in higher-quality products and enhanced project outcomes. Furthermore, incorporating AI in defect analysis improves overall project efficiency and effectiveness. Through the analysis of historical data and prediction of future defects, AI-powered tools empower project teams to proactively take measures to prevent potential issues. This leads to successful project delivery with a high-quality product. The potential to fix defects quickly and accurately, along with dynamic efforts to prevent future issues, results in improved project outcomes and increased project success”. **(Sahadevan, 2023)** “ Handling Scope Creep and Raise in Expectations: Scope creep refers to the continuous expansion of project scope beyond the originally defined boundaries, leading to delays and budget overruns. In project management, scope creep can arise due to inadequate planning, poor communication, or frequent changes in requirements. Through constant monitoring of the project's progress and data analysis

to spot potential scope modifications, artificial intelligence (AI) can assist project managers in controlling scope creep. Project managers may handle problems as they arise and keep the project on schedule and within budget by using AI tools to identify changes in scope and potential issues with expectations”. **Fridgeirsson, (2021)**” The average scoring result shows that the participants believe that AI will likely have the highest effect on project cost management, 58% thought AI would have a very high or high effect on project cost management. 51% of respondents thought AI would have a very high or high effect on project schedule management, and 47% on project risk management in the next 10 years. The respondents believe that AI would have a medium to high effect on project quality management or 61%, and 60% on project procurement management. According to the results, AI would likely have the least effect on project stakeholder management in the next 10 years. For the other areas of knowledge, project integration management, project scope management, project resource management, project communication management, the result was very similar”. And “ The participants believe that AI will have the most effect on monitoring and controlling project work, 49% thought it would have a very high or high effect. It was also assumed that AI would have a high effect on developing a project management plan, developing a project charter, and performing an integrated change control. AI was believed to have the least effect on managing project knowledge, closing a project or phase, and directing and managing project work. The main results for the processes of the project integration management can be seen in Figure 1. AI is likely to have the greatest effect on creating a work breakdown structure (WBS), 50% answered high or very high effect. 40% of participants said that AI would have a very low or low effect on defining scope, 31% on controlling scope, and 27% on validating scope”. **(Sahadevan, 2023)** “ Additionally, AI-powered tools may provide project managers with suggestions for corrective measures and effective communication with stakeholders, minimizing the impact of scope creep on project timelines and budgets. Managing expectations is key to project success. Understanding stakeholder expectations is crucial to delivering project deliverables that meet their needs. AI analysis of project data can offer insights into potential challenges and improvements, aiding project managers in managing expectations. Early recognition and addressing of issues can decrease the chance of stakeholder dissatisfaction and disappointment. Furthermore, AI tools can enable project teams to deliver projects that meet or exceed stakeholder expectations by providing recommendations for effective communication and stakeholder management. Overall, incorporating AI into project management helps project managers to manage scope creep and expectations effectively, leading to higher project success rates and better outcomes”. **(Sahadevan, 2023)** “Predicting and Experimenting: Project teams may now analyse historical data and experiment with alternative scenarios to forecast results due to the advancement of AI-powered tools in project management. In order to avoid unexpected delays or cost overruns, project managers may obtain real-time insights and make informed decisions. Using AI in project management helps reduce risks, enhance results, and boosting total project delivery accuracy and efficiency. In a nutshell, AI is proven to be a beneficial ally in the field of project management”. **(Sahadevan, 2023)** “Team Empowerment to Replace Central Management: The ability to empower teams and reduce reliance on central management is one of the major advantages of employing AI tools in project

management. Artificial intelligence (AI) can shed light on areas where team members might need extra help or training by analysing data and seeing trends and patterns. This enables project managers to allocate team members more responsibility while lessening their effort. They may still exercise oversight and make sure that the project's objectives are being accomplished. Regardless of a team member's location or time zone, AI tools can support better collaboration and communication. These collaboration tools enable team members to connect with one another in real-time, track progress, and exchange information with ease. This reduces the need for centralized management to handle these interactions. Overall, the use of AI in project management can help teams become more autonomous and self-sufficient, which reduces the need for central management and increases team members' sense of ownership. Project managers can give team members more responsibility by utilizing AI to analyse data and deliver insights, increasing efficiency and lowering the risk of errors or delays". **Korke et al., (2023)** "Artificial Intelligence in Construction Project Management: Nevertheless, artificial intelligence possesses its own set of advantages. It can solve difficult issues to the levels of expertise of professionals by imitating the expertise of experts. Overall, the field of civil engineering is ripe with potential application areas for artificial intelligence's wide range of capabilities" and "AI-powered robots have been directly adopted on construction sites in order to take over repetitive and routine construction duties such as bricklaying, welding, tiling, and others. This is done in order to free up human workers to focus on more complex tasks. This is being done in order to lessen the amount of manual labour that is necessary for the completion of these jobs". They can operate continuously without taking a break at an almost identical pace and level of quality, demonstrating that the suitable deployment of intelligent machinery will ensure efficiency, productivity, and even profitability..

(Sahadevan, 2023) "Focus on Objectives Instead of Processes: Finally, AI tools can help project managers concentrate more on goals than processes. With the analysis of project data, AI can determine which techniques are most effective for accomplishing project goals. Project managers can concentrate on the most efficient process and choose the best course of action for attaining project goals. In overall terms, AI is revolutionizing project management, giving companies tools to boost productivity and all-around performance. Project managers can produce improved outcomes and complete successful projects by swiftly identifying risks, analysing defects, managing scope creep and expectations, predicting project outcomes, empowering team members, and focusing on objectives". **Fridgeirsson, (2021)**" Researchers who have studied the future impact of AI [8–11] estimated that AI is likely to increase the productivity of some workers and replace others, but what fields will be most affected remains unknown". The researches we came cross are all in agreement about the importance of AI in project management and the potential of enhance decision making, improving project outcome, data collection accuracy, enhancing analysis and insights, risk identification accuracy, saving time for project managers to focus on the

serious tasks by automating administrative and repetitive tasks and to enhance collaboration and project communication.

6.3 Dependent Variables: (Rephrase)

A dependent variable is the outcome or response that researchers measure in an experiment or study. It is called "dependent" because it is presumed to depend on the influence of other variables, known as independent variables. The dependent variable is what the researcher is interested in explaining or predicting, and its variations are observed to understand the effect of the independent variables. For example, in a study examining the impact of study time (independent variable) on test scores (dependent variable), test scores would be the dependent variable.

6.3.1 Enhancing Decision Making:

AI significantly enhances decision-making by providing data-driven insights, predictive analytics, and automation capabilities that help organizations make faster and more accurate choices. This predictive capability supports proactive decision-making, enabling organizations to anticipate future outcomes, assess risks, and optimize strategies accordingly. **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”. **El Khatib & Al Falasi, (2021)** “All organizations rely on different decisions to drive their operations, and their performance is dependent on the effectiveness of their choices. It is for this reason that large firms implement PMIS (Project Management Information System) to facilitate effective decision-making and efficient management of information (Radovic-Markovic & Vucekovic, 2015)” **El Khatib & Al Falasi, (2021)** “PMIS is considered to be beneficial to project managers managing single and complex projects because it contributes to timelier decision making and project success (Raymond & Bergeron, 2008) “. **El Khatib & Al Falasi, (2021)** “It is clear that the better the availability of information, the better the impact on both efficiency and accuracy of business decisions. In addition, PMIS is indispensable in the area of decision-making as it can monitor by the instability in a system, verify a course of action and take action to keep the system in control. As Kolbjørnsrud, Amico and Thomas (2016) mentioned in Harvard Business Review, “Human judgment is unlikely to be automated, intelligent machines can add enormously to this type of work, assisting in decision support and data-driven simulations as well as search and discovery activities”. Another research carried out by Tarafdar et al. (2019) and published” **El Khatib & Al Falasi, (2021)** “Companies

