

Artificial Intelligence Integration and Project Manager Efficiency in Public Sector Projects: The Moderating Role of Organizational Readiness in Pakistan

Maham Usman¹, Dr Muhammad Imran Majeed², Dr. Abdullah Hammad³

¹ MS Scholar, Project Management, National Business School (NBS), The University of Faisalabad, Email: Mahamusman1503@gmail.com

² Assistant Professor, NBS, The University of Faisalabad, Corresponding Author
Email: imranmajeed.nbs@tuf.edu.pk

³ Assistant Professor, NBS, The University of Faisalabad,
Email: abdullahhammad.nbs@tuf.edu.pk

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Abstract

Artificial intelligence (AI) has emerged as a transformative technology capable of improving managerial decision-making, coordination, and operational efficiency in project-based organizations. However, empirical research examining the influence of AI on managerial efficiency, particularly within public sector projects in developing economies, remains limited. This study investigates the relationship between artificial intelligence integration and project manager efficiency in Pakistani public sector projects while examining the moderating role of organizational readiness. The research is grounded in an integrated theoretical framework combining the Technology Acceptance Model (TAM), the Technology–Organization–Environment (TOE) framework, and Diffusion of Innovation (DOI) theory to explain how technological and organizational factors influence AI-enabled managerial outcomes. A quantitative research design was employed using a structured questionnaire distributed to project managers and senior project officials working in public sector project-based organizations in Pakistan. Data were analyzed using regression and moderation analysis to examine the direct effect of artificial intelligence integration on project manager efficiency and the moderating influence of organizational readiness. The results indicate that artificial intelligence integration significantly improves project manager efficiency by enhancing managers' ability to process information, make timely decisions, coordinate project activities, and respond effectively to project uncertainties. Furthermore, the findings reveal that organizational readiness strengthens this relationship, as organizations with stronger leadership support, technological infrastructure, and skilled personnel are better able to translate AI-enabled systems into tangible managerial efficiency gains. These results highlight the importance of both technological capability and organizational preparedness in achieving successful digital transformation. The study contributes to the literature by examining managerial efficiency as a distinct outcome of AI integration and by providing empirical evidence from the public sector context of a developing economy. The findings also offer practical insights for policymakers and public sector managers seeking to enhance project management effectiveness through artificial intelligence initiatives.

Keywords: Artificial Intelligence Integration, Project Manager Efficiency, Organizational Readiness, Public Sector Projects, Technology Adoption, Technology Acceptance Model

Introduction

The rapid advancement of digital technologies has significantly transformed managerial practices and organizational processes across both private and public sector environments. Among these technologies, artificial intelligence (AI) has emerged as one of the most influential innovations shaping contemporary organizational decision-making and operational efficiency. AI systems enable organizations to analyze large volumes of data, generate predictive insights, and automate routine tasks, thereby enhancing managerial capabilities and improving decision quality. As organizations increasingly operate in complex and data-intensive environments, the adoption and integration of AI technologies have become critical for maintaining efficiency, responsiveness, and strategic effectiveness (Jarrahi, 2018).

Early research on technology adoption primarily focused on individual users' acceptance of information systems. One of the most widely recognized theoretical frameworks in this area is the Technology Acceptance Model (TAM), which proposes that perceived usefulness and perceived ease of use determine an individual's intention to adopt and utilize a technological system (Davis, 1989). Although TAM provides valuable insights into user behavior, it mainly explains individual-level adoption decisions and does not fully capture broader organizational and environmental conditions that shape the effectiveness of technology implementation.

To address this limitation, scholars introduced the Technology–Organization–Environment (TOE) framework, which highlights the role of organizational characteristics and external environmental conditions in influencing technological innovation adoption (Tornatzky and Fleischer, 1990). Complementing this perspective, Diffusion of Innovation (DOI) theory explains how innovations spread within organizations and societies over time through processes of communication, experimentation, and institutionalization (Rogers, 2003). Together, these frameworks emphasize that technology adoption and its outcomes depend on the interaction between individual perceptions, organizational structures, and environmental context (Khan & Ullah, 2021).

With the emergence of artificial intelligence, research has increasingly shifted from examining technology adoption toward understanding how advanced technologies influence managerial performance and organizational transformation. Artificial intelligence differs from earlier information systems in that it can process complex datasets, learn from patterns, and generate predictive and prescriptive insights that support decision-making processes. These capabilities allow managers to make more informed decisions, improve forecasting accuracy, and optimize resource allocation in dynamic organizational environments (Dwivedi et al., 2023). In project-based organizations, where uncertainty, time constraints, and interdependent tasks are common, the integration of AI technologies has the potential to significantly enhance managerial effectiveness. Project management environments are characterized by complex coordination among stakeholders, strict deadlines, resource limitations, and evolving project requirements. Project managers play a central role in planning, coordinating, monitoring, and controlling project activities to ensure successful project execution. Efficient project management therefore requires timely information processing, effective communication, and the ability to respond quickly to emerging risks and uncertainties. Artificial intelligence technologies can support these managerial functions by providing real-time data analysis, predictive risk assessment, and automated monitoring systems that assist project managers in making informed decisions (Marnewick, 2023). Despite the growing potential of AI-enabled systems in project management, empirical research examining their impact on managerial efficiency remains limited. Much of the existing literature focuses on technology adoption intentions, organizational innovation capabilities, or overall project performance outcomes. Comparatively little attention has been given to managerial efficiency as a distinct outcome of artificial intelligence integration. Project manager efficiency refers to the ability of project managers to effectively utilize time, information, and organizational resources to perform core managerial functions such as planning, coordination, decision-making,

and monitoring. Understanding how AI technologies influence this managerial capability is therefore critical for evaluating the practical value of digital transformation initiatives in project-based organizations (Mergel et al., 2023; Verhoef et al., 2023).

The importance of examining AI integration in the public sector is particularly significant. Public sector organizations operate within institutional environments characterized by formalized procedures, hierarchical governance structures, and strict accountability requirements. These conditions shape managerial discretion and influence how digital technologies are implemented and utilized within organizational processes. While artificial intelligence has been widely adopted in private sector organizations to enhance efficiency and competitiveness, its integration in public sector project environments remains uneven and often constrained by institutional, technical, and organizational challenges (Wirtz, Weyerer and Geyer, 2019). AI systems enable organizations to analyze large volumes of data, generate predictive insights, and automate routine tasks, thereby enhancing managerial capabilities and improving decision quality (Jarrahi, 2018; Dwivedi et al., 2023; Wamba et al., 2024; Almansour et al., 2025).

Developing countries face additional barriers in translating digital technology investments into managerial performance improvements. Studies examining digital transformation initiatives in developing economies highlight limitations related to infrastructure capacity, technical expertise, and institutional coordination. In Pakistan, public sector organizations have increasingly introduced digital technologies to improve governance, transparency, and service delivery. However, research suggests that these initiatives often encounter implementation challenges due to insufficient digital infrastructure, skills shortages, and bureaucratic resistance to change (Siddiqui and Mehmood, 2021; Zuiderwijk, Chen and Salem, 2021). These constraints indicate that the effectiveness of artificial intelligence integration depends not only on technological availability but also on the organizational conditions that support its implementation.

