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Artificial intelligence and project management maturity: A study of selected project-based organizations in Pakistan

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ABSTRACT

Artificial intelligence (AI) is significantly impacting modern project management (PM) nowadays, especially as it begins to be integrated into business applications. This study focused on evaluating the readiness for AI implementation and the maturity level of PM in selected project-oriented organizations in Pakistan. Data from 12 such organizations were gathered through focus groups to examine the status of AI readiness and PM maturity and to explore their association. The methods used included exploratory data analysis and research on extreme cases. The findings indicated that AI readiness was relatively high in areas of governance and legal aspects but lower in solution development. Conversely, PM maturity was found to be higher in PM but less developed in program and portfolio management. Analysis of extreme cases suggested a positive relationship between AI readiness and PM maturity, supporting the idea that AI can enhance PM. These findings are crucial both for theoretical understanding and practical application.

1. Introduction

Contemporary businesses are deploying and utilizing technology to enhance efficiency, effectiveness, and quality in their products/services, processes, management systems, projects, and relational mechanisms. Consequently, the integration of human competencies with technological systems has led to improved performance (Singh et al., 2023). This integration has also extended to the discipline of project management (PM).

One of the most dramatic developments that has influenced the discipline of PM is artificial intelligence (AI), which provides several new tools and techniques to escalate efficiency and effectiveness within ever-changing business environments, and the modern PM environment is no exception. The use of AI applications is increasing rapidly in PM due to the rapid developments of new technologies, and this trend will constantly escalate in the future. AI integration in PM has created a smart environment like a "smart PM monitoring system."

AI can transform many aspects of PM, from automating general administration to analytical-driven risk identifications and estimations, powering project planning, and providing action-oriented recommendations (Dam et al., 2019). For instance, agile methodology, which is a prominent PM methodology, can be transformed and implemented in its true sense. Similarly, project planning that involves work breakdown structure (WBS) can be altered into mind maps, and relations between various tasks/activities can be established automatically. IT tools can help project managers manage and handle various aspects of projects. These tools can assist project managers in effectively engaging with stakeholders and project teams and providing good and flexible judgment (Victor, 2023). AI reduces the pressure and burden on project managers by the use of machines. Project managers can obtain accurate results because the tasks performed by the machines are usually free of errors

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and mistakes (Wamba-Taguimdje et al., 2020). AI also assists in strategizing the project managers. For instance, AI tools can recommend other courses of action or alternative ways to handle complex projects in uncertain environments. These tools can also enhance the creativity and productivity of project teams through emotional intelligence.

Nevertheless, the maturity aspect of the PM is crucial to ensure that all other aspects are being managed properly by giving due importance to the other aspects. PM maturity essentially deals with process evolution and is considered an effective way to keep track of how effectively strategies, processes, and decision-making mechanisms are being implemented. The maturity of an organization can be different from other organizations depending on the industry, strategy, available resources, scope of the projects, and short-term and long-term objectives (Crawford, 2021). Various organizations take various measures to improve their PM maturity. One of the ways to improve PM maturity is the use of AI, which can enhance existing competencies (Skinner, 2021).

Although prior literature provides many valuable contributions regarding the use of AI to enhance PM maturity, it still lacks in several aspects. For instance, the use of AI and its applications for improving PM maturity is a specific area that has not been deeply looked at and remains largely unexplored (Skinner, 2021). Although the integration of AI in businesses leads toward improved PM and enhances PM maturity (Victor, 2023; Skinner, 2022; Skinner, 2021), PM is still young in the field of AI and needs more and more work to achieve its fundamental objectives (Alshaikhi and Khayyat, 2021). Moreover, the majority of the prior AI assessment tools emphasized strategy, data, technology, processes, and people aspects related to AI (Sadiq et al., 2021). However, governance, legal, and security aspects related to AI need further investigation (Park et al., 2021). More importantly, Pakistan is developing as a significant market in AI-based solutions (Khan et al., 2022). However, Pakistan is lagging behind the world in AI usage and reaping the economic benefits of AI. The usage of AI and its applications in PM are especially in the early stages in Pakistan. As a result, the current state of AI readiness and PM maturity in Pakistan is not well-known or understood. Previous studies on the relationship between AI and PM have been conducted in organizations with sufficient knowledge, expertise, skills, and resources (Skinner, 2021; Fridgeirsson et al., 2021). However, very little research has been done in developing countries, where technological development is low due to a lack of knowledge, skills, expertise, and resources. Project-based organizations in Pakistan have not been studied. Moreover, the association between AI and PM maturity has not been fully grasped in the prior literature. Only a very few studies have strived to investigate this association (Skinner, 2021). Thus, empirical research is required to fully comprehend the association between the AI implementation readiness status and PM maturity. The study fulfilled the aforementioned research gaps by investigating the following research questions through a standard paradigm of empirical research:

Q1: What is the AI implementation readiness status in the project-based organization in Pakistan?
Q2: What is the PM maturity level in the project-based organization in Pakistan?
Q3: Is there an association between the AI implementation readiness status and PM maturity in the project-based organization in Pakistan?

Project-based organizations are selected due to the following reasons: 1) these organizations are ahead in implementing new and emerging technologies as compared to organizations with functional and mixed organizational hierarchy, 2) most project-based organizations belong to the private sector, which are more open to embrace new technologies and innovative opportunities due to their competitive nature. Data were gathered through focus groups in the selected organizations. Exploratory data analysis and extreme case research were performed to answer the aforementioned research questions. The existing state of AI implementation readiness status and PM maturity level in project-based organizations in Pakistan is needed to determine the possibility of further research regarding the impact of various perspectives of AI adoption and utilization on PM maturity enhancement in this context.