which implement AI in data collection improved higher accuracy of data and improved decision-making quality by revealing trends. Higher accuracy is achieved as a result of AI in data collection. Boone says. “AI could identify slowly ramping trends in that stream of data that are significant but hard to see—” **Khayyat M. & Alshaikhi A. (2021).** ”Artificial intelligence or the adoption of artificial intelligence is used to process human intelligence to make effective decisions or solve problems”. **Muller et. Al, (2024)** “The surveyed experts also indicated three primary areas through which AI impacts efficiency, accuracy, and decision-making within project management: Data collection and reporting, Performance monitoring, and Project time management and scheduling”. **El Khatib & Al Falasi, (2021)** “AI is playing a vital role in the data management and in the decision-making. The AI had played a key role in the UAE market especially in project management. El Khatib, A. Al Falasi DOI: 10.4236/ajibm.2021.113016 258 American Journal of Industrial and Business Management ment to manage and collect data. The high accuracy of data management under AI is one of the most significant advantages to using AI”. **Ong, (2020)** “ The three most common data analysis techniques that are commonly applied to assist project managers in making informed decisions are **statistical analysis** (e.g., regression, analysis of variance and covariance, scatter plots, pareto charts and t-test), **time series analysis** (e.g., single-equation regression and multi-equation simulation) and **probabilistic models** (e.g. event history analysis, Markov chains and systems dynamics modelling) (Nayab, 2019)” **El Khatib & Al Falasi, (2021)** “There is a positive impact on making a quality decision through AI. For instance, AI had proven to manage a more significant amount of data than any other source used in the past by organizations”. **(El Khatib & Al Falasi, 2021)** ”The possibility of risk identification with the help of AI helps in making quality decisions. The risks and amount of data in an organization both increase with the size of the operation. The management of data collection and organization through AI can help reduce the risk. The Project managers clarified that in banks where the loan defaulters are high in number, it is essential to identify the types of customers who are in such category. The AI can help identify and notify the decision makers in advance for any such users”. **Weng. (2023)** “The integration of ChatGPT-4 into project management methodologies holds significant potential for enhancing efficiency, decision-making, and overall project outcomes. By following the lessons learned and best practices outlined above, organizations can effectively harness the power of AI-driven tools like ChatGPT-4 and transform their project management processes for the better”. There are many factors that could affect decision making enhancement which has been discussed and stated in many researchers. **(Mahmood et al., 2023)** ” Artificial intelligence can be used as a collaborative design tool as well to help in managing projects and the Tangible User Interface (TUI) system can be an example. The TUI system is a control and visualization tool to help novice users to design neighborhoods to ensure building high-quality communities. The tool has been used to simulate and help improve decision making process for urban planning in many cities around the world. It helps identify better cities’ solutions as it encourages machine learning and search algorithms to assist non-experts in having

accurate and cost-effective approach to deliver real-time information that can contribute to performance and decisions evaluation. The Tangible User Interface was used in designing one of the neighborhoods in Riyadh city. The project included many parameters that the developers need to consider when planning such as energy efficiency, walkability, and daylighting. As a result, the system helped the planners to visualize their ideas and provide them with design feedback regarding their parameters, accuracy planning, and costs to help them make better decisions. Furthermore, human beings are likely to make mistakes and they lack experience. Such projects can't afford these faults; therefore, AI has to be equipped when the business is planning for critical goals (Ahmed et al., 2022; Alzoubi et al., 2019; El Khatib et al., 2020b; Raja et al., 2020).” **El Khatib & Al Falasi, (2021)** “It is clear that the better the availability of information, the better the impact on both efficiency and accuracy of business decisions” **Ruiz, (2020)**. “In the future, AI will make all the decisions and will manage the resources in an optimal and timely manner, while the project manager will take the role of data scientist, working as part of a team with the AI to interpret the data and the decision making. Overall then, project managers will continue to play a crucial role when the AI is fully developed”. **Weng. (2023)** “In conclusion, applying ChatGPT to project management presents undeniable advantages in terms of efficiency and decision-making support. However, data privacy and security challenges must be addressed to ensure the responsible and secure use of AI in project management processes”. **El Khatib & Al Falasi, (2021)** “The drawn conclusion was that AI application improves data quality and integrity leading to improved speed and effectiveness of decision making in both single and multiple project environments”. **Tubman, (2022)** “The United States financial industry is adopting AI to complete projects and meet its aims. Recent research was carried out at Mashreq Bank, which applied AI to boost efficiency by programming activities and limiting transaction periods. They witnessed over 150,000 transactions that had no errors in one day. Using artificial intelligence to construct this technique has enabled Mashreq Bank to handle more operations while decreasing bias in data used and led to a pool of information with improved reliability that can be retrieved and examined. Inferences are drawn on to make more effective future decisions”. **(Mahmood et al., 2023)** ” Use of AI in Decision Making in PMIS: Due to the huge amount of complex data and information, Decision Support System tools help project managers analyze these data to assist in better decision making. According to (Nuseir et al.,2021), decision support systems, information technology, and artificial intelligence can all be utilized for knowledge and data management purposes. These 3 combinations can make a support system that helps in analyzing data, finding relationships and patterns, and new information that can be a help in making decisions in projects. For example, Artificial intelligence can be used in complex data analysis as according to report publisher, AI can help in detecting issues and alert users when they need to interfere, and plan and schedule resources based on the project goals”. Form the above research it's become clear the potential of AI to help projects manger to take faster and more accurate decisions, based on the massive

history data that AI can analyze and interpret and thus project managers can be more accurate and fast to take the right decision.

6.3.2 Improving Project Output:

AI enhances project outcomes by using predictive analytics, automation, and real-time insights to improve decision-making, risk management, and resource allocation. These capabilities streamline workflows, optimize communication, and enable project managers to make timely, informed decisions, ultimately leading to more efficient and successful project completions. **Weng. (2023)** “To fully leverage the benefits of AI-driven project management solutions, seamless integration with current systems and processes is crucial. Organizations can address this challenge by developing custom integrations and plugins for popular project management software, ensuring that ChatGPT can effectively complement existing tools and workflows. This will enable project managers to access AI-generated insights and recommendations within their preferred project management platform, thereby streamlining the decision-making process”. (**Mahmood et al., 2023**) “Including artificial intelligence is an essential

involvement in managing projects as new technologies are arising and depending on old style tools and techniques will no longer work for new complex projects. The reasons of utilizing artificial intelligence in project management information system are to help make better use of data and be more productive. For example, many companies like Amazon and Ocado are using artificial intelligence in managing their warehouses and many other firms in examining legal documents and record through data analysis. Moreover, AI can help in the integration process as it can be seen from cost management perspective in where budget updates in databases are simultaneously updated in the forecast report without any human input. AI can also be applied in what is called the autonomous project management system where it has to understand the stakeholders' communication and be able to meet their satisfaction criteria. AI will be a big help in project management throughout the project planning phase where project manager will need to plan and assign activities and resources to better achieve project goals. In addition to that, changes might happen to the project timeline so activities' assignment will be a recurring process, but this is not the issue. The main challenge in here is having wrong estimation and as a human being might overlook some details, AI can take this responsibility in managing project plan, predicting duration and cost, and maintaining project schedule through the use of big data”. **El Khatib & Al Falasi, (2021)**, “Service-related companies especially the financial sector find it easy to implement the AI in PM: The financial sector in UAE is using AI to implement their projects and achieve their objectives. 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”. **(Korke et al., 2023)** “Methods from the field of artificial intelligence can also be used to substantial effect in the area of optimization problems. The purpose of these challenges is to ensure that the construction project is carried out in an efficient and effective manner. For example, artificial intelligence has made it possible for new methods to be developed, such as process mining, which offers helpful insights into the intricate building process [15]. Process mining enables several useful activities, including the monitoring of essential workflows, the forecasting of deviations, the identification of hidden bottlenecks, and the extraction of patterns of collaborative behaviour. The implementation of such recently gained information is necessary for the successful completion of the project and has the potential to direct the optimization of the construction execution process. It is predicted that unnecessary steps, reworks, and arguments, along with potential delays and poor cooperation, will be avoided. Additionally, it is hoped that these things will be avoided. The result of this is that strategic decisions may be made for the early-stage troubleshooting of problems, which drives the increase of operational efficiency. In addition to this, it is effective in avoiding adjustments that are more time-consuming and costly in the stage that comes after this one. There is a wide variety of different sorts of optimization algorithms, and each one of these algorithms is a powerful tool that can be utilized to construct more convincing architectural designs that strike the optimal balance between time, money, and quality [16].” **El Khatib & Al Falasi, (2021)**, One of the Managers stated that the tools used by most companies in AI is Chabot which acts as a replacement to customer service executives and also serves as a data collection point. The interaction with these Chatbots is wholly automated and thus reduces the chances of the human error and human mood distraction. The quality of data is improved as it is collected and filed by the entirely automated process. The chances of failure are one in ten million as compared to human error which is 1 in 10,000. This multifold accuracy did not only reduce time but saved the organization from any financial cost as a result of PMIS information processed by a human”. **(Korke et al., 2023)** “In the process of determining the condition of civil infrastructure, the laborious and unreliable visual examination has been steadily replaced by the automated and reliable computer vision techniques. This has been accomplished using newer technology. Deep learning strategies have taken centre stage in the most recent iterations of advancements made in computer vision technology. These techniques make use of end-to-end learning in order to automatically interpret, evaluate, and comprehend the data that is included within images and videos. Computer vision is primarily used to perform visual tasks for two main purposes known as inspection and monitoring, which have the potential to promote the understanding of complex construction tasks or structural conditions in a manner that is comprehensive, swift, and reliable [18]. That is number of people who need to be employed in dangerous situations. Computer vision is primarily used to perform visual tasks for two main purposes known as inspection and monitoring. Computer vision is primarily used to conduct visual tasks for these two primary