One of the most critical factors influencing successful technology implementation is organizational readiness. Organizational readiness refers to the collective commitment and capability of an organization to implement and sustain change initiatives (Weiner, 2009). In the context of artificial intelligence adoption, readiness involves leadership support, technological infrastructure, and employee competence required to effectively utilize AI-enabled systems. Organizations that demonstrate higher levels of readiness are more likely to integrate advanced technologies into managerial workflows and derive meaningful performance benefits from their implementation.

While organizational readiness has been widely recognized as an important determinant of successful technology adoption, its role as a moderating factor in the relationship between artificial intelligence integration and managerial efficiency remains underexplored. In project-based public sector environments, variations in readiness levels may significantly influence whether AI technologies enhance managerial efficiency or remain underutilized. Examining this moderating role is therefore essential for understanding why similar technological initiatives produce different outcomes across organizations. The Pakistani public sector provides an important context for investigating these issues. Public sector projects in Pakistan involve large-scale infrastructure, development, health, and education initiatives that require effective coordination among multiple stakeholders and institutions. Project managers operating in these environments must navigate complex administrative procedures, limited resources, and evolving policy requirements while maintaining efficiency in project execution. The integration of artificial intelligence technologies could potentially support these managerial tasks by improving information processing, risk identification, and project monitoring capabilities.

However, empirical evidence on how artificial intelligence integration influences project manager efficiency within Pakistani public sector projects remains scarce. Existing studies on digital transformation in Pakistan primarily focus on e-government initiatives or information system adoption rather than AI-enabled managerial performance. Consequently, there is limited

understanding of how artificial intelligence technologies affect project management practices in the public sector and how organizational readiness conditions these effects.

This study addresses this gap by examining the relationship between artificial intelligence integration and project manager efficiency in Pakistani public sector projects. Furthermore, it investigates the moderating role of organizational readiness in shaping the effectiveness of AI-enabled managerial practices. By integrating insights from the Technology Acceptance Model, the Technology–Organization–Environment framework, and Diffusion of Innovation theory, the study provides a comprehensive perspective on the technological, organizational, and behavioral factors influencing artificial intelligence integration in project-based public sector environments.

Through this investigation, the study contributes to both theory and practice. From a theoretical perspective, it extends technology adoption research by linking artificial intelligence integration to managerial efficiency outcomes within project management contexts. From a practical perspective, the findings provide insights for policymakers and public sector managers seeking to enhance project management effectiveness through digital transformation initiatives.

Literature Review

Artificial Intelligence in Project-Based Organizations

Artificial intelligence (AI) has emerged as a transformative technological capability that reshapes how organizations process information, make decisions, and coordinate complex activities. Unlike traditional information systems designed primarily for record keeping or communication, AI-enabled systems can analyze large datasets, identify patterns, and generate predictive insights that support managerial decision-making. These capabilities have positioned artificial intelligence as a strategic tool for improving operational efficiency and organizational performance across multiple sectors (Dwivedi et al., 2023). Project-based organizations present a particularly relevant context for the application of artificial intelligence. Projects often involve complex tasks, uncertain environments, multiple stakeholders, and strict time and resource constraints. Effective project management therefore requires continuous monitoring of project progress, rapid decision-making, and efficient coordination among team members. Artificial intelligence technologies provide tools that can enhance these managerial functions by enabling advanced analytics, real-time monitoring, and predictive risk assessment (Marnewick, 2023; Hossain et al., 2024; Almansour et al., 2025). Recent studies indicate that AI applications are increasingly integrated into project management processes such as planning, scheduling, risk analysis, and performance monitoring. For example, machine learning algorithms can analyze historical project data to forecast potential delays and recommend optimal resource allocation strategies. Similarly, AI-enabled monitoring systems can detect deviations from project plans and generate alerts that allow managers to respond quickly to emerging problems (Hossain et al., 2024). Through these capabilities, artificial intelligence enhances managers' ability to manage complexity and uncertainty within project environments. Importantly, the value of artificial intelligence does not lie solely in automation but also in its capacity to augment managerial capabilities. AI systems support managers by providing analytical insights that complement human expertise rather than replacing managerial decision-making altogether. This human–AI collaboration enables managers to process large amounts of information efficiently while retaining the contextual judgment necessary for complex decision-making (Jarrahi, 2018). As a result, artificial intelligence is increasingly viewed as a managerial support capability embedded within organizational decision processes.

Evolution of Artificial Intelligence in Organizational Contexts

The evolution of artificial intelligence within organizations reflects broader changes in digital technology and data analytics. Early AI systems were largely based on rule-based expert systems designed to replicate human decision-making using predefined rules. Although these systems

provided limited decision support, their practical application remained restricted due to inflexible design and limited integration with organizational workflows. Advancements in machine learning, computational power, and big data analytics have significantly expanded the capabilities of artificial intelligence. Contemporary AI technologies can learn from historical data, identify patterns, and adapt to changing environments. These developments allow organizations to use AI systems for forecasting, optimization, and decision support across complex operational environments (Wamba et al., 2024; Vial, 2024). Within managerial contexts, artificial intelligence has evolved from a technical support tool to an integral component of organizational decision-making infrastructures. AI-enabled systems now support a wide range of managerial activities including demand forecasting, resource planning, performance monitoring, and strategic analysis. These capabilities enable managers to make more informed and timely decisions, thereby improving operational efficiency and organizational effectiveness (Dwivedi et al., 2023).

At the same time, scholars emphasize that artificial intelligence should be understood as part of a socio-technical system rather than purely a technological artifact. The effectiveness of AI systems depends on how they are embedded within organizational structures, managerial practices, and institutional contexts. This perspective highlights the importance of organizational readiness and managerial competence in determining whether artificial intelligence technologies produce meaningful performance improvements (Vial, 2024).

Artificial Intelligence Integration in Project Management Processes

Artificial intelligence integration in project management refers to the systematic incorporation of AI-enabled tools into core project management activities. This integration involves embedding intelligent systems within planning, scheduling, monitoring, and risk management processes to enhance managerial decision-making and operational efficiency. During the project planning phase, artificial intelligence systems can analyze historical project data and generate predictive insights that help managers develop more accurate schedules and allocate resources more effectively. Machine learning algorithms can identify patterns in previous projects to estimate task durations and detect potential scheduling conflicts. These capabilities allow project managers to make evidence-based planning decisions rather than relying solely on intuition (Marnewick, 2023). In the execution and monitoring phase, artificial intelligence enables real-time tracking of project performance through automated data collection and analytical dashboards. AI-enabled monitoring systems continuously analyze project metrics such as cost, time, and quality indicators, providing managers with timely information about project progress. This real-time feedback allows project managers to detect deviations early and implement corrective actions before problems escalate (Wamba et al., 2024). Artificial intelligence also supports project risk management by modeling complex risk scenarios and estimating probabilities of adverse outcomes. Predictive analytics tools can identify potential risks based on historical data and current project conditions, enabling managers to implement preventive strategies. By improving the accuracy of risk assessment and decision-making, AI technologies contribute to more efficient project management processes. However, the effectiveness of AI integration depends on several contextual factors including data quality, technological infrastructure, and managerial competence. Without adequate organizational support and skilled personnel, AI systems may generate complex outputs that are difficult for managers to interpret or apply effectively (Jarrahi, 2018).