The next section presents the literature review and theoretical background, followed by the methodology and the results. The conclusion is given in the last section.

2. Literature review and theoretical background

2.1. PM maturity

Organizations have been using various tools, techniques, and methods for PM over many decades. Over the last two decades, PM has become a diverse field using applications of its knowledge domain. Various methodologies and standards of PM, program, and portfolio management have been developed and are being used worldwide in government, private, and non-profit organizations. PM knowledge, applications, and research have evolved from a variety of disciplines, including management sciences, management information systems, construction engineering, system engineering, etc., to achieve success (Locatelli et al., 2023). Nowadays, almost one-fourth of the world's economic activities are being performed and managed in the form of projects and programs for capital formation, and even trends are rising more in developing and emerging economies than in developed economies (Sijabat, 2022). Consequently, many organizations are altering their functional hierarchies into project-based hierarchies.

However, the success of PM mappings with organizational competencies, systems, culture, and

environment is determined through the organizational maturity in PM, which is usually termed PM maturity. The term maturity is defined as "the level of an organization's ability to deliver the desired strategic outcomes in a predictable, controllable, and reliable manner" (Machado et al., 2021). To enhance this organizational ability, numerous PM maturity models have been developed. These maturity models emphasize determining essential steps, processes, and tasks required to obtain measurable and meaningful results. PM maturity models usually provide a framework or standards to improve business results through the assessment of merits and demerits in PM. Gan and Chin (2018) argued that PM maturity models are instruments to quantify the organizational abilities and capabilities for managing projects successfully. These models help organizations benchmark their strategies, abilities, competencies, systems, and processes with other identical organizations. Mullaly (2014) advocated that maturity models improve organizational processes and systems. Anantatmula and Rad (2018) believe that PM maturity helps organizations achieve PM excellence. A typical approach to assessing PM maturity starts with assessing existing processes and practices. Subsequently, benchmarking is performed to compare PM capabilities. Finally, PM capabilities are enhanced to the next level of maturity and so on (Jamaluddin et al., 2010). Thus, PM maturity models are vital for developing, tracking, and ensuring the efficiency and effectiveness of the projects.

2.2. AI

AI can be defined as "the capability of a machine to imitate intelligent human behavior" (Mintz and Brodie, 2019). The main purpose of AI adoption and implementation is learning, reasoning, and perceptions that make AI rationalize and take action to achieve goals (Haenlein and Kaplan, 2019). AI has tremendous potential to think and solve problems like human beings but with more accuracy and speed than human beings. The basic concept of how AI makes machines and computers think like human beings and perform various tasks consists of two sub-concepts: machine learning and deep learning (Jakhar and Kaur, 2019). Machine learning involves how algorithms improve through experience. This sub-concept encompasses various issues like collection and analysis of the data, training algorithms, or utilization of algorithms to predict the future. Deep learning involves layers of neural networks. These layers are reinvigorated by the human brain. Every neural, similar to the human brain, transfers a signal to other connected neutrals and so on. The major difference between machine learning and deep learning is that in machine learning, the algorithm has particular characteristics to be evaluated, whereas in deep learning, the algorithm has raw data and determines the important characteristics for itself. Nevertheless, AI is a disruptive technology that radically alters the traditional methods of work in organizations (Gentsch, 2018). Many researchers advocated that AI can deal with data uncertainty to solve many industrial and engineering issues (Peng et al., 2019). AI produces multidimensional knowledge because many technologies are highly relevant to AI, such as computer vision, processing models, natural language, machine learning, machine reasoning, and deep learning (Dahlan, 2018). AI provides many benefits, including reliability, cost-effectiveness, and certainty in solving various issues (Garg and Sharma, 2021). Due to escalating information assistance in organizations and the need to assess and predict future values, a lot of organizations are adopting and implementing AI to enhance their abilities. AI provides a competitive advantage to organizations that overshined their competitors in the marketplace and adds value by increasing organizational performance and effectiveness (Zhang et al., 2020). AI implementation should be evaluated continuously using well-established standards and procedures to ensure that organizational objectives and goals are being achieved.

2.3. AI and PM maturity

In the past, the application of AI was mainly restricted to academic research and development only. Nowadays, AI is continuously implemented in various types of industries due to the escalating emergence of computer technologies in modern businesses. Many tasks that project managers perform on a day-to-day basis can be automated through AI. AI can automate tedious tasks more efficiently and simply, which saves project managers' time, and can collect data from multiple sources and incompatible systems more efficiently and correctly. This has changed the role of the project manager as a leader and communicator rather than a performer of routine tasks (Pan and Zhang, 2021). Through the adoption of AI, PM can obtain support and insight into desired outcomes. AI provides support for quality decision-making, and its implementation makes it possible to eradicate unrequired and duplicate data and information. AI systems help in project planning by using auto-scheduling, which makes the plans more robust and sound. These systems utilize progress and task status, which are very easy to track, and they provide alerts to project managers (Alshaikhi and Khayyat, 2021). The adoption and implementation of AI facilitate many other project planning tools to help project managers and project stakeholders. For example, hybrid computers are capable of performing various procedural and knowledge-processing techniques, such as decision analysis and network-based scheduling, which enable project managers to set objectives and control projects. Machine learning and predictive analytics positively impact project outcomes through key performance indicators (KPIs), as well as resource estimation and estimation management. El Khatib and Al Falasi (2021) argued that modern PM techniques like agile and continuous