purposes in order to achieve intelligent management in the construction project. Inspection applications perform tasks such as automated damage detection, structural component recognition, identification of hazardous behaviour, and condition identification”. **(Korke et al., 2023)** “Monitoring applications are a non-contact method for obtaining a quantitative comprehension of the infrastructure's status. This knowledge can be utilized, for instance, to estimate strain, displacement, and the length and breadth of fractures. In conclusion, vision-based approaches in CEM are relatively inexpensive, basic, productive, and accurate. These methods can reliably convert image data into actionable information for the evaluation of structural health and assurance of construction safety”. **Tubman, (2022)** “According to a 2020 MIT poll, 60 percent of manufacturers are adopting AI to improve product quality, increase speed and transparency across the distribution network, and optimize inventory control. Companies face various obstacles regularly, such as unexpected machinery breakdowns or poor product delivery. Manufacturers may increase operational efficiency, launch new goods, adjust design concepts, and plan long-term financial measures to further their AI transformation by leveraging Machine learning and artificial intelligence. AI use in industrial facilities is becoming increasingly popular among businesses. Based on Capgemini's survey, more than 50% of European firms (more than half of the firm) are installing AI applications, with Japan (31%) and the US (28%) behind in second and third place, respectively (Gray-Hawkins et al., 2019). Routine upkeep (29 percent of manufacturing Artificial Intelligence use cases) and Superiority (27 percent)”. **(Sahadevan, 2023)** “ Impact of Artificial Intelligence on Technology Artificial intelligence (AI) is transforming technology in numerous ways. The best about AI-based systems is their ability to discover, understand and enhance processes. These systems can process a vast amount of customer data to produce complex real-time decisions. Three categories explain the effect of self-learning systems on technology: learning ability, data processing, and decision-making ability. **(Sahadevan, 2023)** “ The amount of necessary human intervention will determine if AI-based systems are successful. A drop in the level of human intervention makes AI systems more transparent and valuable for the end-users. We will get to know what future innovation will look like by analysing IoT products such as Nest, YouTube, and Netflix. These products recognize customers' behaviour and adapt to their preferences. Having access to pertinent data is essential to build effective self-learning and improvising systems”. **(Mahmood et al., 2023)** “Reasons of utilizing AI in PMIS, The use of artificial intelligence in project management can drive the industry toward a magnificent project outcome. Using AI in managing projects can help identify critical issues, make predictions, speed up processes, and many more. AI will affect project management in all its disciplines using machine learning algorithms through risk management and project management then will rely on artificial intelligence in assessing project performance to help in predicting risks through the project life cycle (Khatib et al., 2016)”. **(Sahadevan, 2023)** “ AI will undergo significant growth in the upcoming years. From small companies to large organizations like banks, it will be widely adopted in a wide range of industries, revolutionizing data processing and improvising data-driven decision-making. The

capability of AI systems to comprehend and utilize information meticulously will be vital to their success. AI-based solutions will be controlling the direction of technology and considerably impact our day-to-day life”. (Korke et al., 2023) “Additionally, AI-powered robots have been directly adopted on construction sites in order to take over repetitive and routine construction duties such as bricklaying, welding, tiling, and others. This is done in order to free up human workers to focus on more complex tasks. This is being done in order to lessen the amount of manual labour that is necessary for the completion of these jobs. They can operate continuously without taking a break at an almost identical pace and level of quality, demonstrating that the suitable deployment of intelligent machinery will ensure efficiency, productivity, and even profitability”. (Sahadevan, 2023) “ Another application of AI in IT is to improve protection. Cyberattacks are getting to be more advanced and troublesome to spot, requiring more progressed security measures. Artificial intelligence-powered security tools can analyse and screen systems in real time, recognize threats in real time, and respond to incidents faster than people. They can also learn from prior attacks and foresee future ones, making them a critical part of cybersecurity defence. AI is additionally utilized in IT to robotize employments, decrease manual labour, and increase proficiency. Data entry, customer support, and other repetitive activities can be automated utilizing tools such as Robotic Process Automation (RPA) and chatbots. Employees can concentrate on more complex tasks that require human intervention, increasing overall productivity”. (Korke et al., 2023) “ It is thought that AI methods will become the next digital frontier if AI abilities continue to grow. These ways will be able to efficiently translate massive amounts of data into valuable information, which will lead to a high degree of automation and intelligence in both industry and commerce. The adoption of AI approaches is currently lagging behind the process in the construction industry, despite the fact that a significant amount of engineering data is increasing at an unprecedented high rate in the construction project. As a result of this, there is a significant amount of interest in applying a variety of AI methodologies in the CPM domain in order to capitalize on the advantageous opportunity presented by digital evolution for increased productivity and profitability”. AI has potential to increase the project outcome since it’s potential ability to accurately collect data accurately, identify risk, analyze insight and data and take fast and accurate decision, hence we can expect AI also has a potential to increate the project outcome.

6.3.3 Data Collection accuracy:

AI significantly enhances data collection accuracy by automating processes, reducing human error, and analyzing large volumes of information in real time. AI can validate, clean, and standardize data, ensuring higher accuracy from the outset. Additionally, AI-driven data collection systems can capture complex patterns and detect anomalies, helping to identify errors or inconsistencies that might be missed manually. This precision supports better decision-making, as accurate data is essential for generating

reliable insights across fields like healthcare, finance, and project management. **Tubman, (2022)** “The use of AI in data collecting results in greater accuracy. According to Boone. "AI might uncover gradually escalating tendencies in that quantity of information that are substantial but difficult to perceive or easy for people to dismiss even if they do perceive them." **Muller et. Al, (2024)** “The surveyed experts also indicated three primary areas through which AI impacts efficiency, accuracy, and decision-making within project management: • Data collection and reporting, • Performance monitoring, and • Project time management and scheduling” **Mahmood, (2023)** “The reasons of utilizing artificial intelligence in project management information system are to help make better use of data and be more productive. For example, many companies like Amazon and Ocado are using artificial intelligence in managing their warehouses and many other firms in examining legal documents and record through data analysis”. **Mahmood, (2023)** ” Reasons of utilizing AI in PMIS: The use of artificial intelligence in project management can drive the industry toward a magnificent project outcome. Using AI in managing projects can help identify critical issues, make predictions, speed up processes, and many more. AI will affect project management in all its disciplines using machine learning algorithms through risk management and project management then will rely on artificial intelligence in assessing project performance to help in predicting risks through the project life cycle (Khatib et al., 2016)”. **Mahmood, (2023)** “Including artificial intelligence is an essential involvement in managing projects as new technologies are arising and depending on old style tools and techniques will no longer work for new complex projects. The reasons of utilizing artificial intelligence in project management information system are to help make better use of data and be more productive. For example, many companies like Amazon and Ocado are using artificial intelligence in managing their warehouses and many other firms in examining legal documents and record through data analysis. Moreover, AI can help in the integration process as it can be seen from cost management perspective in where budget updates in databases are simultaneously updated in the forecast report without any human input”. **Tubman, (2022)** “According to one of the SME, Chabot is one of the AI technologies that most firms use. It is an additional service for customer managers and an information collection point. These Chabot's' conversations are automated, reducing the risk of human error and psychological misdirection. The quality of data increases when it is collected and filed utilizing an utterly automated technique. Failure is ten million times more frequently than human error, one thousand times. This multifold accuracy saved a significant amount of time and prevented the company from incurring any financial expenditures due to the manual processing of PMIS data”. **(Korke et al., 2023)** “The Digital Age: It is essential to note that Building Information Modeling (BIM) has been the primary impetus behind the digitalization of the construction industry. In recent years, BIM has advanced far further than 3D modeling in terms of its ability to supply a pool of information for the whole lifecycle of a project [13]. BIM has the potential to function as an AI-capable digital backbone, which can further accelerate the digitization of information used in intelligent CEM. For BIM, it provides a platform for not only

gathering vast volumes of data about all parts of the project, but also for sharing, exchanging, and analysing data in real-time to enable in-time communication and cooperation among a range of parties. This is accomplished using a building information model (BIM). The usage of BIM is the means by which this can be accomplished. They do this as part of the artificial intelligence (AI) methodology, with the goal of automating and improving the building process. The data comes from the building information modeling (BIM) system. The integration of BIM and AI has the potential to transform paper-based jobs into online administrative tasks. For one thing, it is able to provide information that is both the most efficient and the most effective in terms of keeping the ongoing project continuously up to date. This capability is one of its distinguishing characteristics. An additional advantage is that it may make use of the data that is contained in the BIM in order to perform real-time analysis. This makes it possible for quick responses to be taken in order to simplify the process, shorten the amount of time it takes to operate, cut expenses, lower risk, and optimize personnel arrangement, among other things". **Tubman, (2022)** "The industry's primary focus is on customer engagement. AI catboats for quick consumer responses and personalization of the user experience, RPA (Robotic process automation), Machine learning (ML), Natural language processing (NLP) together with voice recognition will be at the forefront of the industry's information technology. The use of AI in data collecting results in greater accuracy. According to Boone. "AI might uncover gradually escalating tendencies in that quantity of information that are substantial but difficult to perceive or easy for people to dismiss even if they do perceive them." **Mahmood, (2023)** "AI can also be applied in what is called the autonomous project management system where it has to understand the stakeholders' communication and be able to meet their satisfaction criteria". **(Sahadevan, 2023)** " AI tools such as IBM Watson, Google TensorFlow, and Microsoft Azure, can be used by companies. Among other characteristics, these tools possess computer vision, natural language processing, and machine learning. For enhancing data processing, automation, and security in existing IT platforms these tools can be incorporated. To summarize, AI is an imperative component of cutting-edge IT, and its execution can give businesses with a competitive advantage. Better data analysis, security, and automation are driving the demand for AI in IT. Businesses can incorporate AI into their IT systems to make strides productivity, efficiency, and accuracy, due to the accessibility of diverse AI tools". **Mahmood, (2023)** "AI will be a big help in project management throughout the project planning phase where project manager will need to plan and assign activities and resources to better achieve project goals. In addition to that, changes might happen to the project timeline so activities' assignment will be a recurring process, but this is not the issue. The main challenge in here is having wrong estimation and as a human being might overlook some details, AI can take this responsibility in managing project plan, predicting duration and cost, and maintaining project schedule through the use of big data". **BELHARET, (2020)** "Encouraging better practice: AI can gently encourage teams to improve the quality of the data they are inputting (such as chat apps). that cannot be automated. Machines may not be able to display a human's intuition, but AI