Organizational Readiness for Artificial Intelligence Implementation

Organizational readiness has been widely recognized as a critical factor influencing the successful implementation of technological innovations. Weiner (2009) defines organizational readiness as the shared commitment and capability of organizational members to implement change initiatives effectively. In the context of artificial intelligence, readiness reflects an organization's

preparedness to integrate advanced technologies into its managerial and operational processes (Weiner, 2009; Mikalef et al., 2024). Organizations with high levels of readiness are more likely to successfully implement artificial intelligence systems and integrate them into routine decision-making processes. Leadership support plays a crucial role in establishing strategic direction, allocating resources, and encouraging employees to adopt new technologies. When organizational leaders actively promote digital transformation initiatives, employees are more likely to accept and utilize AI-enabled systems. Technological infrastructure is another essential component of organizational readiness. Artificial intelligence systems require reliable data sources, computing resources, and integrated information systems to function effectively. Organizations lacking adequate technological infrastructure may struggle to implement AI systems successfully, even when managerial interest in digital technologies is strong. Human resource capability represents the third key dimension of organizational readiness. Employees must possess the necessary skills and knowledge to interpret AI-generated insights and apply them within their work processes. Training and skill development programs are therefore essential for ensuring that artificial intelligence technologies contribute to improved managerial performance (Mikalef et al., 2024).

Project Manager Efficiency

Project manager efficiency refers to the ability of project managers to effectively utilize time, information, and organizational resources to perform managerial functions within project constraints. Unlike broader constructs such as project success or organizational performance, project manager efficiency focuses specifically on the effectiveness of managerial processes. Efficient project managers demonstrate strong planning capabilities, effective communication, and the ability to coordinate complex project activities. They are able to manage multiple stakeholders, allocate resources effectively, and respond quickly to changing project conditions. These managerial capabilities are particularly important in complex project environments characterized by uncertainty and resource limitations (Turner, 2014). In public sector project environments, project manager efficiency is influenced by additional institutional factors including bureaucratic procedures, regulatory requirements, and accountability mechanisms. Public sector managers must ensure that project activities comply with formal governance structures while maintaining efficiency in planning and execution. These constraints often limit managerial flexibility and increase the complexity of project coordination (Flyvbjerg, 2017). Prior research suggests that improving managerial efficiency can significantly enhance project performance by reducing delays, improving resource utilization, and strengthening coordination among project stakeholders. Consequently, understanding the factors that influence project manager efficiency is essential for improving project outcomes in both public and private sector organizations.

Artificial Intelligence and Managerial Efficiency

Recent studies have increasingly examined the relationship between artificial intelligence integration and managerial efficiency. Artificial intelligence technologies enhance managerial efficiency primarily by improving information processing capability and reducing cognitive workload. AI-enabled systems can analyze large datasets and generate insights that support managerial decision-making (Dwivedi et al., 2023; Hossain et al., 2024). Predictive analytics tools allow project managers to anticipate potential risks and develop proactive strategies to address them. By improving forecasting accuracy and enabling real-time monitoring, AI technologies allow managers to respond quickly to emerging project issues. These capabilities reduce the time required for decision-making and enhance managers' ability to coordinate complex project activities (Dwivedi et al., 2023). Artificial intelligence also improves coordination efficiency by automating routine administrative tasks such as data collection, reporting, and performance monitoring. Automation reduces the administrative burden on project managers, allowing them to

focus on strategic activities such as stakeholder management and team coordination. However, the efficiency-enhancing effects of artificial intelligence are not guaranteed. Studies indicate that poorly implemented AI systems may increase managerial workload by generating complex outputs that are difficult to interpret. Additionally, managers may resist using AI tools if they perceive them as unreliable or difficult to use (Vial, 2024).

Organizational Readiness as a Moderating Factor

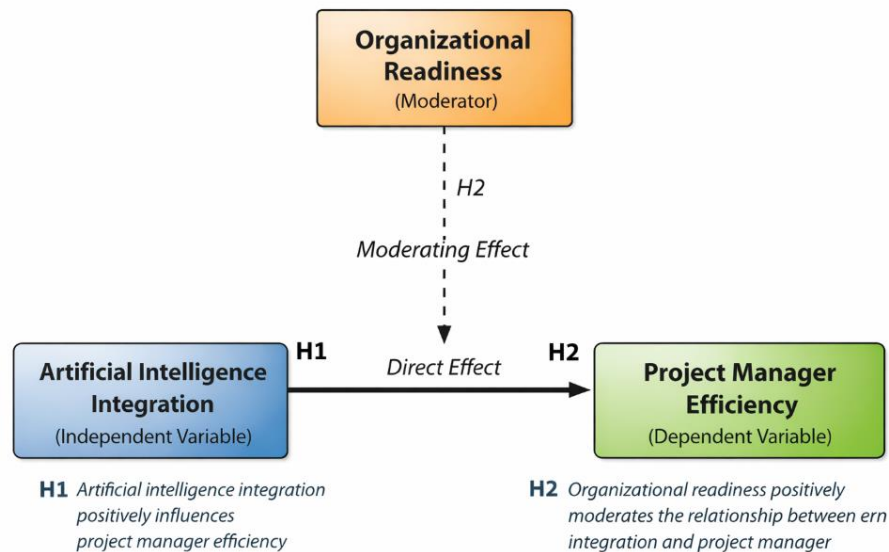
Technology-performance research increasingly emphasizes that the effectiveness of digital technologies depends on organizational conditions. Rather than producing uniform outcomes, technological innovations generate value through interaction with contextual factors such as organizational culture, leadership support, and resource availability. Organizational readiness has therefore been conceptualized as a moderating factor influencing the relationship between technology adoption and performance outcomes. Studies show that organizations with higher readiness levels derive greater benefits from technological innovations because they possess the capabilities required to implement and utilize these technologies effectively (Weiner, 2009). In the context of artificial intelligence integration, organizational readiness may strengthen the relationship between AI technologies and managerial efficiency. Organizations that possess strong leadership support, advanced technological infrastructure, and skilled personnel are more likely to successfully integrate AI systems into managerial workflows. Conversely, organizations with low readiness levels may experience limited benefits from AI technologies due to inadequate resources or employee resistance to change.