allied help overcome uncertainties. Many project aspects like task and staff scheduling, risk management, scheduling, resource assignments, and budget management can be done through AI. Some other aspects of AI can be applied in PM. Many PM tasks are time-consuming and can be automated easily and performed through AI. For instance, the lessons learned from previous projects can be reviewed for targeted project stages more easily and quickly. The past estimates can be analyzed to predict future estimates more quickly and accurately. The potential risks, changes, and actions can easily be identified by scanning project documentation, email, and collaborations. Current risk management plans can be improved through the analysis of previous risk management activities. Suggestions can be made by looking into the patterns of previous delays. Smart recommendations can be made to assign skilled and more relevant resources to particular activities to ensure the project's success. No doubt, when decisions- are made based on evidence-based data, then results are credible. Putting projects correctly in the very beginning is an excellent strategy that leads to successful project completion.

This is a general perception that organizations that utilize AI systems, tools, and applications have higher PM maturity. For instance, Skinner (2021) found a positive relationship between AI and PM maturity. He further described that the organizations with lower PM maturity, i.e., level 1 do not apply AI in PM and conversely, the organizations with higher maturity, i.e., level 5, considerably apply AI in PM. In other words, the organizations with lower maturity levels apply AI at a very basic level, whereas the organizations with lower maturity levels apply AI at an advanced level. Organizations with higher PM maturity gather actionable insights, analyze data, and develop an understanding of how to apply AI in PM.

3. Methodology

3.1. Research method

As the research in the domain of AI implementations and its association with PM maturity is in its initial stages and currently fewer theoretical models have been developed through which we can proceed, this study is exploratory instead of hypothesis testing. Through this exploratory research, we want to contribute by providing a basis for future research. Exploratory studies are usually built on secondary research such as available and published data and/or literature, qualitative approaches like informal discussions with the management, employees, customers, competitors, etc., and formal approaches like in-depth interviews, case studies, focus groups, etc.

The objective of this study is to determine the AI implementation readiness status and PM maturity level and their association with the selected project-based organizations in Pakistan. Therefore, the case study research method could be the best approach to investigate the AI implementation readiness status and PM maturity level and their association in this context. Case study is a frequently applied method for status and maturity-related assessments. However, due to the diversity of project-based organizations in Pakistan, a multi-case study approach better serves the purpose. This approach improves confidence in the results and the possibility of replication of the results (Yin, 2014). Results acquired through a multi-case study approach are more convincing than a single case study (Oates et al., 2022). Thus, we adopted a multi-case study approach for this study.

3.2. Selection of the organizations

The preliminary list of the project-based organizations was obtained from the directories of the Securities and Exchange Commission of Pakistan (SECP), Pakistan Engineering Council (PEC), and Pakistan Software Export Board (PSEB). The first two are regulatory bodies, and the third one is an apex government body mandated to promote Pakistan's IT Industry in local and international markets. The directories of these regulatory bodies provided the names and contacts of the organizations. The selection criteria were that the organization must have AI function in the organization, must have a formal PM office (PMO), must have better AI and PM processes, adequate level of AI and PM infrastructure, sufficient use of AI and PM applications, and experienced AI and PM personnel. Based on the selection criteria, a total of 12 project-based organizations were selected for this study. Other project-based organizations which did not fulfill the selection criteria were excluded from the study.

3.3. The instrument

The tool to assess AI implementation readiness status in the organizations was RFD BUS012A AI assessment tool of US Pennsylvania Office of Administration†. This tool estimates AI implementation readiness status in six areas including “business”, “architecture and technical”, “solution development”, “security”, “legal”, and “governance”. Each area is assessed by 2-3 statements on a level of 0, 3, 5, and 7 (where “0 = elements/conditions do not exist, 3 = some elements/conditions exist, 5 = most elements/conditions exist, 7= all elements/conditions exist”). The tool to measure PM maturity in organizations was adapted from Andersen and Jessen (2007). This tool assesses PM maturity in three areas i.e., project, program, and portfolio management. All these three areas were assessed through 12 statements each on a maturity level from 1 to 5 (where “1 = ad hoc practices, 2 = some practices, 3 = consistent practices, 4=

† https://www.oa.pa.gov/Policies/Documents/rfd_bus012a.xlsx

integrated practices, 5 = continually improving practices") defined by Thomas and Mullaly (2008).

3.4. Data collection

The data were gathered using focus groups. Donaldson and Koepke (2022) argued that focus groups enhance the apparent validity and reliability of data and help in reaching consensus and generating new ideas. Senior managers and heads in the selected project-based organizations organized the focus groups and their sessions. Each focus group consisted of five to seven participants, including both AI and PM professionals. These groups discussed and reached consensus on the readiness for AI implementation and the level of PM maturity in their organizations. This approach provided triangulation, which means collecting data from multiple sources to minimize bias. The focus group members included director generals, program directors and managers, project directors and managers, project officers and coordinators, and project team members and users. Before the sessions, each focus group was briefed about the study's purpose, and they received a presentation on the AI implementation readiness and PM maturity level questionnaires. Most members understood the six areas of the AI readiness assessment and the three areas of the PM maturity assessment and their scores, although some initially had confusion. Their questions were clarified with examples, analogies, and explanations. The questionnaires were distributed to the focus groups well before the sessions began.