is here to stay. It's going to inevitably change how we do business today". **Wang, (2023)** " It establishes a local area network and database to manage project information from an overall perspective, comprehensively considering the sharing of data among various functional departments, reducing data redundancy, and ensuring data compatibility and consistency [3]. The important function of a management information system is to achieve informationization, standardization, flowability, and modernization of enterprise management, enabling real-time monitoring of project management. It achieves online management of progress, cost, quality, and risk, reducing losses caused by slow or inconsistent information flow, and improving decision-making speed and efficiency". The Data collection accuracy impact of AI is extended to many industries such as construction site monitoring. **(Korke et al., 2023)** "For the purpose of construction-site monitoring, drones and sensors are utilized to autonomously gather data and take pictures and videos regarding the construction status, environment, and progress. This is done with the intention to offer a broader overview of the construction location throughout every phase of the project without the involvement of human intervention. This is done in order to achieve the goal of providing a more comprehensive picture of the site. Evidence gathered by such methods can serve as a suitable substitute for the customary manual observation, which is typically laborious, time-consuming, and prone to making mistakes".

6.3.4 Enhancing data analysis and insights:

AI transforms data analysis by quickly processing vast datasets, identifying patterns, and generating actionable insights with high precision. AI enables more in-depth analysis that goes beyond traditional methods, uncovering trends and correlations that may not be immediately apparent. AI's ability to analyze unstructured data, such as text, images, and audio, broadens the scope of insights available to organizations. This enhanced analytical power allows for more informed, data-driven decisions, enabling businesses to respond proactively to market changes, optimize operations, and refine strategies across sectors like healthcare, finance, and project management. **(El Khatib & Al Falasi, 2021)** " Organizations are developing their capabilities to embrace AI in data collection, data management and utilize the data for better decision-making. UAE is highly dynamic in welcoming AI for a better purpose. The barriers that hold organizations in adapting AI for data collection and management can overcome through collaboration and proper planning. DERQ as an organization is a perfect example of how AI technology is thriving in the UAE market for using AI for data management and decision-making. In the future, AI will not be a choice but will be an integral part of their strategy for survival ". **Ong, (2020)**. "The three most common data analysis techniques that are commonly applied to assist project managers in making informed decisions are statistical analysis (e.g., regression, analysis of variance and covariance, scatter plots, pareto charts and t-test), time series analysis (e.g., single-equation regression and multi-equation simulation) and

probabilistic models (e.g., event history analysis, Markov chains and Systems dynamics modelling) (Nayab, 2019)” **(Sahadevan, 2023)** “ Unfortunately, many organizations struggle to utilize their data effectively. Advanced AI systems have brought about a significant improvement for development teams by allowing them to process a massive amount of data at an unprecedented pace, which yields valuable insights. These systems connect various subsystems such as marketing, engineering, sales, production, and finance, providing a comprehensive view of new products well before their official release”. **(Korke et al., 2023)** “Automation; The management of projects can become more technically automated and objective thanks to artificial intelligence. Conventional methods of construction management often rely on manual observation and operation, which is fraught with the potential for erroneous judgments and errors that are more complex. It has been shown that solutions based on AI can help overcome the many restrictions that relate to this type of construction management. For example, machine learning algorithms are use in order to intelligently learn from the vast amount of data that has been acquired for the purpose of uncovering previously unknown information”. **Ong, (2020)**. “With the applications of Data Science and Artificial Intelligence increasing in many industries, its impact will also significantly alter the landscape of projects. The future of Data Science is very optimistic. It is anticipated that, with the prevalence of data, an environment which fosters the development and growth of this field will be inevitable (Nellutla, 2018; Sanchez et al., 2019). Similar to other sectors, a large volume of data on projects and the management of projects is continuously being collected on a regular basis” **(Sahadevan, 2023)** “ Need for Artificial Intelligence in Information Technology, Artificial intelligence (AI) is now an essential requirement for modern businesses, transforming the field of information technology and offering benefits such as increased productivity, efficiency, and accuracy. Moving forward data analysis is one of the foremost basic requirements for AI in IT. With the enormous amounts of data delivered each day, physically analysing and extracting insights from it is getting to be progressively troublesome. Machine learning algorithms, natural language processing, and computer vision are examples of AI tools that can automate data processing, reducing the time and effort required to assess information. Businesses can utilize these tools to gain profitable experiences and make data-driven choices”. **(Mahmood et al., 2023)** “ Another advantage of using AI in project management is in risk management where risks exist and that can lead to the project failure, therefore, adopting AI in predicting risks through historical data analysis and issue logs can save effort, resources, cost, and identify possible project threats to plan for preventive actions or redevelop a better mitigation plan”. **Ong, (2020)**. “Data Science forms the foundation on which Artificial Intelligence processes are based. Existing techniques and applications from Data Science (such as data preparation, exploration, analysis and so on) in project management are mostly generalized in nature”. **Ong, (2020)**. “The reasons of utilizing artificial intelligence in project management information system are to help make better use of data and be more productive. For example, many companies like Amazon and Ocado are using artificial intelligence in managing their warehouses

and many other firms in examining legal documents and record through data analysis” **Weng, (2023)** “ In conclusion, a major challenge in applying ChatGPT to project management is ensuring that AI-driven solutions do not replace human judgment and decision-making. While AI generated insights can greatly enhance the decision-making process, project managers must strike a balance between relying on AI recommendations and leveraging their own expertise and intuition. To address this challenge, organizations should establish clear guidelines on the appropriate use of AI-generated insights in project management, emphasizing the importance of human judgment in the decision-making process. This will help ensure that AI-driven project management solutions are used as a valuable tool to support human decision-making, rather than supplanting it”. AI tools has a potential to analyze a massive amount of data accurately and quickly which can be used for various reason such as data collection and risk identification which give AI tools and advantage and a potential to enhance data analysis and insights.

6.3.5 Risk Identification Accuracy:

AI improves risk identification accuracy by using predictive models and data-driven algorithms to detect potential risks early and with greater precision. By analyzing historical data, patterns, and trends, AI can forecast likely risk scenarios and highlight anomalies that may signal emerging threats. In sectors like finance, healthcare, and project management, this enables proactive risk management, allowing teams to implement preventive measures and minimize disruptions. Overall, AI enhances both the speed and accuracy of risk identification, leading to more resilient and responsive operations. **(Alada, 2023)** “Risk management provides decision-makers a systematic approach to identify, assess, and mitigate risks. It also enables decision-makers to make more informed and effective decisions. However, within the decision-making perspective, the success in risk management process generally depends on human expertise and judgment [5]” **(El Khatib & Al Falasi, 2021)** “ The possibility of risk identification with the help of AI helps in making quality decisions. The risks and amount of data in an organization both increase with the size of the operation. The management of data collection and organization through AI can help reduce the risk”. **Mahmood (2023)** “Another advantage of using AI in project management is in risk management where risks exist and that can lead to the project failure, therefore, adopting AI in predicting risks through historical data analysis and issue logs can save effort, resources, cost, and identify possible project threats to plan for preventive actions or redevelop a better mitigation plan”. **Weng, (2023)** “ To mitigate these challenges, organizations should adopt a multi-layered approach that includes conducting thorough risk assessments, implementing robust security measures, and continuously monitoring and evaluating AI-generated outputs. Project managers should also work closely with their IT departments and cybersecurity teams to establish best practices and guidelines for using AI tools like ChatGPT. Additionally,