Research Gap

Despite growing interest in artificial intelligence and digital transformation, several important gaps remain in the literature. First, existing research has largely focused on technology adoption or organizational performance outcomes, while limited attention has been given to managerial efficiency as a distinct outcome of artificial intelligence integration. Second, much of the empirical evidence on AI-enabled managerial practices originates from developed economies and private sector organizations. Public sector project environments in developing countries remain underrepresented in empirical research. Third, although organizational readiness has been recognized as an important determinant of technology implementation success, few studies have examined its moderating role in the relationship between artificial intelligence integration and managerial efficiency. Addressing these gaps requires empirical investigation within specific institutional contexts. The present study contributes to the literature by examining the relationship between artificial intelligence integration and project manager efficiency in Pakistani public sector projects while considering the moderating role of organizational readiness.

Conceptual Research Model

Based on the literature discussed above, this study proposes a conceptual model examining the relationship between artificial intelligence integration and project manager efficiency, while considering the moderating role of organizational readiness. The model is grounded in the Technology Acceptance Model (TAM), the Technology–Organization–Environment (TOE) framework, and Diffusion of Innovation (DOI) theory, which collectively explain how technological adoption and organizational conditions influence managerial outcomes.



As illustrated in Figure 1, **artificial intelligence integration** is conceptualized as the independent variable, while **project manager efficiency** represents the dependent variable. Artificial intelligence technologies enhance managerial performance by enabling advanced data analytics, predictive insights, and automation of routine tasks. These capabilities allow project managers to make more informed decisions, improve coordination among project stakeholders, and respond more effectively to uncertainties within project environments. Consequently, higher levels of AI integration within project management processes are expected to lead to greater managerial efficiency. The model also incorporates organizational readiness as a moderating variable. Organizational readiness refers to the degree to which an organization possesses the necessary resources, leadership support, technological infrastructure, and employee competence required to successfully implement technological innovations. Prior research suggests that the benefits of digital technologies are often contingent upon the organizational environment in which they are implemented. Organizations with higher readiness levels are more capable of integrating new technologies into their workflows and utilizing them effectively. In this context, organizational readiness is expected to strengthen the relationship between artificial intelligence integration and project manager efficiency. When organizations demonstrate strong leadership commitment, adequate infrastructure, and skilled personnel, artificial intelligence systems can be fully utilized to support project management activities. Conversely, in organizations with lower levels of readiness, artificial intelligence technologies may remain underutilized or fail to generate significant managerial benefits.

Accordingly, the conceptual model proposes two hypotheses. The first hypothesis suggests that artificial intelligence integration positively influences project manager efficiency. The second hypothesis proposes that organizational readiness positively moderates the relationship between artificial intelligence integration and project manager efficiency, such that the relationship becomes stronger when organizational readiness is high. The proposed research model therefore provides a theoretical framework for examining how technological and organizational factors jointly influence managerial efficiency in public sector project environments.

Theoretical Framework and Hypotheses Development

Theoretical Foundations

Understanding how artificial intelligence (AI) influences managerial efficiency requires an integrated theoretical perspective that captures technological, organizational, and behavioral dimensions of technology adoption. This study draws upon three well-established theoretical

frameworks widely used in information systems and innovation research: the **Technology Acceptance Model (TAM)**, the **Technology–Organization–Environment (TOE) framework**, and **Diffusion of Innovation (DOI) theory**. Together, these perspectives provide a comprehensive foundation for explaining how artificial intelligence integration influences project manager efficiency and how organizational readiness conditions this relationship. The Technology Acceptance Model (TAM) explains technology usage at the individual level by emphasizing how users' perceptions influence their adoption behavior. According to TAM, individuals are more likely to adopt and utilize a technology when they perceive it as useful and easy to use (Davis, 1989). In the context of artificial intelligence in project management, project managers' perceptions of AI tools—such as their ability to improve decision-making, reduce workload, and enhance forecasting accuracy—play an important role in determining whether these systems are actively utilized in managerial tasks. However, focusing solely on individual acceptance does not fully explain the organizational conditions that enable or constrain technology implementation. To address this limitation, the Technology–Organization–Environment (TOE) framework provides a broader perspective by highlighting how technological characteristics, organizational structures, and external environmental factors collectively influence technology adoption (Tornatzky and Fleischer, 1990). Within public sector project environments, organizational readiness—including leadership support, infrastructure availability, and employee capability—represents a key organizational condition influencing the effectiveness of artificial intelligence implementation. The third theoretical lens, Diffusion of Innovation (DOI) theory, explains how innovations spread within organizations over time. According to Rogers (2003), the diffusion of innovations depends on factors such as perceived benefits, communication among organizational members, and institutional support. In project-based organizations, AI integration often begins with pilot initiatives and gradually expands as managers gain experience and confidence in AI-enabled systems. By integrating TAM, TOE, and DOI perspectives, this study captures the multi-level dynamics shaping artificial intelligence integration. TAM explains how project managers interact with AI tools, TOE explains how organizational conditions enable or constrain AI implementation, and DOI explains how AI-supported practices diffuse within organizations over time. This integrated theoretical framework provides a robust basis for examining the relationship between artificial intelligence integration and project manager efficiency.

Artificial Intelligence Integration and Project Manager Efficiency

Artificial intelligence integration refers to the extent to which AI-enabled systems are embedded within organizational processes and managerial decision-making activities. Rather than representing simple technology adoption, AI integration reflects the degree to which intelligent systems support routine managerial functions such as planning, monitoring, and coordination. In project management environments, managers are responsible for making complex decisions under conditions of uncertainty. These decisions often involve analyzing large volumes of data related to project schedules, budgets, resources, and risks. Artificial intelligence technologies enhance managerial efficiency by providing advanced analytical capabilities that enable managers to process information more effectively. For example, machine learning algorithms can analyze historical project data to forecast potential delays and recommend optimal resource allocation strategies. Similarly, AI-enabled monitoring systems can detect deviations from project plans and generate alerts that allow managers to take corrective actions in a timely manner. These capabilities improve the accuracy and speed of managerial decision-making, which are key components of project manager efficiency. Artificial intelligence also contributes to efficiency by automating routine administrative tasks such as data collection, reporting, and performance tracking. Automation reduces the administrative burden on project managers, allowing them to focus on strategic activities such as stakeholder coordination and problem-solving. By improving

information availability and reducing cognitive workload, AI integration enables project managers to perform their roles more effectively. Empirical research supports the positive relationship between artificial intelligence integration and managerial performance. Studies indicate that AI-enabled systems improve forecasting accuracy, enhance coordination, and strengthen risk management capabilities within project environments (Dwivedi et al., 2023; Marnewick, 2023). These improvements contribute directly to managerial efficiency by enabling faster and more informed decision-making.

Based on these theoretical and empirical insights, the following hypothesis is proposed:

H1: Artificial intelligence integration has a positive effect on project manager efficiency.