A case study protocol was developed based on Yin's (2014) guidelines. Each focus group was asked to evaluate the readiness for AI implementation and PM maturity in their organizations using the questionnaire statements. Two researchers observed each focus group session. If a focus group gave a high score for AI readiness or PM maturity, the researchers asked for documented proof. If proof was not provided, the researchers referred to documents they had already obtained from the organization or its website and requested the group to adjust the score accordingly. Each session lasted 2-3 hours. To ensure validity, the researchers also reviewed organizational documents such as business policies, strategies, plans, procedures, archival records, and performance reports.

3.5. Data analysis

The AI implementation readiness status and PM maturity level of the selected case study organizations were analyzed through exploratory data analysis. For this, the collected data were analyzed using the AI implementation assessment tool, PM maturity assessment tool, and SPSS software. The SPSS software was applied due to its ability to conduct exploratory data analysis and provide results in figures, tables, and graphs. However, the association between AI implementation readiness status and PM maturity was analyzed through extreme case research. For this, we selected extreme cases based on the PM maturity level of the selected project-based organizations, Flyvbjerg (2006) argued that extreme cases research is remarkably helpful "to obtain information on unusual cases, which can be especially problematic or especially good in a more closely defined sense." The two project-based organizations with the highest PM maturity and the two organizations with the lowest PM maturity were selected for further analysis of case study organizations. Four organizations are sufficient for in-depth cross-case analysis because it is hard to develop a theory with less than four organizations, and difficult to manage the complexity and volume of data with more than ten organizations (Eisenhardt, 1989). Consequently, a comparison was made between two higher- and lower-performing organizations in terms of AI implementation readiness status and PM maturity level.

4. Results and discussion

4.1. Distribution of the organizations with respect to the industry

A total of 12 project-based organizations participated in this study. The distribution of the organizations with respect to the industry is shown in Table 1. The distribution shows that the majority of the organizations belong to the software/systems/IT sector (5 organizations), followed by the civil/construction sector (4 organizations), and the electrical/electronic sector (2 organizations). However, one organization belongs to the mechanical/industrial sector.

Table 1: Distribution of the organizations with respect to the industry

Industry	No. of organizations
Systems and software	5
Civil/construction	4
Electrical/electronics	2
Mechanical/industrial	1

4.2. Respondents' profile

The respondents' profile shown in Table 2 indicates that respondents were mainly director generals projects (5.88%), program directors and managers (22.06%), project directors and managers (54.41%), project team members and users (17.65%). This shows that more project directors and managers participated in this study, followed by program directors and managers, followed by project team members and users, and followed by director generals projects.

Table 2: Respondents' profile

Respondents profile	Count	%
Director generals projects	4	5.88
Program directors and managers	15	22.06
Project director and managers	37	54.41
Project team members and users	12	17.65

4.3. Distribution of the respondents in the focus groups

Each organization participated in this study through its focus group. Each focus group contained 5-7 members. The distribution of the respondents in the focus groups is shown in Table 3. The distribution shows that each focus group consists of both AI and PM people. This provided triangulation, i.e., collection of data from different sources to minimize bias and increase confidence in the results. Triangulation is crucial in this type of study because the data collected on the AI implementation readiness status and PM maturity level may be biased if these are collected from one type of person. AI people may rate the AI implementation readiness status on the higher side and the PM maturity level on the lower side. Similarly, PM people may rate the PM maturity level on the higher side and the AI implementation readiness status on the lower side. The representations of both types of persons in the focus groups provide the true picture of the AI implementation readiness status and PM maturity level.

Table 3: Distribution of the respondents in the focus groups

	Org. A	Org. B	Org. C	Org. D	Org. E	Org. F	Org. G	Org. H	Org. I	Org. J	Org. K	Org. L	Total
AI people	3	3	3	2	2	2	3	3	1	2	2	4	30
PM people	3	2	4	4	3	3	4	2	4	3	3	3	38
Total	6	5	7	6	5	5	7	5	5	5	5	7	68

4.4. AI implementation readiness status

The AI implementation readiness status in the selected project-based organizations in Pakistan is shown in Table 4, which provides the AI implementation readiness score in the six areas, i.e., “business,” “architecture and technical,” “solution development,” “security,” “legal,” and “governance.” Table 4 shows that Organization D demonstrates the highest AI implementation readiness score (117 out of 119), followed by Organization I, which demonstrates the second highest AI implementation readiness score (115 out of 119). However, organizations B and K demonstrate the lowest (43 out of 119) and the second lowest (45 out of 119) AI implementation scores, respectively, in these areas. Other organizations show different AI implementation readiness scores based on their strategies and policies, priorities and interests, and available resources and skills. In the selected project-based organizations, the overall AI implementation readiness scores range from 43 to 117.

When analyzing the AI implementation readiness score in six areas, Table 4 shows that the highest score is in the "governance" area (168 out of 252). This suggests that organizations in Pakistan pay significant attention to governance issues and regulatory frameworks when implementing AI in their projects. The second most important area is the "legal" area (158 out of 252), indicating that organizations also prioritize legal requirements for AI implementation.

However, the "solution development" area has the lowest score (118 out of 168), indicating a weakness in this aspect. Organizations need to improve their capabilities in solution development to be better prepared for AI implementation in their projects. Therefore, focusing on and enhancing the "solution development" area is crucial for organizations to become ready for AI-related tasks in PM.