organizations should maintain transparency with their stakeholders about the use of AI and the measures taken to protect data privacy and security”. (El Khatib & Falasi, 2021) “ The Project managers clarified that in banks where the loan defaulters are high in number, it is essential to identify the types of customers who are in such category. The AI can help identify and notify the decision makers in advance for any such users. Organizations are developing their capabilities to embrace AI in data collection, data management and utilize the data for better decision-making. UAE is highly dynamic in welcoming AI for a better purpose. The barriers that hold organizations in adapting AI for data collection and management can overcome through collaboration and proper planning. DERQ as an organization is a perfect example of how AI technology is thriving in the UAE market for using AI for data management and decision-making. In the future, AI will not be a choice but will be an integral part of their strategy for survival”. (Korke et al., 2023) “ These insights can aid project managers in fast prioritizing potential risks and deciding proactive actions as opposed to reactive ones for the purpose of risk reduction. Streamlining operations on the job site, modifying employee arrangement, and ensuring that projects are completed on time and without exceeding their budget are some examples of proactive risk reduction efforts. To put it another way, artificial intelligence presents exciting potential for the achievement of early troubleshooting, which can contribute to the prevention of unfavourable failure and accidents in the intricate workflow. Additionally, robots can take over tasks that could be hazardous, hence reducing the amount of people that need to be involved in hazardous areas”. AI has the possibility to support many field in project management such as engineering, procurement and construction to uncover the uncertainties, (Korke et al., 2023) “ Artificial Intelligence in Construction Project Management: In the field of civil engineering, many issues, particularly in engineering design, construction management, and programme decision-making, were influenced by many uncertainties that could be solved not only by the need for mathematics, physics, and mechanics calculations, but also depend on the experience of practitioners. This was especially true for engineering design, construction management, and programme decision-making. For instance, when it comes to the design of engineering projects, the administration of construction projects, and the decision-making process for programming, many problems were influenced by various uncertainties”. Korke et al. 2023, stated that the uncertainty in construction project can not be solved with only the, rather than that, it depends on the experience of the practitioners, Korke again stated that all the said methods are not enough due to of lack of precision and he stated the need to AI to overcome such issues. (Korke et al., 2023) “This information and experience are not only illogically insufficient but also imprecise, and they cannot be handled using normal methods due to their lack of precision. Nevertheless, artificial intelligence possesses its own set of advantages. It can solve difficult issues to the levels of expertise of professionals by imitating the expertise of experts. Overall, the field of civil engineering is ripe with potential application areas for artificial intelligence's wide range of capabilities”. (Korke et al., 2023) “To learn data collected from the construction site, a variety of artificial intelligence methods, such as probabilistic

models, fuzzy theory, machine learning, neural networks, and others, have been applied with the goal to capture interdependencies of causes and accidents, measure the probability of failure occurrence, and evaluate the severity of the risk from both the qualitative and quantitative points of view. This was done in order to improve safety on the construction site”. **Tubman, (2022)** “ Artificial intelligence might not be in a position to replace judgments made by a human, mainly when focusing on the foreseeable future. Still, it shows a vital role in supporting humans. The negative impact and volume of information in an organization rise as the business grows. AI-assisted data collecting and organizing can help to mitigate uncertainties. The project manager explained that in financial sectors, including banks, where the number of loan nonpayers is significant, it is essential to classify the clients that fall into this category. For any such people, AI can assist in identifying and notifying policymakers in advance. Machine learning aids data analyses and may provide consultants with direction (Becker et al., 2018)”. **(Korke et al., 2023)** “Artificial Intelligence Methods are able to effectively overcome the limits of traditional risk analysis, such as the ambiguity and "vulnerability" that occurs from professional experience and subjective judgement. They are able to do this by using a combination of statistical modeling and simulation techniques. As a result of this, AI-based risk analysis has the potential to deliver helpful and predictive insights on significant issues.” **(El Khatib & Al Falasi, 2021)** ”The possibility of risk identification with the help of AI helps in making quality decisions. The risks and amount of data in an organization both increase with the size of the operation. The management of data collection and organization through AI can help reduce the risk. The Project managers clarified that in banks where the loan defaulters are high in number, it is essential to identify the types of customers who are in such category. The AI can help identify and notify the decision makers in advance for any such users”. The risk identification is different from one industry to another, when it comes to healthcare industry, Tubman (2022) explain it in a different way than other industries and his analysis resulted in that the healthcare industry is one area where Artificial Intelligence cannot, without a certain, take the place of humans. **Tubman, (2022)** “ For instance, how to start and navigate the project given certain limits and address the specific obstacles and risks to get the optimal results based on what has succeeded in previous tasks. In the healthcare industry, one example in which artificial intelligence is applied in making decisions whose objective is to manage risk. The implementation phase of projects in the healthcare system, for instance, is highly distinctive. There are additional layers of stakeholders that must approve each stage of the process. Project management in the healthcare sector involves individuals who might be taking care of a given patient, emphasizing the need for interpersonal language. **a).** For instance, a doctor relieved of command should advise the incoming doctor about a patient's current situation, which, if not done appropriately, may result in an undesirable decision. This is one area where Artificial Intelligence cannot, without a certain, take the place of humans. **b).** Projects cannot be late or over budget in a profession where patients' lives are at stake. Computer project management, a comparatively new technology, may be applied in building project strategies that can be altered and re-baselined around near-real-time

concerning the presentation of prior teams and the project's development. Tubman, (2022) stated that the modern project management solutions are unlike to healthcare industry, **Tubman, (2022)** “ Unlike modern project management solutions, AI can precisely forecast possible challenges based on preliminary information, decreasing risk. This comprises hazards associated with the project's employees, vendors, and companies. By merging the latest project data with historical data, cost assumptions and time restrictions may be assessed by running different scenarios and generating, evaluating, and ranking possible alternatives”. Another research is in agreement with Tubman, (2022) and stated that healthcare industry is unique and he refers to the same reason as Tubman (2022) that many layers of stakeholders needs to sign off on every step of the process and therefore, his study resulted to human to human communication is indispensable, **BELHARET, (2020)** “Risk Management, AI may not replace human judgment in the foreseeable future, but it is highly needed to support humans. In the healthcare industry, for example, the execution phase of projects is quite unique. There are more layers of stakeholders who need to sign off on every step of the process. Project management in the healthcare industry involves a lot of people who could be taking care of one particular patient which makes clear that human to human communication is indispensable. **(Korke et al., 2023)** “ Even when there is a large level of unpredictability in the environment, artificial intelligence is able to monitor, analyze, examine, and anticipate possible hazards in terms of safety, quality, efficiency, and cost across teams and work areas. This capability has gained widespread acceptance for the purpose of risk detection, assessment, and prioritization [17]”. Risk identification is one of the major opportunities AI tools are offering, returning back to historical data and find out a relative information to collect, analyze and take decision accordingly is a complex task which is impacted by time and cost, human will take more time and to do so, in contrast AI tools can do it with less time and without human being.

6.3.6 Saving Time for Project Manager (Operation Efficiency):

AI provides project managers with more time to focus on critical issues by automating repetitive and administrative tasks, such as scheduling, data entry, and basic reporting. Through AI-driven tools, AI takes over time-consuming tasks, freeing project managers to concentrate on high-level decision-making, risk mitigation, and team management. This shift allows managers to address complex project challenges more effectively, improve strategic planning, and engage more deeply with stakeholders, ultimately driving project success. **El Khatib & Al Falasi, (2021)** “PMIS is considered to be beneficial to project managers managing single and complex projects because it contributes to timelier decision making and project success (Raymond & Bergeron, 2008) “. **BELHARET, (2020)** “ While many of the daily tasks project managers perform can be automated through the use of AI, the true value behind Project Management Professionals lies in their ability to effectively mentor, guide, and communicate with other stakeholders. These are the higher-level skills where human interaction, sound and flexible judgment, empathy, and connection to teams and stakeholders need the “Human-ness” in order to be truly effective. Robots and

artificial intelligence may automate the tedious tasks that consume a small part of a project manager's time, such as taking information from multiple sources and putting together nice PowerPoint decks, focussing on proper messaging to the appropriate audience, and/or normalizing project data from incompatible systems. However, the most primary role of a project manager is leadership and communication.[6]" (**Korke et al., 2023**) "In order to facilitate automatic data analysis and decision making, these algorithms are also included into software that is used for project management. The insights that are obtained from such advanced analytics enable managers to gain a better understanding of the construction project, to formalize the tacit knowledge that has been gathered from previous project experiences, and to promptly recognize difficulties with the project in a data-driven manner [14]. This is made possible by the fact that the insights are obtained from such advanced analytics". **Weng. (2023)** "As AI continues to evolve and become more sophisticated, addressing data privacy and security challenges will remain a critical aspect of integrating AI tools like ChatGPT into project management. By taking proactive steps and adopting a security-first mindset, organizations can harness the potential of AI while safeguarding sensitive project data and maintaining the trust of stakeholders. Ultimately, this will enable project managers to leverage AI's benefits without compromising data privacy and security". **BELHARET, (2020)** " When it comes to project management team leaders, a primary advantage for AI devices, at least for now, is the fact that they can save time on busywork. A considerable amount of time is placed into record-keeping, recording, and various other remedial activities for most of the employees. This also makes the entire process more effective, which in effect will save time and budget expenses by allowing workers to concentrate on the tasks that really matter.[4]" **Khayyat M. & Alshaikhi A. (2021)**. "Project management gets insight and support into possible outcomes through the adoption of AI. This will help to boost decision-making quality. The system helps to eliminate unnecessary and redundant information. Project planning uses auto-scheduling to make the plan more robust. PwC paper, for instance, mentioned that they use task status and progress status, which can be tracked very easily. This helps to provide an alert for the project manager [A. Belharet et al., "Report on the Impact of Artificial Intelligence on Project Management", SSRN Electronic Journal, 2020. Available:10.2139/ssrn.3660689.]". **Khayyat M. & Alshaikhi A. (2021)**. "They tend to be highly educated and this will help them to adapt to the new waves of automation rather than being replaced with the machines they will remain to complement it. According to [B. Moore, "Gartner: AI to reduce project management workload", Itbrief.co.nz, 2021. [Online]. available:<https://itbrief.co.nz/story/gartner-ai-to-reduce-project-managementworkload>. [Accessed: 08- Nov- 2020].] 80% of daily work will be eliminated, such as data collecting, reporting and tracking by AI, as well as we will witness how the role of project managers will shift in order to integrate their skills and professionalism with AI capabilities into a new way of procedures and practices. Even more than that, transforming routine tasks to the machine will allow manpower to perform their ability to do other tasks that cannot be managed by AI". **BELHARET, (2020)** " Thanks to AI, PMs will be able to devote more time to strategic and tactical thinking and judgment since repetitive tasks and routines can be automated. This would mean that a PM will focus on more value-added activities". **BELHARET, (2020)** " Project

