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Impact of Project Management Resources on IT Projects Sustainability: An ESG based Framework

by

Muhammad Faheem

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Abstract

The increasing complexity of information technology (IT) projects and the growing importance of sustainability have created a need for organizations to integrate environmental, social, and governance (ESG) considerations into project management practices.

This study examines the impact of Project Management Resources (PMR) on IT project sustainability through an ESG-based framework, while investigating the role of Artificial Intelligence (AI) Adoption as a mediating mechanism and Stakeholder Engagement as a moderating factor. The study is theoretically grounded in Resource-Based View (RBV) Theory and Stakeholder Theory, which provide complementary perspectives for understanding how organizational resources, technological capabilities, and stakeholder relationships contribute to sustainable project outcomes.

A quantitative research approach was adopted, using a structured questionnaire to collect data from professionals associated with IT projects. The collected data were analyzed using appropriate statistical techniques to assess the reliability and validity of the measurement instruments and to test the proposed relationships among the study constructs. The analysis included assessment of measurement properties and hypothesis testing concerning Project Management Resources, AI Adoption, Stakeholder Engagement, and ESG Performance.

The findings demonstrate that Project Management Resources have a significant positive relationship with ESG Performance, indicating that effective utilization of project-related resources can contribute to improved environmental, social, and governance outcomes. The findings further demonstrate the importance of AI Adoption within the proposed framework, indicating that AI adoption is positively associated with Project Management Resources and ESG Performance and provides an important mechanism through which organizational resources can contribute to sustainable project outcomes. However, the proposed moderating effect of Stakeholder Engagement on the relationship between Project Management Resources and ESG Performance was not statistically significant. This finding

suggests that stakeholder engagement may require more context-specific or multi-dimensional examination to determine the conditions under which it strengthens sustainable project outcomes.

The study contributes to the existing literature by integrating Resource-Based View Theory and Stakeholder Theory into an ESG-based IT project sustainability framework. The findings emphasize that organizations can improve sustainable project outcomes by developing effective project management resources and integrating AI-enabled capabilities into project planning, decision-making, monitoring, and resource utilization. Practically, the study highlights the importance of strengthening project teams, collaborative resources, AI capabilities, ESG-oriented performance mechanisms, and stakeholder-management practices. The study also provides a foundation for future research using longitudinal, multi-sectoral, and multi-dimensional approaches to further examine the complex relationships between project management resources, AI adoption, stakeholder engagement, and ESG performance.

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Abbreviations

AI	Artificial Intelligence
ESG	Environmental, Social and Governance
KMO	Kaiser-Meyer-Olkin
PM	Project Management
PMR	Project Management Resources

Chapter 1

Introduction

The introduction part of the research thesis comprises of background, gap analysis, problem statement, research questions, research objectives, Theoretical foundation, significance of the study.

1.1 Background of the Study

Environmental, social, and governance (ESG) performance is increasingly used to evaluate organizations in addition to financial results. This has an impact on valuation, risk assessments, and legitimacy in the eyes of investors, regulators, and the general public (Sætra, 2023).

The AI-ESG protocol assesses and reveals the effects of artificial intelligence capabilities, assets, and activities on the environment, society, and governance. Stronger ESG performance boosts a company's reputation, makes it easier to obtain funding, increases its capacity for innovation, and puts it in a better position to support the Sustainable Development Goals (SDGs) (Wang and Zhang, 2025). The topic has changed from whether to invest in ESG to how businesses can methodically manage and enhance ESG outcomes as ESG expectations rise.

In this environment, program and project management resources such as budgets, governance structures, tools, procedures, and specialised sustainability staff are beginning to emerge as a crucial but poorly defined internal driver of sustainability.

According to recent research on Industry and sustainable project management, projects must be aligned with long-term sustainability goals by incorporating ESG principles into project governance, resource allocation, and execution (Szekely and Kesmarki-Gally, 2025).

Simultaneously, artificial intelligence (AI) has emerged as a strategic asset with significant potential to improve ESG performance. According to empirical research, AI capabilities can enhance ESG results by enhancing risk management, facilitating green innovation, optimising resource allocation, and boosting process efficiency (Wang and Zhang, 2025).

AI adoption assists businesses in managing social risks, tracking environmental effects in real time, and enhancing governance through improved internal control and information transparency (Xiao and Xiao, 2025).

The relationship between AI adoption and more general sustainable development or competitiveness outcomes is mediated by ESG performance in a number of studies, highlighting AI's function as a lever for sustainability (Xiao and Xiao, 2025). Another essential component of ESG performance is stakeholder engagement. Stakeholder understanding, trust, and expectations are shaped by ESG reporting and disclosure, which in turn affect resilience and sustainable culture (Mohamed Riyath and Inun Jariya, 2024). Evidence shows that ESG reporting can foster a stronger sustainability culture through stakeholders' sustainability awareness, and that strategic use of AI and stakeholder engagement enhances this process (Mohamed Riyath and Inun Jariya, 2024). According to stakeholder theory, corporations can better align ESG initiatives with stakeholder needs by using AI-enabled transparency and responsiveness, which strengthens collaboration and legitimacy (Yu et al., 2025). Combining these streams reveals a complex capability chain: project management resources facilitate structured ESG initiatives; artificial intelligence adoption may mediate this link by converting those resources into data-driven, effective, and innovative ESG practices; and stakeholder engagement may moderate the effectiveness of AI-enabled ESG management by influencing how information, expectations, and collaboration amplify or dampen ESG outcomes (Sklavos et al., 2024). The impact of project management resources on

ESG performance, using AI adoption as a mediator and stakeholder engagement as a moderator, had not been clearly modelled in previous research, which had looked at AI-ESG linkages and stakeholder roles in sustainable culture separately.