Table 4: AI implementation readiness score in the six areas

	Business	Architecture and technical	Solution development	Security	Legal	Governance	Total
Org. A	15	13	14	13	13	17	85
Org. B	5	9	6	7	7	9	43
Org. C	9	9	10	9	9	11	57
Org. D	21	21	12	21	21	21	117
Org. E	13	9	10	11	15	17	75
Org. F	9	11	10	9	11	11	61
Org. G	11	9	10	13	13	13	69
Org. H	11	13	10	11	15	13	73
Org. I	19	21	12	21	21	21	115
Org. J	11	13	12	7	9	11	63
Org. K	5	9	6	7	9	9	45
Org. L	21	17	6	11	15	15	85
Total	150	154	118	140	158	168	

Fig. 1 demonstrates the average AI implementation readiness status in the six areas in the selected project-based organizations in Pakistan. The radar view in Fig. 1 shows that the average AI implementation readiness status is the highest in the “governance” area (14 out of 21), followed by the “legal” area (13.17 out of 21) and the “architecture and technical” area (12.83 out of 21). However, the area in which these organizations are weak is the “solution development” area (9.83 out of 14). This means that organizations should pay enough attention to the “governance,” “legal,” and “architecture and technical” areas while considering AI implementation in managing their projects. However, these organizations are weak in the “solution development” area when considering AI implementation-related tasks when managing their projects. Therefore, these organizations must focus on the “solution development” area to become ready

for AI implementation-related tasks in managing their projects.

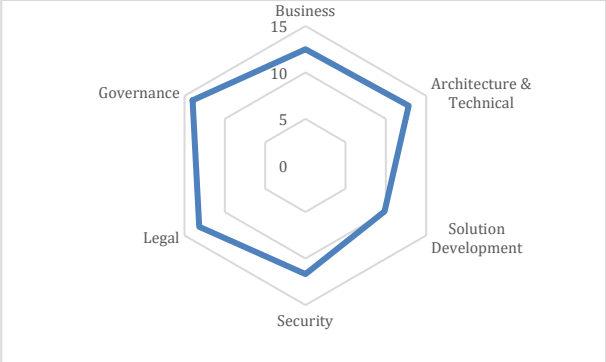

Fig. 1: Average AI implementation readiness status in the six areas

Fig. 2 demonstrates the organization-wise AI implementation readiness status in the six areas in the selected project-based organizations in Pakistan. The line graph in Fig. 2 shows that Organization D performed better in all six areas than the other organizations. More specifically, the highest score is in the “governance” and “architecture and technical areas,” “business,” “legal,” and “security” areas in which this organization achieved a maximum score of 21. However, this organization performed poorly in the “solution development” area, where it only achieved a score of 12. Therefore, this area needs further improvement. Fig 2 also shows that organization I performed better than the other organizations except organization D. This organization is the second most performed organization amongst all the six organizations in terms of their AI implementation score. This organization performed better in the “governance,” “legal,” “security,” and “architecture and technical” areas and achieved a score of 21 in each of these areas. The performance of the organization I is also better in the “business” area, where its score is 19. However, this organization performed poorly in the “solution development” area, like Organization D, where its score was only 12. It means that “solution development” is also a problem in Organization 1. Thus, organizations D and I are the top-performing organizations in the list of the selected six organizations regarding their AI implementation readiness status.

Similarly, the results in Fig. 2 show that Organization A and Organization L are ranked third in AI implementation readiness. Organization A scored well in the "governance" (17) and "business" (15) areas but did poorly in the "architecture and technical," "security," and "legal" areas, scoring 13 in each. Organization L performed best in the "business" area with a score of 21, followed by "architecture and technical" (17) and "governance" and "legal" (15 each). However, Organization L is very weak in "solution development."

The results also show that Organization B and Organization K are very weak in all areas, ranking lowest in AI implementation readiness. Organization B scored very poorly in "business" (5) and "solution development" (6), and Organization K had similar scores in these areas. Both organizations also scored low in "architecture and technical," "security," and "governance" (9 each). However, Organization K performed slightly better in the "legal" area than Organization B.

Other organizations showed variable performance in different areas. Organizations D and I are the top performers, while Organizations B and K are the lowest in AI implementation readiness.

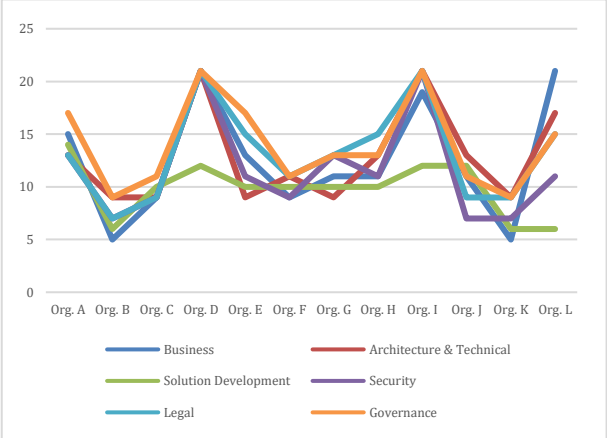

Fig. 2: Organization-wise AI implementation readiness status in the six areas

4.5. PM maturity level

The PM maturity level in the selected project-based organizations in Pakistan is shown in Table 5. Table 5 provides the maturity scores in three areas: "PM," "program management," and "portfolio management."