managers work in swamps of data – tasks, time estimates, priorities, milestones, capacity, workload, costs, and other digitized variables. Data is valuable only if it's broken down, analyzed, and refined. A possible way to unlock the value of project data is to apply a predictive model to it. • Predictive Analytics helps project managers analyze their projects under various scenarios and create simulations out of their programs and portfolios. • It helps project managers answer a vast range of “what-if” questions that predict the possible outcome of the project if something has to be changed. • Predictive Analytics that powers project forecasting software will instantly help them investigate the chain reaction and make decisions backed up by data when project management is under concern.[34]” **Ruiz, (2020)**. “In the future, AI will make all the decisions and will manage the resources in an optimal and timely manner, while the project manager will take the role of data scientist, working as part of a team with the AI to interpret the data and the decision making. Overall then, project managers will continue to play a crucial role when the AI is fully developed” **BELHARET, (2020)** “ Considering that AI acts as a project management’s ‘virtual partner’; project leaders must have an innovative mindset and customize their knowledge to drive this digital transformation forward. Having strong ‘digital know-how’ and data science skills is key, alongside security and privacy knowledge. The legal and regulatory knowledge to manage contracts is also important. AI and project managers will have to collaborate in the digital era”.

(Mahmood et al., 2023) “The use of Artificial Intelligence in constructing smart cities help to ensure infrastructure lifecycle management, operational management, and delivery performance align with the project portfolio and objectives. Due to its vital necessity because such projects considered complex as they contain big data that requires more attention from project managers. Therefore, project managers should be able to provide real-time information on cost, schedule, and risks to stakeholders and be able to track processes and workflows of the project. From smart cities perspectives and while managing such complex projects with variety of parameters, managers and planners should consider number of capabilities to ensure a successful project such as ease of use, accessibility of project information, and having an enterprise wide-view for a holistic view to ensure efficient portfolio management and be able to identify opportunities to help in decision making (Alshawabkeh et al., 2021; M. Alshurideh et al., 2022; Muhammad Turki Alshurideh et al., 2022d; T M Ghazal et al., 2023c). Having this amount of data can be a helpful asset in adopting AI for such projects”. **BELHARET, (2020)** “ As AI becomes more effective, project managers will rely on the decisions of the machines that: • Will advise future trends, • Automate time scheduling, • Respond to requests coming from superiors and staff. Such frameworks integrate with common collaboration tools such as Slack, as well as project management software such as JIRA to make it more effective when it comes to problem solving. Studies have shown that project managers spend more than half of their time on administrative tasks such as dealing with check-ins and managing updates”. **(Mahmood et al., 2023)** “ In most project activities and areas there is the availability of data that helps in using resources for decision making which can be seen in adopting the Internet of Things in smart cities development projects. The availability of connectivity led to the mass creation of data around the world and data became the most important source of a leading economy and innovation (Aljumah et

al., 2020; El Khatib and Ahmed, 2019)”. Project Managers need an efficient tool such as AI-driven tools to monitor and control the project efficiently, and therefore, equipping the project managers with the required tools to do their task will definitely save a lot of time rather than spending more time on the traditional tools. Ruiz, 2020 stated the limitation of the traditional tools, **Ruiz, (2020)** “AI tools are highly useful to the project manager in terms of controlling and monitoring the project; however, many of the reviewed models involve weaknesses and limitations, which indicates that project managers should continue to use their experience when making evaluations according to the results”. **(Mahmood et al., 2023)** “A report published by Smart Dubai stated that the amount of data created will be around 180 zettabytes by the year 2025 which is equal to a billion terabytes (I. A. Akour et al., 2022; Nuseir et al., 2021). The huge amount of data available will need to be interpreted and analyzed in order to help in making the decisions, therefore, artificial intelligence can be utilized as a tool for such role. An example of using big data can be seen in the city of Calgary in Canada where they developed a PI System to gather updated information about the city water system to be able to monitor it and take preventive actions against flood (Muhammad Turki Alshurideh et al., 2022b; Blooshi et al., 2023) as cities are being digitized using technologies and AI to analyze data allowed planners and decision makers to collect data and formulate suitable policies to help solve different kinds of issues”. **BELHARET, (2020)** “The following include ways AI adds value to the role of a Project Manager: • AI frees up time for project managers to focus on strategic-level goals and planning. • AI may appear to be a threat to job security, but it may instead increase the value that project management professionals can bring to the table. • AI helps companies achieve long-term objectives successfully by further solidifying the significance of roles by adding value to them “. **(Mahmood et al., 2023)** “From another perspective, how can big data and AI help in the development of smart cities? Smart Dubai can be used as an example to illustrate the creation of a Smart city using big data management. A smart City as defined by (M T Alshurideh et al., 2022; Nuseir et al., 2021) is not about technology but it is more like a set of complex interrelated city areas each with its own constraints and adoption possibilities”. **BELHARET, (2020)** “As awareness of the profession continues to increase, it is expected that a greater proportion of project work will earn more distinct attribution for the profession itself, giving more recognition and appreciation to the role of the project manager.[33]” **(Sahadevan, 2023)** “Managers may get insights into how projects are progressing, spot possible risks, and create strategies to reduce them with the use of AI-based project management approaches. AI may also help with resource scheduling, monitoring, and allocation to make sure projects are completed on schedule and under budget. By automating repetitive operations, spotting patterns and trends, and arriving at informed decisions, AI technology will continue to advance, enhancing productivity and efficiency in project management. Project managers may improve accuracy, optimize resource allocation, and streamline workflows by utilizing AI technology, which will result in effective project delivery and increased organizational competitiveness”. **BELHARET, (2020)** “The rise of virtual assistants will help project managers to stay up to date on trends in their industries and help them to recruit experts to bring even more value to projects. Recommendations are a very important and useful aspect of AI. Machine

learning algorithms are capable of giving recommendations on prioritising projects based on data from previous projects”. (**Mahmood et al., 2023**) “Dubai as well has developed an open and shared Data framework and a special department that is focusing on Data management as they believe that technologies should be fed with as much data as possible to reveal their real abilities (Aljumah et al., 2023). It can be observed from Smart Dubai that the available data alone and technology alone will not be sufficient, however, they should be combined as data should be interpreted and provided to technology to make better use of them and help in making decision regarding different areas in the city. **BELHARET, (2020)** “AI bots are capable of stepping up and handling these less intensive tasks for the project manager with current systems cutting time spent on busy work in half. This is a big time-saver, enabling project managers to: • Concentrate more on the dynamic processes behind their strategic management. • To focus more time on their employees, which in turn can help them empower their employees and find further efficiencies. • Such managers will concentrate more on what matters to them with the time saved using AI-enabled project management systems. • Make the work atmosphere more relaxed where workers feel valued and realize they have the necessary resources in place”. This is a great opportunities for project managers to utilize their time more serious tasks, unfortunately project Mangers spend a lot of time on coordination and administration, by utilizing AI tools for such coordination and administration activities can spare more time to project mangers to use it in complex tasks and decision making processes.