Organizational Readiness and Technology Implementation

Organizational readiness represents the collective capability and commitment of an organization to implement technological change effectively. According to Weiner (2009), readiness reflects both psychological and structural preparedness for change, including leadership support, resource availability, and employee competence. In the context of artificial intelligence implementation, organizational readiness plays a critical role in determining whether AI technologies can be effectively integrated into managerial processes. Organizations with high readiness levels typically possess supportive leadership, adequate technological infrastructure, and skilled personnel capable of interpreting AI-generated insights. Leadership support is particularly important because it shapes strategic priorities and resource allocation decisions. When senior management actively promotes digital transformation initiatives, employees are more likely to engage with new technologies and integrate them into their daily work practices. Technological infrastructure also influences the success of AI implementation. Artificial intelligence systems require reliable data sources, integrated information systems, and sufficient computing capacity to function effectively. Without adequate infrastructure, organizations may struggle to implement AI technologies successfully. Human resource capability represents another important component of organizational readiness. Employees must possess the analytical skills and technological competence required to interpret AI-generated insights and apply them in decision-making processes. Organizations that invest in training and skill development are therefore more likely to successfully integrate artificial intelligence into managerial workflows. These dimensions collectively determine whether artificial intelligence technologies can generate meaningful improvements in managerial efficiency. Organizations lacking readiness may experience difficulties implementing AI systems or fail to fully utilize their capabilities.

Moderating Role of Organizational Readiness

Although artificial intelligence integration has the potential to enhance managerial efficiency, its effectiveness may vary across organizations depending on contextual conditions. Organizational readiness represents a critical contextual factor that may influence the strength of the relationship between AI integration and managerial efficiency. In organizations characterized by high readiness levels, artificial intelligence systems are more likely to be effectively embedded within managerial workflows. Supportive leadership encourages managers to use AI-enabled tools, technological infrastructure enables seamless data integration, and skilled employees are capable of interpreting AI outputs. Under these conditions, AI integration is more likely to translate into meaningful improvements in project manager efficiency. Conversely, organizations with low readiness levels may struggle to realize the potential benefits of artificial intelligence technologies. Limited leadership support, inadequate infrastructure, and insufficient employee skills can hinder the effective use of AI systems. In such environments, project managers may rely less on AI-generated insights or experience difficulties integrating these systems into their work processes.

Prior research on technology-performance relationships supports the moderating role of organizational readiness. Studies have shown that organizations with higher readiness levels derive greater benefits from digital technologies because they possess the capabilities required to implement and utilize these technologies effectively (Mikalef et al., 2024). Therefore, organizational readiness is expected to strengthen the positive relationship between artificial intelligence integration and project manager efficiency.

Accordingly, the following hypothesis is proposed:

H2: Organizational readiness positively moderates the relationship between artificial intelligence integration and project manager efficiency, such that the relationship becomes stronger when organizational readiness is high.

Conceptual Framework

Based on the theoretical foundations and hypotheses developed above, this study proposes a conceptual framework examining the relationship between artificial intelligence integration and project manager efficiency, with organizational readiness acting as a moderating variable.

In this framework:

- Artificial Intelligence Integration serves as the independent variable.
- Project Manager Efficiency represents the dependent variable.
- Organizational Readiness functions as a moderating variable influencing the strength of the relationship between AI integration and managerial efficiency.

The conceptual framework reflects the assumption that artificial intelligence technologies enhance managerial efficiency, while organizational readiness determines the extent to which these technological capabilities are effectively utilized within project management processes.

Methodology

This study adopts a quantitative research design to empirically examine the relationship between artificial intelligence (AI) integration and project manager efficiency, while also investigating the moderating role of organizational readiness within Pakistani public sector projects. A quantitative approach is appropriate for the present study because it enables the measurement of theoretically derived constructs and allows statistical examination of relationships among variables across a defined population. Quantitative designs are widely employed in information systems and organizational research to test hypotheses and validate theoretical frameworks through empirical data. The research utilizes a cross-sectional survey design in which data were collected from respondents at a single point in time. Cross-sectional designs are particularly suitable for studies investigating perceptions, organizational practices, and managerial behaviors where the objective is to examine relationships among variables rather than changes over time. Given that the study focuses on project managers' current experiences with artificial intelligence technologies and organizational readiness conditions, the cross-sectional design provides an efficient and methodologically appropriate approach for testing the proposed theoretical model.

The study is grounded in the positivist research philosophy, which assumes that social phenomena can be observed objectively and analyzed using empirical data. Positivism emphasizes systematic observation, measurement, and statistical analysis to examine relationships among variables. The use of structured questionnaires, standardized measurement scales, and statistical hypothesis testing aligns with the assumptions of positivist inquiry. This philosophical orientation allows the researcher to examine relationships between artificial intelligence integration, organizational readiness, and project manager efficiency through objective analysis of empirical evidence.

Consistent with the positivist paradigm, the study employs a deductive research approach. Deductive research begins with established theories and empirical findings and derives testable hypotheses that are subsequently examined using collected data. The conceptual framework of this study is informed by the Technology Acceptance Model, the Technology–Organization–Environment framework, and Diffusion of Innovation theory. These theoretical perspectives provide the foundation for examining how artificial intelligence integration influences project manager efficiency and how organizational readiness moderates this relationship. The deductive approach ensures logical consistency between theory, research design, and empirical testing.

The target population for this research consists of project managers and senior project-related officials working in Pakistani public sector project-based organizations. These professionals are directly involved in project planning, execution, monitoring, and control activities, making them appropriate respondents for evaluating the integration of artificial intelligence technologies within project management processes. Public sector organizations included in the study comprise federal and provincial government departments, development authorities, and public sector organizations responsible for infrastructure, development, health, and education projects. These organizations represent environments where project management plays a critical role in achieving policy and development objectives. A purposive sampling strategy was employed to select respondents with relevant professional experience and exposure to digital systems or AI-supported tools used in project environments. Purposive sampling is appropriate when the research requires informed responses from a specific professional group rather than general population representation. Respondents were selected based on their involvement in project management activities and their familiarity with digital technologies used in organizational processes. The study collected data from approximately 250 respondents, which provides an adequate sample size for statistical analysis involving regression and moderation testing. Methodological guidelines in social science research suggest that sample sizes exceeding 200 observations provide sufficient statistical power for multivariate analysis. The selected sample size therefore supports reliable estimation of relationships among the study variables and enhances the robustness of empirical findings.

Primary data were collected through a structured questionnaire survey distributed to project managers and senior project officials working in public sector organizations. The questionnaire was self-administered and distributed through electronic channels and professional networks to ensure access to respondents across different public sector institutions. The survey instrument was designed to capture respondents' perceptions regarding artificial intelligence integration, organizational readiness, and project manager efficiency within their organizational contexts.