Table 5 indicates that Organization D has the highest maturity score (10.39 out of 15), followed by Organization I, with the second-highest score (9.77 out of 15). However, Organizations B and K have the lowest (4.24 out of 15) and second-lowest (4.29 out of 15) scores, respectively. Other organizations have varying maturity scores based on their strategies, policies, priorities, interests, resources, and competencies. The overall maturity scores in the selected organizations range from 4.24 to 10.39.

Analyzing the PM maturity scores in the three areas, Table 5 shows that the highest maturity score is in the "PM" area (31.86 out of 60), followed by "program management" (28.99 out of 60), and the lowest in "portfolio management" (26.37 out of 60). This suggests that the organizations focus more on PM when striving for maturity. "Program management" is the second most emphasized area, indicating its importance for improving maturity.

However, "portfolio management" has the lowest score, indicating a weakness in this area. The organizations need to focus more on "portfolio management" for better maturity. Portfolio management involves managing a mix of programs and projects, requiring more expertise and resources. Therefore, it is reasonable to believe that portfolio management maturity is low in the selected

organizations. The same applies to program management, which deals with interrelated and interdependent projects and requires more expertise and resources than PM. In contrast, PM involves managing individual projects, which might be why PM maturity is relatively higher in the selected organizations. The results indicate that almost all selected organizations follow this trend regarding their maturity levels. Fig. 3 shows the average maturity in the three areas for the selected project-based organizations in Pakistan. The radar chart in Fig. 3 indicates that the average maturity is highest in the "PM" area (2.66 out of 5), followed by "program management" (2.20 out of 5) and "portfolio management" (2.20 out of 5). This means that the selected organizations are strong in PM maturity but weak in portfolio management maturity. Therefore, these organizations should focus on improving the "portfolio management" area to enhance their overall maturity.

Fig. 4 illustrates the organization-wise PM maturity in the three areas for the selected project-based organizations in Pakistan. The line graph in Fig. 4 shows that Organization D performed the best in all three areas compared to the other organizations. Specifically, Organization D scored highest in the "PM" area (3.06 out of 5), followed by "program management" (3.55 out of 5) and "portfolio management" (3.24 out of 5). Organization I is the second-best performer, scoring 3.45, 3.22, and 3.10 in the "PM," "program management," and "portfolio management" areas, respectively. Thus, Organizations D and I are the top performers in terms of PM maturity levels.

The results also show that Organizations B and K are the weakest in all areas, with the lowest PM maturity scores. Organization B scored 1.68 in "PM," 1.40 in "program management," and 1.16 in "portfolio management." Organization K scored similarly, with 1.62 in "PM," 1.47 in "program management," and 1.20 in "portfolio management," although it performed slightly better than Organization B in "program management" and "portfolio management." Other organizations showed varying performance across different areas. Therefore, Organizations D and I are the top performers, while Organizations B and K are the lowest performers in terms of PM maturity.

Table 5: PM maturity level in the three areas

Organizations	PM	Program management	Portfolio management
Org. A	2.50	2.33	2.25
Org. B	1.67	1.42	1.17
Org. C	2.67	2.42	2.17
Org. D	3.67	3.00	3.25
Org. E	2.42	2.33	1.92
Org. F	3.00	2.17	2.08
Org. G	2.67	2.17	2.17
Org. H	2.75	2.67	2.42
Org. I	3.42	3.25	3.00
Org. J	2.92	2.83	2.50
Org. K	1.67	1.50	1.17
Org. L	2.58	2.33	2.25

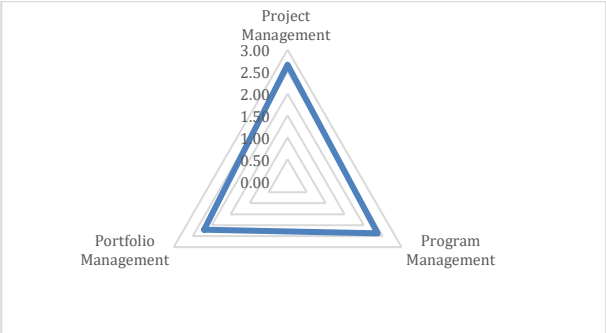

Fig. 3: Average PM maturity in the three areas

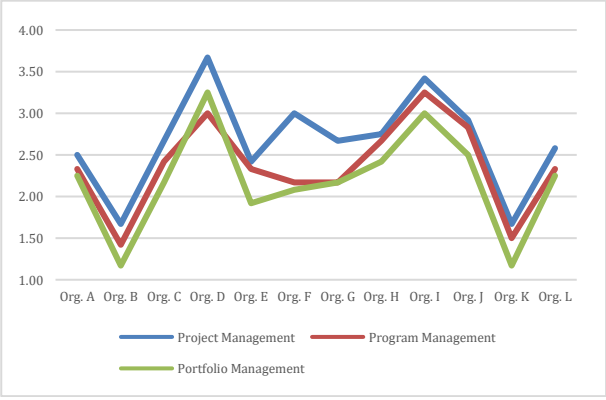

Fig. 4: Organization-wise PM maturity in the three areas

4.6. Association between AI implementation readiness status and PM maturity

An extreme case analysis was performed to analyze the association between AI implementation readiness status and PM maturity level in the selected project-based organizations in Pakistan. Eisenhardt (1989) argued that polarized organizations (extreme cases) are required when the purpose is to investigate a research phenomenon that exists in organizations but cannot be easily discovered or previously unexplored. As the third research question deals with the association between AI implementation readiness status and PM maturity, polarized organizations were required to analyze this association. Polarized organizations (two top and two low-performing organizations) provide a better and clearer picture of this association due to the higher variability in their scores. Other organizations with slight variability cannot serve this purpose. Therefore, two top and two low-performing organizations based on their maturity scores were selected. More specifically, organizations D and I were taken as two top-performing organizations due to their higher average PM maturity scores, and organizations B and

K were taken as two low-performing organizations due to their lower average PM maturity scores, as shown in Table 6.