6.3.7 Effective Collaboration & Communication:

AI enhances collaboration and communication by streamlining information sharing, automating routine tasks, and improving access to real-time data across teams. Through tools like AI-powered chatbots, virtual assistants, and collaborative platforms, team members can stay connected, resolve issues faster, and communicate more effectively, regardless of location. In project management, for instance, AI tools provide real-time updates and insights, helping teams align their efforts and make informed decisions together. This improved flow of information fosters stronger teamwork, reduces misunderstandings, and supports more coordinated and efficient project execution. **Tubman, (2022)** “Collaboration is a cyclical process in which organizations or people share information, learn, and establish an agreement to achieve common goals. Individuals and organizations form partnerships during collaborative processes. A relationship's nature might change depending on how strong it is. Integrated relationships are businesses working together to achieve a similar purpose or acquire mutual advantages. They are characterized by trust and commitment. Collaboration between diverse actors is a major influential factor in project-based companies. Existing research on project actor collaboration focuses on customer-supplier relationships, all of which are aided by Artificial Intelligence”. **Weng, (2023)** “Project managers should be encouraged to question and validate AI-generated recommendations, fostering a culture of critical thinking and collaboration between human and AI-driven processes. By acknowledging and addressing these

ethical considerations, organizations can ensure that their use of AI in project management aligns with their values and commitment to ethical business practices”. **Tubman, (2022)** “ The strength of project collaboration and the ability to implement information is thought to be moderating variables in the relationship between cooperating triggers and collaboration results”. **(El Khatib & Al Falasi, 2021)** “ Organizations are developing their capabilities to embrace AI in data collection, data management and utilize the data for better decision-making. UAE is highly dynamic in welcoming AI for a better purpose. The barriers that hold organizations in adapting AI for data collection and management can overcome through collaboration and proper planning. DERQ as an organization is a perfect example of how AI technology is thriving in the UAE market for using AI for data management and decision-making. In the future, AI will not be a choice but will be an integral part of their strategy for survival”. **Weng. (2023)** “In addition to process automation and data analysis, AI can also enhance communication and collaboration within project teams. Tools like ChatGPT-4 can assist in drafting emails, creating reports, and even providing real-time language translation, thereby breaking down communication barriers and facilitating more effective teamwork. Overall, the integration of AI into project management practices has the potential to significantly enhance productivity and contribute to the successful completion of projects”. **Tubman, (2022)** “ Artificial intelligence improves information flow and removes communication barriers inside a group. A good organizational culture inside a project allows knowledge exchange and cross-border collaboration. It is impacted by the organization's rules, procedures, and reward and incentive structure, which determine the channels via which information flows and is incorporated. Individuals can self-organize their information and join peoples of practice to enhance problem-solving and communication sharing. Project organizational culture fosters individual interaction and collaboration to increase information flow”. **(Sahadevan, 2023)** “ Additionally, AI-powered tools may provide project managers with suggestions for corrective measures and effective communication with stakeholders, minimizing the impact of scope creep on project timelines and budgets. Managing expectations is key to project success. **Tubman, (2022)** “ AI engages and involves more people in decision-making processes by providing them with the ability to participate in the process online or through other forms of communication. This ensure that the decisions made are for the betterment of organizations. Furthermore, AI ensures cooperation quality play in multi-partner collaborative developments by providing decision-makers with the ability to interact and work with other parties cooperatively. AI can help reduce the chances of conflict and improve the overall quality of the project management system. Additionally, AI improves communication among these parts by providing decision-makers with the ability to access all relevant information. This ensures that decisions are made efficiently and effectively”. **Tubman, (2022)** “ Lastly, AI increase transparency and accountability in decision-making processes by providing decision-makers with the ability to access all relevant information. This can help to ensure that decisions are made based on accurate information and without bias”. We tend to agree to the AI tools potential to enhance collaboration and communication, since AI is able to

provide project managers with the corrective measures and suggestion for the better communication based on the previous historical data, it's then possible for AI tools to enhance collaboration and communication.

7. Literature Review & Hypotheses Development

7.1 Literature Review:

7.1.1 Studies related to project Management utilizing Artificial Intelligence:

Müller et al. (2024) conducted a study titled "Artificial Intelligence and Project Management: Empirical Overview, State of the Art, and Guidelines for Future Research," which aimed to provide a comprehensive empirical assessment of AI adoption in project management. Drawing from a global survey of 2,314 professionals across 129 countries, the study offers valuable insights into the current state of AI utilization and its transformative influence on project management practices. Key areas where AI has shown to enhance efficiency, accuracy, and decision-making include data collection and reporting, performance monitoring, and project scheduling and time management. The study further highlighted a significant skills gap, as 62% of participants rated their companies below average in terms of AI training support, while 65% of professionals possessed only basic AI knowledge. This finding underscores the critical need for more robust training initiatives and targeted research on effective AI training methods within the project management industry. In contrast, the current study expands on Müller et al.'s work by focusing specifically on AI integration within Saudi engineering projects, examining both organizational and regulatory factors unique to the region. While Müller et al. emphasize global adoption trends and general efficiency improvements, this study explores AI's role in advancing project management in Saudi Arabia, considering factors such as regional training needs, infrastructure, and regulatory constraints.

Al-Shehri et al. reached to (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.

Weng conducted a study (Weng, 2023) titled "Putting Intellectual Robots to Work: Implementing Generative AI Tools in Project Management," with the objective of providing a comprehensive guide for project managers on the effective use of ChatGPT in their project management practices. The study highlights both the advantages and challenges of integrating ChatGPT, focusing on critical areas such as data privacy, security, ethical implications, adoption barriers, and change management. Weng's findings identified several key areas for future improvements in ChatGPT's capabilities, including better integration with project management methodologies (e.g., Agile, Kanban), opportunities for customized development, and enhanced training and support for non-technical staff. The current study differs from Weng's research in its focus on identifying the factors affecting project management through AI in industrial engineering projects, proposing a unique model and methodology within specific spatial boundaries. The current study differs from Weng's research in its focus on identifying the factors affecting project management through AI in industrial engineering projects, proposing a unique model and methodology within specific spatial boundaries. Sahadevan reached to (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.

Sahadevan reached to (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.

Taboada et al. reached to (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 tools 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 tools. 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.

Wang reached to (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 tool 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 tools 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 tool, the current study aims to integrate AI into project management and examine the influencing factors.

Savio & Ali reached to (Savio & Ali. 2023) titled "Artificial Intelligence in Project Management & Its Future," the research explores the current tools 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 tools 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.

Fridgeirsson et al. reached to (Fridgeirsson 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 affect 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 Fridgeirsson et al.'s study in both methodology and the scope of AI tools. While Fridgeirsson 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.

Kork conducted a study (Kork et al., 2023) titled "*Role of Artificial Intelligence in Construction Project Management*," aiming to investigate AI's impact on improving construction project outcomes through optimization, risk management, and automation. The study examines AI applications such as process mining, computer vision, and AI-driven robotics to enhance efficiency and mitigate risks

on construction sites. It highlights AI's potential to automate repetitive tasks, perform real-time project monitoring, and apply predictive insights for early-stage problem-solving, ultimately reducing time, cost, and safety risks in construction management. The current study differs from Kork's in its focus on AI integration within Saudi Arabia's industrial engineering sector, specifically in understanding factors affecting AI adoption. While Kork et al. emphasize AI's transformative potential for construction management, the current study explores AI's impact on broader project management practices in engineering, identifying unique challenges and opportunities within a specific regional context.

Mahmood et al. conducted a study (Mahmood et al., 2023) titled "How Artificial Intelligence can Leverage Project Management Information System (PMIS) and Data-Driven Decision Making in Project Management" with the objective of exploring AI's potential to enhance PMIS functions and support data-driven decisions within project management. The study utilized a qualitative approach, including case studies and interviews with Smart Dubai, to examine AI's role in integrating big data, improving project phase management, and enhancing decision-making processes. Results highlighted AI's ability to enable faster, more accurate decisions by automating data analysis, facilitating real-time adjustments, and supporting project managers in critical planning and execution phases, especially as projects in smart cities grow in complexity. The current study differs from Mahmood et al.'s by focusing on AI adoption within Saudi engineering projects, investigating broader adoption dynamics such as cultural readiness, infrastructure maturity, and organizational strategy. While Mahmood et al. concentrated on how AI strengthens PMIS functionality and data handling, the current study examines how these systems can be adapted to Saudi project management settings, considering regional and sector-specific challenges that influence AI implementation beyond technical integration alone.

Tayibe Seyman-Güray reached to (Seyman-Güray, 2023) titled "Investigating AI Applications in Construction Industry: A Systematic Review," the goal was to explore the potential of AI tools in addressing labor, resource allocation, and planning issues in the construction industry. The study highlights AI's transformative impact on construction by improving data accuracy, enhancing project workflows, and optimizing labor allocation strategies. It also identifies challenges such as resistance to technology adoption, high implementation costs, and skill deficits. The study emphasizes the need for improved training programs and compatibility with older systems. The current study differs from Seyman-Güray's in its focus on industry-specific challenges, objectives, spatial scope, and methodology.

Bento conducted a study (Bento et al., 2022) titled "Artificial Intelligence in Project Management: Systematic Literature Review," with the goal of identifying the potential benefits and limitations of AI in project management through a systematic literature review. The study provides organizations with practical insights on leveraging AI, highlighting guidelines on advantages, challenges, tools, and technologies to aid AI implementation in project management. Findings suggest that AI is effective in optimizing rule-based tasks like scheduling and risk assessment but remains less suitable for areas requiring empathy, such as human resource management. The current study differs from Bento's in its focus on

integrating AI within project management practices specific to engineering firms in Saudi Arabia, with unique objectives, spatial boundaries, and methodological approach.