The questionnaire consisted of multiple sections corresponding to the key constructs of the study. Respondents were asked to indicate their level of agreement with each statement using a five-point Likert scale ranging from strongly disagree to strongly agree. Likert-scale measurement is widely used in organizational and behavioral research because it allows respondents to express varying degrees of agreement while generating data suitable for statistical analysis. All study variables were measured using multi-item scales adapted from previously validated empirical studies. Artificial intelligence integration was measured using items that assess the extent to which AI technologies are embedded within organizational processes, decision-making activities, and workflow practices. These items capture both the functional use of artificial intelligence technologies and their perceived contribution to improving organizational performance and decision accuracy. Project manager efficiency was measured using items that capture core managerial capabilities including communication effectiveness, planning and monitoring activities, resource management, coordination among project stakeholders, leadership capability, and effective use of technology in project management. The measurement approach focuses on managerial processes rather than project outcomes, ensuring that the construct reflects the efficiency of managerial activities rather than overall project success.

Organizational readiness was measured as a multidimensional construct capturing the organization's preparedness to implement technological and organizational change initiatives. The measurement items reflect psychological commitment to change, leadership support, employee motivation, and organizational capability to coordinate change implementation. These dimensions collectively represent the organization's capacity to integrate advanced technologies such as artificial intelligence into managerial workflows. Data analysis was conducted using the Statistical Package for the Social Sciences (SPSS). The analysis began with descriptive statistics to summarize respondent characteristics and examine the distribution of responses across study variables. Reliability analysis was then conducted using Cronbach's alpha to assess the internal consistency of measurement scales. Cronbach's alpha values above 0.70 were considered acceptable indicators of reliable measurement.

Following reliability assessment, correlation analysis was performed to examine relationships among study variables and identify potential multicollinearity issues prior to regression analysis. Multiple regression analysis was subsequently used to test the direct effect of artificial intelligence integration on project manager efficiency. To examine the moderating role of organizational readiness, an interaction term between artificial intelligence integration and organizational readiness was included in the regression model. Moderation analysis allows the researcher to determine whether the strength of the relationship between the independent and dependent variables varies depending on the level of the moderating variable. Before conducting regression analysis, standard statistical assumptions were assessed to ensure the validity of results. These assumptions included normality of residuals, linearity of relationships, homoscedasticity of error terms, and absence of multicollinearity among predictor variables. Ensuring these assumptions strengthens the robustness and credibility of statistical findings.

To maintain research integrity, ethical considerations were carefully observed throughout the research process. Participation in the survey was voluntary, and respondents were informed about the purpose of the study before completing the questionnaire. Confidentiality and anonymity were maintained by avoiding the collection of personally identifiable information. Responses were used solely for academic research purposes and reported only in aggregated form. These procedures ensured compliance with standard research ethics and protected the rights and privacy of all participants.

Results and Data Analysis

This section presents the empirical findings of the study. The analysis begins with descriptive statistics describing respondent characteristics, followed by reliability analysis to assess internal consistency of measurement scales. Correlation analysis is then conducted to examine relationships among the study variables. Finally, regression and moderation analyses are performed to test the proposed hypotheses regarding the relationship between artificial intelligence integration, organizational readiness, and project manager efficiency.

Respondent Demographics

A total of **250 valid responses** were collected from project managers and senior project officials working in Pakistani public sector project-based organizations. The demographic profile of respondents provides insight into the professional background and experience of participants involved in the study. Most respondents held positions directly related to project management responsibilities, including project managers, project coordinators, and senior project officers. A majority of respondents reported several years of professional experience in project management, indicating that the sample consisted of individuals with substantial exposure to project-based organizational environments. Table 1 presents the demographic distribution of respondents according to gender, professional role, and years of project management experience.

Table 1: Demographic Characteristics of Respondents (N = 250)

Variable	Category	Frequency	Percentage
Gender	Male	168	67.2%
	Female	82	32.8%
Professional Role	Project Manager	110	44.0%
	Senior Project Officer	78	31.2%
	Project Coordinator	62	24.8%
Experience	1–5 years	72	28.8%
	6–10 years	108	43.2%
	More than 10 years	70	28.0%

The demographic distribution indicates that the respondents possess sufficient professional experience and relevant roles within project management environments, supporting the reliability of their responses regarding artificial intelligence integration and managerial efficiency.

Descriptive Statistics

Descriptive statistics were calculated to examine the central tendency and variability of responses for each study variable. The results provide a preliminary understanding of respondents' perceptions regarding artificial intelligence integration, organizational readiness, and project manager efficiency within their organizations.

Table 2: Descriptive Statistics

Variable	Mean	Standard Deviation
Artificial Intelligence Integration	3.76	0.62
Organizational Readiness	3.81	0.58
Project Manager Efficiency	3.89	0.55

The mean values for all constructs are above the neutral midpoint of the Likert scale, indicating generally positive perceptions of artificial intelligence integration, organizational readiness, and managerial efficiency within the sampled organizations.

Reliability Analysis

Reliability analysis was conducted to assess the internal consistency of the measurement scales used in the study. Cronbach's alpha coefficients were calculated for each construct. Values greater than 0.70 indicate acceptable reliability for social science research.

Table 3: Reliability Analysis

Construct	Number of Items	Cronbach's Alpha
Artificial Intelligence Integration	18	0.91
Project Manager Efficiency	18	0.89
Organizational Readiness	18	0.93

The results demonstrate that all constructs exhibit high levels of internal consistency. Cronbach's alpha values exceed the recommended threshold of 0.70, confirming the reliability of the measurement scales used in this study.

Correlation Analysis

Correlation analysis was performed to examine the relationships among the key study variables and to identify potential multicollinearity issues prior to regression analysis.

Table 4: Correlation Matrix

Variable	1	2	3
1. Artificial Intelligence Integration	1		
2. Organizational Readiness	0.54**	1	
3. Project Manager Efficiency	0.61**	0.58**	1

Note: $p < 0.01$

The correlation results indicate significant positive relationships among all variables. Artificial intelligence integration is positively correlated with project manager efficiency ($r = 0.61, p < 0.01$), suggesting that higher levels of AI integration are associated with greater managerial efficiency. Organizational readiness also shows a significant positive correlation with both artificial intelligence integration and project manager efficiency. The correlation coefficients remain below the commonly accepted threshold for multicollinearity concerns (0.80), indicating that the variables are sufficiently distinct for regression analysis.

Regression Analysis

Multiple regression analysis was conducted to examine the direct effect of artificial intelligence integration on project manager efficiency.

Table 5: Regression Results

Predictor	Beta (β)	t-value	p-value
Artificial Intelligence Integration	0.57	9.82	<0.001

Model Summary:

- $R^2 = 0.37$
- $F = 96.43$
- $p < 0.001$

The results indicate that artificial intelligence integration has a significant positive effect on project manager efficiency ($\beta = 0.57, p < 0.001$). The model explains approximately **37% of the variance** in project manager efficiency.

These findings provide empirical support for the hypothesis that artificial intelligence integration enhances managerial efficiency within project-based public sector organizations.

Moderation Analysis

To examine the moderating role of organizational readiness, an interaction term between artificial intelligence integration and organizational readiness was included in the regression model.