Table 6: Two top-performing and two low-performing organizations in terms of average PM maturity score

Organizations		Average PM maturity score
Top performed	Org. D	3.31
	Org. I	3.22
Low Performed	Org. K	1.45
	Org. B	1.42

Moreover, the average AI implementation readiness status score of organizations D, I, K, and B are shown in Table 7. We compared the average AI implementation readiness status score with the average PM maturity score of these organizations to analyze the association between AI implementation readiness status and PM maturity. Fig. 5 illustrates this association.

Table 7: AI implementation readiness status score of two top-performing and two low-performing organizations

Organizations	Average AI implementation readiness score
Org. D	19.50
Org. I	19.17
Org. K	7.50
Org. B	7.17

Fig. 5 demonstrates the line graph of the association between the average AI implementation readiness status score and the average PM maturity score. Fig. 5 indicates that organizations D and I have higher average PM maturity due to their higher AI implementation readiness status, whereas organizations B and K have lower average PM maturity due to their lower AI implementation readiness status scores. Hence, we can conclude that there is a positive association between AI implementation readiness status and PM maturity level in project-based organizations in Pakistan.

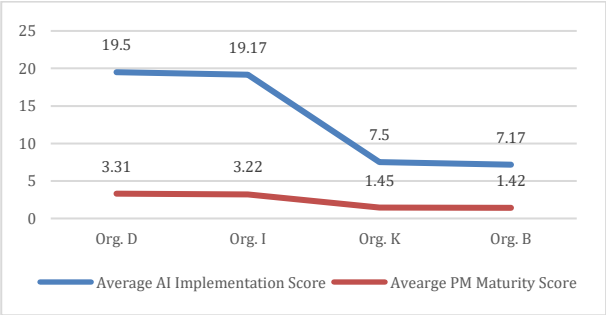

Fig. 5: Association between AI implementation readiness status and PM maturity

4.7. Discussion

The study investigated the AI implementation readiness status and PM maturity level and their association with the selected project-based organization in Pakistan. A multi-case study approach was applied to collect data from the focus groups in 12 selected organizations to determine the AI implementation readiness status and PM maturity level. Consequently, extreme case research was performed to identify the association between the AI implementation readiness status and PM maturity. The results indicate that the AI implementation readiness status in the selected project-based organizations is the highest in the "governance" area, followed by the "legal" area. This shows that these organizations are highly conscious and serious about complying with regulatory and legal requirements. This might be because these organizations are registered in various regularity bodies. Due to their registration in various regulatory bodies, these organizations strictly follow and obey the rules and regulations of these regulatory bodies. That's why these organizations have shown the highest AI implementation readiness status in these areas. However, these organizations have shown that AI implementation readiness status is the lowest in the "solution development" area. This might be because these organizations have inadequate knowledge, expertise, competencies, and resources to implement AI in this area. Another reason might be the fact that all of the selected project-based organizations belong to a developing country, and most of these organizations are at the initial stage or at the planning stage of adopting AI solutions. However, these organizations should focus on this area to improve their AI implementation readiness status because the "solution development" area is the main area where the AI implementation readiness status can be accounted for and is vital to judging the true implementation of AI.

Moreover, the results indicate that the PM maturity level in the selected project-based organizations is the highest in the "PM" area, followed by the "program management" area and "portfolio management" area. This shows that these organizations are comparatively strong in PM maturity as compared to the other two mentioned areas. This might be because the selected project-based organizations focus more on individual projects rather than projects as a system. Individual project managers manage their respective projects by properly applying PM methodologies and standard operational procedures. However, these organizations give less attention to program management and portfolio management. They mainly manage their project on an individual or project-to-project basis rather than a system of projects (program and portfolio management). These organizations should manage their projects at the organizational level, for which they must pay attention to program and portfolio management. They should use their resources centrally and evaluate their strategies and policies at the organizational level. There are many advantages of managing projects centrally, including efficient and effective use of PM methodologies, centralized use of projects' resources in terms of resource optimization and resource leveling, identification of weak areas in strategies and policies, feedback for formulating and updating strategies and policies, effective implementation of project best practices, and ultimately improvement in organizational competitiveness and performance. Furthermore, the

results indicate that the organizations with higher AI implementation readiness status have higher PM maturity, and organizations with lower AI implementation readiness status have lower PM maturity. This shows that the AI implementation readiness status is positively related to PM maturity in the environment and context of the selected project-based organizations. This might be because organizations with higher PM maturity emphasize new and emerging technologies more than organizations with lower PM maturity. Mature organizations have mature organizational structures, processes, and relational mechanisms that help them to deploy and implement new and emerging technologies, such as AI, to manage their projects. When organizations are immature and young, then it becomes difficult for them to adopt and implement new and emerging technologies at the organizational level or even at some parts of the organization, such as PM. Hence, it is reasonable to believe that mature organizations have capabilities, competencies, and required knowledge and resources to deploy and implement AI-related tasks in their context. Thus, the association between AI implementation readiness status and PM maturity is found in the context of project-based organizations in Pakistan.