Maphosa & Maphosa, (2022) conducted a bibliometric analysis titled 'Artificial Intelligence in Project Management Research: A Bibliometric Analysis,' to explore AI applications in PM, focusing on trends, research hotspots, and challenges. The study identified gaps in AI's adoption in PM, such as limited integration in developing regions and the lack of proactive AI tools for 'what-if' analysis. Unlike other studies, this work provided a systematic mapping of global trends in AI-PM research. The current study diverges from Maphosa and Maphosa work by focusing specifically on the factors influencing AI adoption within Saudi engineering projects. While Todorovic focusing on trends, research hotspots, and challenges. The study identified gaps in AI's adoption in PM, such as limited integration in developing regions and the lack of proactive AI tools for 'what-if' analysis. Unlike other studies, this work provided a systematic mapping of global trends in AI-PM research

Sheoraj and Sungku reached to (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 tools. 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.

Tubman conducted a study (Tubman, 2022) titled "The Use of Artificial Intelligence in International Decision-Making Processes in Project Management," aiming to explore how AI enhances decision-making and collaboration across global project management. Using case studies of ten major companies, the research identified that AI improves data quality, enables more accurate decision-making, and fosters efficient cross-team collaboration by enhancing data accessibility and transparency. Despite AI's potential, challenges such as data quality issues, the need for skilled human oversight, and organizational resistance remain significant. The current study diverges from Tubman's work by focusing specifically on the adoption of AI within the Saudi industrial engineering sector, examining the unique factors that affect AI implementation in project management. Tubman's study broadly addresses the role of AI in global collaboration and decision-making, whereas the current study narrows its scope to

regional challenges, such as skills shortages and infrastructure limitations, within Saudi project management.

El Khatib and Al Falasi examined (El Khatib & Al Falasi, 2021) "Effects of Artificial Intelligence on Decision Making in Project Management" with the objective of understanding how AI impacts decision-making processes in project management, focusing specifically on data quality, integrity, and volume. Their study analyzed both primary and secondary data, concluding that AI improves data quality and integrity, which in turn enhances the speed and accuracy of decision-making in single and multi-project environments. The current study differs from El Khatib and Al Falasi's research in its aim to investigate the integration of AI in project management within Saudi Arabia's industrial engineering sector. While El Khatib and Al Falasi focused on AI's impact on decision-making, the current study assesses factors influencing AI adoption and its effects on project outcomes, providing a different perspective on AI's role in enhancing project management practices.

Fridgeirsson conducted a study (Fridgeirsson et al., 2021) titled "An Authoritative Study on the Near Future Effect of Artificial Intelligence on Project Management Knowledge Areas," with the objective of examining how AI might impact the 10 knowledge areas in project management as outlined by the Project Management Body of Knowledge (PMBOK). The study used a quantitative, cross-sectional method to assess expert insights, finding that AI is expected to have the most significant effects on cost management, schedule management, and risk management, while having minimal impact on stakeholder management and processes requiring human leadership. The current study differs from Fridgeirsson's research in its focus on exploring the integration of AI within Saudi Arabia's industrial engineering sector, with unique objectives, a different model, and spatial boundaries specific to the region's engineering challenges.

Khayyat and Alshaikhi conducted a study (Khayyat & Alshaikhi, 2021) titled *"An Investigation into the Impact of Artificial Intelligence on the Future of Project Management,"* aiming to assess AI's potential in automating project management tasks and the implications for human roles. The study finds that while AI can automate certain project tasks, it cannot replace human expertise entirely. Human involvement remains essential for operating, guiding, and monitoring AI tools due to limitations in data quality, technical integration, and the complexity of project management decision-making. The current study diverges from Khayyat and Alshaikhi's research by focusing on the factors influencing AI adoption specifically within Saudi Arabia's industrial engineering projects. While Khayyat and Alshaikhi emphasize AI's impact on reducing human resource dependency, the current study explores AI's integration and its broader impact on project outcomes and operational efficiency within the industrial sector.

Todorovic conducted a study (Todorovic, 2021) titled "A Framework for Leveraging Artificial Intelligence in Project Management," aiming to explore how AI can enhance project management efficiency by reducing administrative workload and improving resource optimization through predictive analytics. The study utilized both a literature review and case study to examine the impact of AI applications, such as machine learning and NLP-powered chatbots, in

streamlining project management processes. Key findings indicate that AI integration can improve project timelines and resource allocation but is limited by existing skill gaps and inadequate technological support. The current study diverges from Todorovic's work by focusing specifically on the factors influencing AI adoption within Saudi engineering projects. While Todorovic addresses general efficiency improvements and predictive capabilities of AI, the current study evaluates additional regional barriers and enablers, such as regulatory and economic factors, to create a more comprehensive framework for successful AI implementation in Saudi Arabia's construction and engineering sectors.

Allal-Chérif et al. (2020) conducted a study titled "Intelligent Purchasing: How Artificial Intelligence Can Redefine the Purchasing Function" to analyze AI's influence on purchasing, including its role in decision-making, supplier management, and collaboration. The study identifies gaps, such as limited data exploitation and resistance to change, while highlighting AI's transformative potential for strategic innovation. Unlike other research focusing broadly on AI's impact, this study narrows down its scope to purchasing functions, providing practical insights into AI's role in redefining organizational interfaces. The current study diverges from Allal-Chérif et al. (2020) work by focusing specifically on the factors influencing AI adoption within Saudi engineering projects.

Belharet et al. conducted a study (Belharet et al., 2020) titled "Report on the Impact of Artificial Intelligence on Project Management," with the objective of exploring AI's potential to enhance project management through improvements in resource allocation, risk management, and automation of routine tasks. The study identified that AI can significantly optimize project efficiency by automating data processing and predictive analytics, which allows project managers to focus more on strategic decision-making. However, Belharet et al. noted that AI cannot fully replace human intuition, especially in creative and team-oriented tasks, and that data quality and integration challenges remain substantial barriers. The current study differs from Belharet et al.'s by specifically examining the adoption of AI in project management within Saudi engineering projects, focusing on factors that influence AI implementation in this regional and industry-specific context. While Belharet et al.'s study emphasizes AI's functional contributions to project management efficiency, the current study seeks to understand broader adoption dynamics, including organizational readiness and cultural acceptance of AI, extending beyond operational benefits to include strategic and contextual considerations in Saudi Arabia's engineering sector.

Bodea et al. conducted a study (Bodea et al., 2020) titled "*Artificial Intelligence Adoption in Project Management*" with the objective of identifying primary motivations for adopting AI within project management. Their survey of project management professionals found that over half of respondents highlighted increased productivity (53%), enhanced decision-making capabilities (52%), and improved project performance and reporting (51%) as the top drivers for AI adoption. Respondents emphasized the strategic advantage of AI, noting that automation can free up time for managers to concentrate on higher-level strategic tasks. The current study expands upon Bodea et al.'s work by examining AI adoption specifically within Saudi engineering projects, addressing both the

motivating factors and unique regional challenges affecting AI integration. While Bodea et al. focused on general productivity and decision-support advantages of AI, the current study investigates broader adoption barriers and facilitators in the Saudi context, including regulatory, economic, and cultural factors that influence how AI adoption impacts project management strategies in engineering-focused environments.

Elmousalami conducted a study (Elmousalami, 2020) titled "Comparison of Artificial Intelligence Techniques for Project Conceptual Cost Prediction," with the objective of evaluating 20 AI techniques for their effectiveness in predicting conceptual project costs. The study found that XGBoost, an ensemble method, was the most accurate for cost predictions, achieving a mean absolute percentage error (MAPE) of 9.091% and an adjusted R^2 of 0.929. The research highlighted ensemble methods' capability to improve prediction accuracy and handle data inconsistencies, despite limitations in interpretability. The current study differs from Elmousalami's by focusing on AI's broader impacts on project management in Saudi engineering projects, aiming to understand factors that influence AI adoption beyond cost prediction. Elmousalami's research emphasizes comparative performance among AI models, while the current study expands to analyze AI's potential in various project management functions, including scheduling, risk management, and decision-making.

Ong and Uddin conducted a study (Ong & Uddin, 2020) titled "*Data Science and Artificial Intelligence in Project Management: The Past, Present, and Future*," aiming to explore AI's applications in project management, from risk management to resource optimization and KPI tracking. Their study highlights the transformative role of AI in automating complex project tasks and discusses how future developments may lead to new roles in data science while traditional roles are increasingly replaced by AI-driven solutions. The current study differs from Ong and Uddin's research in its focus on assessing the factors that influence AI adoption in Saudi Arabia's industrial engineering projects. While Ong and Uddin provide an overview of AI applications and their implications, the current study targets AI's integration and its impact on project management outcomes within a specific industry and geographic context.

Ruiz conducted a study (Ruiz et al., 2020) titled "The Application of Artificial Intelligence in Project Management Research; A Review," aiming to explore emerging AI techniques in project management and identify the most effective methods for ensuring project success. The study reviews various AI applications, highlighting the benefits AI offers to project managers in areas such as project monitoring and control. However, it notes that many AI models have limitations, suggesting that project managers should still rely on their expertise alongside AI tools. The study forecasts a future where AI will manage resources and decision-making, while project managers will take on data scientist roles to interpret AI-driven insights. The current study diverges from Ruiz's research in its specific focus on identifying factors that impact project management through AI in industrial engineering projects, using a different proposed model, geographic focus, and applied methodology.

Blinder reached to (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.

Waqar reached to (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 tools. 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.

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2. Appendices