Table 6: Moderation Analysis

Predictor	Beta (β)	t-value	p-value
Artificial Intelligence Integration	0.42	7.10	<0.001
Organizational Readiness	0.36	6.21	<0.001
AI Integration $\times$ Organizational Readiness	0.19	3.44	0.001

Model Summary:

- $R^2 = 0.48$
- $\Delta R^2 = 0.11$

- **F = 76.85**
- **p < 0.001**

The interaction term between artificial intelligence integration and organizational readiness is statistically significant ($\beta = 0.19$, $p < 0.01$). This result indicates that organizational readiness strengthens the relationship between artificial intelligence integration and project manager efficiency.

Organizations with higher levels of readiness are therefore more likely to realize efficiency gains from artificial intelligence integration.

Hypothesis Testing Summary

The results of hypothesis testing are summarized in Table 7.

Table 7: Hypothesis Testing Results

	Hypothesis Statement	Result
H1	Artificial intelligence integration positively influences project manager efficiency.	Supported
H2	Organizational readiness positively moderates the relationship between artificial intelligence integration and project manager efficiency.	Supported

The findings confirm that artificial intelligence integration significantly improves project manager efficiency and that organizational readiness strengthens this relationship.

Discussion

The purpose of this study was to examine the relationship between artificial intelligence (AI) integration and project manager efficiency within public sector project environments, while also investigating the moderating role of organizational readiness. Drawing on the theoretical foundations of the Technology Acceptance Model (TAM), the Technology–Organization–Environment (TOE) framework, and Diffusion of Innovation (DOI) theory, the study sought to explain how technological integration and organizational conditions jointly influence managerial efficiency in project-based organizations. The empirical findings provide important insights into how AI-enabled technologies shape managerial processes and highlight the organizational conditions required for effective technology utilization. The results demonstrate that artificial intelligence integration has a significant positive effect on project manager efficiency. This finding indicates that the integration of AI-enabled tools into organizational workflows enhances managers’ ability to process information, make decisions, and coordinate project activities effectively. Project managers operating in environments where artificial intelligence technologies are embedded within project management systems reported higher levels of efficiency in planning, monitoring, and communication activities. These results support the growing body of literature suggesting that artificial intelligence technologies enhance managerial performance by improving analytical capability and reducing cognitive workload (Dwivedi et al., 2023; Marnewick, 2023; Almansour et al., 2025). The positive relationship between artificial intelligence integration and project manager efficiency can be explained through the enhanced information-processing capabilities provided by AI-enabled systems. Project management environments are characterized by complex decision-making processes that involve analyzing multiple sources of information related to project schedules, budgets, resources, and risks. Artificial intelligence technologies enable managers to analyze large datasets quickly and generate predictive insights that support more informed decision-making. By providing real-time analytical support and automated monitoring capabilities, AI technologies allow project managers to identify potential problems earlier and implement corrective actions more efficiently.

These findings are consistent with the theoretical assumptions of the Technology Acceptance Model, which suggests that managers are more likely to utilize technological systems that improve their work performance. When project managers perceive artificial intelligence systems as useful tools that enhance their ability to perform managerial tasks, they are more likely to integrate these systems into their daily decision-making processes. The results therefore provide empirical evidence supporting the argument that perceived usefulness of artificial intelligence technologies contributes to improved managerial outcomes. Beyond the direct effect of artificial intelligence integration, the results also highlight the important role of organizational readiness in shaping the effectiveness of AI-enabled technologies. The moderation analysis demonstrates that organizational readiness significantly strengthens the relationship between artificial intelligence integration and project manager efficiency. This finding suggests that organizations with higher levels of readiness are better positioned to translate technological capabilities into meaningful managerial improvements. Organizational readiness reflects the extent to which an organization possesses the structural and psychological capacity to implement technological change successfully. In organizations characterized by strong leadership support, adequate technological infrastructure, and skilled employees, artificial intelligence systems are more likely to be effectively integrated into managerial workflows. These organizational conditions enable project managers to utilize AI-generated insights confidently and consistently when making decisions related to project planning, coordination, and monitoring.

The moderating effect of organizational readiness supports the theoretical assumptions of the Technology–Organization–Environment framework, which emphasizes the importance of organizational context in shaping technology implementation outcomes. According to the TOE framework, the successful adoption and utilization of technological innovations depend not only on technological capabilities but also on organizational characteristics such as leadership support, resource availability, and institutional readiness. The present findings provide empirical evidence supporting this perspective by demonstrating that organizational readiness strengthens the efficiency-enhancing impact of artificial intelligence integration. The findings also align with Diffusion of Innovation theory, which suggests that the adoption and effective use of new technologies depend on organizational learning and communication processes. Organizations with higher levels of readiness typically invest in training, skill development, and knowledge-sharing mechanisms that facilitate the diffusion of technological innovations among employees. These processes enable project managers to develop greater confidence in using artificial intelligence technologies and to incorporate them more effectively into project management practices. In contrast, organizations with lower levels of readiness may struggle to realize the full benefits of artificial intelligence integration. Limited leadership support, inadequate infrastructure, and insufficient employee training can create barriers that prevent project managers from utilizing AI technologies effectively. In such environments, artificial intelligence systems may remain underutilized or applied inconsistently, reducing their potential impact on managerial efficiency. These findings highlight the importance of organizational capacity-building efforts in supporting successful digital transformation initiatives within public sector organizations.

The results of this study are particularly significant in the context of public sector project management. Public sector organizations often operate within complex institutional environments characterized by bureaucratic procedures, regulatory constraints, and limited resources. These institutional factors can create challenges for implementing advanced technologies such as artificial intelligence. However, the findings suggest that when organizational readiness is sufficiently developed, AI technologies can significantly enhance managerial efficiency even within the constraints of public sector governance structures.

In the Pakistani context, where public sector organizations are increasingly investing in digital transformation initiatives, the integration of artificial intelligence technologies has the potential to

improve project management practices and enhance service delivery. Public sector projects in areas such as infrastructure development, healthcare, and education often involve large-scale coordination and complex decision-making processes. Artificial intelligence technologies can support these processes by providing analytical tools that improve forecasting accuracy, enhance monitoring capabilities, and facilitate more efficient resource allocation. Another important implication of the findings relates to the role of managerial competence in technology utilization. While artificial intelligence technologies provide advanced analytical capabilities, their effectiveness ultimately depends on managers' ability to interpret and apply AI-generated insights. Organizations must therefore ensure that project managers receive appropriate training and support to develop the skills required to utilize artificial intelligence systems effectively. Without sufficient managerial competence, the benefits of AI integration may remain limited.

The study also contributes to the broader literature on digital transformation by emphasizing the importance of organizational conditions in determining the outcomes of technological innovation. Many digital transformation initiatives fail because organizations focus primarily on technological investment without addressing the organizational capabilities required to support effective technology use. The present findings reinforce the argument that technological implementation must be accompanied by organizational readiness initiatives that strengthen leadership commitment, infrastructure development, and employee competence (Verhoef et al., 2023; Vial, 2024). From a theoretical perspective, the study extends existing research on artificial intelligence and project management by linking AI integration to managerial efficiency outcomes rather than focusing solely on technology adoption or organizational performance. By examining project manager efficiency as a distinct managerial outcome, the study provides a more nuanced understanding of how artificial intelligence technologies influence managerial practices within project-based environments.