4.7.1. Theoretical implications

The study provides several theoretical implications for researchers and academicians and contributes to the prior knowledge base in many ways. First, the study enhances and enlarges the understanding and awareness of the use of AI in project, program, and portfolio management in terms of efficient and effective project planning, execution, monitoring and control, closing, and, ultimately, organizational success. Second, it provides a new theoretical perspective on how projects, programs, and portfolios can be managed through the use of new and emerging technologies that use human capabilities and competencies and work entirely like human beings, such as AI, to ensure success. Third, it adds to the existing theories and frameworks of AI and PM maturity. Fourth, the study corroborates that AI implementation readiness status in organizations is positively related to PM maturity.

Future researchers can use the results to investigate this association in other organizational settings and contexts to enhance the generalizability of the results. They can involve other organizations and countries so that the generalizability of the results can be enhanced in other settings and countries. Traditional PM best practices, tools, and techniques, although contributing a lot to the discipline of PM, can be further improved by involving the component of AI to a large extent. Therefore, new theories and frameworks can be developed based on the findings of this study. The main theoretical contribution of this study is the involvement of AI in PM in the project-based organizations of a developing country. Previous research is mainly based on the context of developing countries that are usually inherited with adequate knowledge, abilities, and competencies, sufficient resources, and updated technologies. However, the context of a developing country usually lacks adequate knowledge, abilities, competencies, provision of resources, and availability of technologies because most of the technologies in developing countries are transferred from developed countries. However, the context of the developing countries is more interesting to explore to see the association between AI and PM maturity. Future researchers can extend this study through additional dimensions and perspectives of AI and PM maturity in the context of other developing countries. They can use other tools and techniques to assess AI and PM maturity to validate and confirm the association between AI and PM maturity. Finally, the study provides new avenues for research in AI, PM maturity, and their association in different contexts.

4.7.2. Managerial implications

The study provides several implications for practitioners and managers and contributes to practice in many ways. First, the results are beneficial for managers, practitioners, and policymakers in formulating and improving their strategies and policies related to AI implementation in project, program, and portfolio management in the project-based organizations of a developing country. They can utilize the results to improve AI implementation readiness status, PM maturity, and, ultimately, their organizational performance. They can develop new plans to utilize AI in their projects, programs, and portfolios to improve efficiency and effectiveness. Due to the relative importance of the six studied AI areas and three PM maturity areas, they can identify weak areas in their context and prioritize their limited resources accordingly. By understanding and updating AI and PM maturity dimensions, they can improve AI implementation readiness status and PM maturity for the desired results. By improving AI implementation readiness status in the “governance” and “legal” areas, they can enhance their compliance requirements for regulatory bodies. By improving the “security” area, they can avoid various cyber and hacking threats. By improving the “business” area, they can develop, maintain, and sustain their business continuity and survival in a competitive environment. By improving the “architecture and technical” area, they can improve their abilities to exploit AI in their businesses. By improving the “solution development” area, they can enjoy the benefits of AI in decision-making and ultimate product/service development. By understanding project, program, and portfolio maturity, they can identify weak areas for improving PM maturity. Considering maturity in three areas of project, program, and portfolio management, a more comprehensive picture of PM maturity can be obtained. In this way, weak areas are identified for improvement, and scarce resources

can be utilized in the limited areas. Through this action, project progress can be fully estimated in all of the areas and coordinated and collaborated with all the relevant parties and stakeholders more effectively. By understanding the association between AI and PM maturity, project, program, and portfolio managers and even the middle and senior management of the project-based organizations in Pakistan can save their time by putting focused effort into the identified areas to improve projects, competitiveness, and organizational performance. Projects are the engine of growth in project-based organizations and play a vital role in organizational survival. Therefore, projects need to be managed through best practices and new and emerging technologies, and AI is one of these emerging technologies. Other project-based organizations in other countries can also take advantage of this study.

5. Conclusions

This study examined the level of AI implementation readiness and PM maturity in 12 project-based organizations in Pakistan. It also explored the relationship between AI readiness and PM maturity. Data were collected from focus groups and analyzed using exploratory methods.

The findings showed that the organizations performed well in "governance" and "legal" aspects of AI readiness but poorly in "solution development." This suggests that these organizations need to focus on improving their solution development capabilities. Regarding PM maturity, the organizations excelled in "project management," followed by "program management" and "portfolio management," indicating weaknesses in the latter two areas that require attention.

The study found a positive relationship between AI readiness and PM maturity, suggesting that AI implementation can enhance PM maturity. Adopting AI in project management can improve efficiency, ensure timely project completion, enhance product/service quality, and reduce human errors. AI can be applied throughout the PM life cycle, from planning to execution, monitoring, control, and closing, as well as in managing multiple projects within a portfolio.

The study highlights the importance of AI in project management and its potential to improve PM maturity, particularly in developing countries like Pakistan. However, it recommends further research to explore the AI-PM maturity relationship in other organizational settings, which would contribute to theory development. Increasing the data sample size would also enhance the reliability of results. Additionally, it suggests analyzing the relationship using causal models and considering organizational variables such as size, number of projects, and industry type. Including qualitative data from participant opinions would provide a deeper understanding of the phenomena and strengthen the results' credibility.

Compliance with ethical standards

Ethical considerations

This study adhered to the ethical standards of the Lahore School of Professional Studies, The University of Lahore. Informed consent was obtained from all participants, ensuring their right to withdraw and the confidentiality of their responses. The study was approved by the Institutional Review Board of The University of Lahore.

Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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