Overall, the findings suggest that artificial intelligence integration represents a valuable tool for improving managerial efficiency in project-based organizations, particularly when supported by strong organizational readiness. By combining technological capabilities with supportive organizational structures, public sector organizations can enhance the effectiveness of project management processes and improve the delivery of public services.

Implications, Limitations, and Future Research

The findings of this study provide several important theoretical and practical implications for research on artificial intelligence integration and project management, particularly within public sector organizations operating in developing economies. At the same time, the study acknowledges certain limitations that provide opportunities for future research to expand and refine the present findings. From a theoretical perspective, this study contributes to the growing literature on artificial intelligence and digital transformation by examining the relationship between artificial intelligence integration and project manager efficiency. While much of the existing research has focused on technology adoption intentions or organizational performance outcomes, comparatively little attention has been given to managerial efficiency as a distinct outcome of artificial intelligence implementation. By focusing on project manager efficiency, the study provides a more nuanced understanding of how artificial intelligence technologies influence managerial processes such as planning, coordination, decision-making, and monitoring in project-based environments.

The study also contributes to the integration of established technology adoption frameworks within the context of artificial intelligence research. By combining insights from the Technology Acceptance Model, the Technology–Organization–Environment framework, and Diffusion of Innovation theory, the research provides a multi-level explanation of how technological, organizational, and behavioral factors jointly shape the outcomes of artificial intelligence integration. The empirical findings reinforce the argument that technological innovations do not

produce uniform outcomes across organizations; rather, their effectiveness depends on the organizational context in which they are implemented. In particular, the identification of organizational readiness as a moderating factor advances the theoretical understanding of technology-performance relationships. The results demonstrate that organizational readiness strengthens the positive relationship between artificial intelligence integration and project manager efficiency. This finding highlights the importance of organizational conditions such as leadership support, technological infrastructure, and employee competence in enabling organizations to realize the benefits of advanced digital technologies. Consequently, the study supports prior research suggesting that organizational capability plays a critical role in translating technological investment into managerial and operational performance improvements.

The study also offers several practical implications for public sector organizations and policymakers involved in digital transformation initiatives. Public sector institutions increasingly face pressure to improve efficiency, transparency, and accountability in the delivery of development and infrastructure projects. Artificial intelligence technologies provide tools that can enhance decision-making, improve forecasting accuracy, and support more efficient coordination of complex project activities. The findings of this study suggest that integrating artificial intelligence into project management systems can significantly improve managerial efficiency, particularly when these technologies are embedded within routine organizational workflows (Salaheldin & Hussein, 2025). However, the results also indicate that technological adoption alone is insufficient to guarantee improved managerial performance. Organizations must ensure that appropriate organizational conditions exist to support the effective use of artificial intelligence technologies. Leadership support is essential for establishing a clear strategic direction and allocating resources necessary for successful technology implementation. Organizational leaders play a critical role in promoting a culture that encourages innovation and supports the adoption of advanced technologies within managerial practices. Technological infrastructure is another key consideration for organizations seeking to implement artificial intelligence systems. Reliable data systems, integrated digital platforms, and adequate computational capacity are necessary for AI technologies to function effectively. Without appropriate infrastructure, artificial intelligence systems may generate limited value or fail to integrate with existing organizational processes.

Employee competence also represents a crucial factor in the successful implementation of artificial intelligence technologies. Project managers and organizational staff must possess the skills necessary to interpret AI-generated insights and apply them effectively in decision-making processes. Training programs and professional development initiatives can help ensure that employees develop the analytical and technological competencies required to work with artificial intelligence systems. For policymakers responsible for public sector modernization initiatives, the findings highlight the importance of adopting a comprehensive approach to digital transformation. Investments in artificial intelligence technologies should be accompanied by policies that strengthen organizational readiness, including capacity-building programs, leadership development, and infrastructure improvements. Such initiatives can help ensure that technological innovations translate into meaningful improvements in public sector project management.

While the study provides valuable insights into the relationship between artificial intelligence integration and project manager efficiency, several limitations should be acknowledged. First, the study relies on self-reported survey data collected from project managers and senior project officials. Although self-reported measures are commonly used in organizational research, they may be subject to response bias, including social desirability bias and subjective perceptions of organizational conditions. Future studies could complement survey-based methods with objective performance indicators or qualitative approaches to obtain a more comprehensive understanding of managerial efficiency. Second, the research adopts a cross-sectional design in which data were collected at a single point in time. Cross-sectional studies allow researchers to examine

relationships among variables but limit the ability to establish causal relationships or observe changes over time. Longitudinal research designs would provide deeper insights into how artificial intelligence integration evolves within organizations and how its effects on managerial efficiency develop over time. Third, the study focuses specifically on public sector project-based organizations within Pakistan. Although this context provides valuable insights into digital transformation within developing economies, the findings may not be directly generalizable to other institutional environments or private sector organizations. Differences in organizational structures, governance systems, and technological maturity may influence how artificial intelligence technologies are implemented and utilized in different contexts. Future research could conduct comparative studies across countries or sectors to examine how institutional differences shape the outcomes of artificial intelligence integration.

Another limitation relates to the scope of variables included in the research model. The study focuses on organizational readiness as the primary contextual factor influencing the relationship between artificial intelligence integration and project manager efficiency. However, other organizational and environmental variables may also influence this relationship. For example, organizational culture, regulatory frameworks, data governance policies, and stakeholder involvement may affect the implementation and effectiveness of artificial intelligence technologies in project management environments. Future studies could expand the conceptual framework by incorporating additional contextual variables to provide a more comprehensive understanding of technology-enabled managerial performance. Future research could also explore the role of artificial intelligence in different phases of the project management lifecycle. While the present study examines the overall relationship between AI integration and managerial efficiency, further investigation could examine how artificial intelligence technologies influence specific project management functions such as risk management, stakeholder communication, and resource allocation. Such research could provide more detailed insights into the mechanisms through which artificial intelligence enhances managerial performance.

Additionally, qualitative research methods such as case studies or interviews with project managers could provide deeper insights into how artificial intelligence technologies are implemented in practice and how managers interact with AI-enabled systems in their daily work activities. Combining quantitative and qualitative approaches would allow researchers to develop a more comprehensive understanding of the socio-technical dynamics shaping artificial intelligence integration in project-based organizations. In summary, while the present study provides important contributions to the literature on artificial intelligence and project management, it also highlights several opportunities for future research to extend and refine the findings. By addressing the identified limitations and exploring additional contextual factors, future studies can further enhance understanding of how artificial intelligence technologies influence managerial practices and organizational performance in complex project environments.

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