By examining how project management resources affect ESG performance, how much AI mediates this relationship, and how stakeholder engagement affects the ESG payoff of AI-enabled project management, this thesis fills that gap.

1.2 Gap Analysis

A growing body of work links AI capabilities and digital transformation to improved ESG performance, often through mechanisms such as innovation, collaboration, resource allocation efficiency, and supply chain performance (Wang and Zhang, 2025). However, the precise function of project management resources, particularly team competencies and collaborative social resources, as antecedents in this chain had been only briefly discussed. Research indicates that AI and digital tools improve innovation, collaboration, and coordination in supply chains and services (Wang and Zhang, 2025), but the fundamental team structures, project coordination techniques, and cross-functional social capital that enable these effects had not been directly theorised or measured. The majority of ESG-AI studies adopt high-level constructs such as digitalisation capability, AI capability, or human capital management without explicitly modelling team-level and collaborative social resources as separate drivers of ESG performance (Lee et al., 2024). This created a knowledge gap regarding the relationship between project management resources and ESG results. Recent empirical studies consistently demonstrate that AI improves ESG performance by increasing creativity, collaboration, efficiency, and transparency(Zhang and Yang, 2024), and some research suggests that ESG (or sustainability) performance acts as a mediator between AI and business results or sustainable development (Xiao and Xiao, 2025). However, AI is typically positioned as an autonomous ESG driver rather than a mediating instrument that converts internal project management resources into ESG gains, and no research had been found that examined the relationship between team/collaborative resources

and ESG performance through AI adoption. Stakeholder perspectives manifest in the literature in three primary ways: ESG strategy and triple-bottom-line performance are shaped by institutional or stakeholder demands, which are occasionally mitigated by digitalisation capabilities (Lee et al., 2024); ESG reporting and stakeholder sustainability knowledge influence resilience and sustainability culture as well as how AI is used (Mohamed Riyath and Inun Jariya, 2024); and there is a general desire for improved AI-ESG disclosure and responsible AI governance in order to satisfy stakeholder expectations. However, it remained uncommon to model stakeholder engagement as a moderator of AI-ESG connections, and no integrated model had conditioned the impact of AI-driven project management resources on ESG performance by stakeholder participation.

1.3 Problem Statement

Many organisations continue to deliver projects that meet time, cost, and scope targets but fail to create long-term sustainable value in environmental, social, and governance (ESG) terms. According to empirical research, sustainable project management remains only partially incorporated into conventional project procedures, and adoption of sustainability technologies is still at a preliminary stage. Project environments are frequently unsustainable for human resources as well, with intense pressure on budget, scope, and schedule resulting in attrition and burnout and exposing flaws in team building, communication procedures, and project resource management. As a result, despite rising external expectations for ethical and transparent behaviour, projects often fall short of broader ESG goals. Additionally, research shows that project and organisational performance improves when sustainability is integrated into project and organisational management, including in international development, project-based organisations, and humanitarian settings. This is achieved through resource planning, structured project management tools, and sustainability-oriented practices. A 2024 Boston Consulting Group survey found that nearly half of all respondents reported that more than 30% of technology development projects suffer from delays and budget

overruns, and nearly one in five respondents indicated that less-than-satisfactory outcomes occur more than 50% of the time. Parallel advancements in artificial intelligence demonstrate how AI capabilities can improve ESG performance by optimising resource allocation, manufacturing efficiency, supply chains, finance, and information disclosure, presenting AI as a strategic sustainability-enabling resource.

It has also been shown that ESG practices themselves improve business and project performance, particularly when backed by effective stakeholder interaction and governance processes and powered by artificial intelligence.

With AI adaption as a mediating mechanism that converts resources into sustainable outcomes and stakeholder engagement acting as a moderator that conditions the strength of these relationships, a systematic empirical investigation into the impact of project management resources on ESG performance was therefore required.

By filling this gap, this thesis advances theory at the nexus of project management, AI, and ESG, and offers useful guidance for creating resource configurations and governance mechanisms that transform projects and projects from merely "delivered" to truly sustainable.

1.4 Research Questions

i. Do project management resources influence project sustainability in terms of ESG performance in IT projects?

ii. Does AI adoption mediate the relationship between project management resources and project sustainability in terms of ESG performance in IT projects?

iii. Does Stakeholder Engagement moderate the relationship between project management resources and project sustainability in terms of ESG performance in IT projects?

1.5 Research Objectives

i. To investigate the impact of project management resources on project sustainability in terms of ESG performance in IT projects.

ii. To investigate the mediating role of AI adoption between project management resources and project sustainability in terms of ESG performance in IT projects.

iii. To investigate the moderating role of Stakeholder Engagement between project management resources and project sustainability in terms of ESG performance in IT projects.

1.6 Significance of the Study

Drawing on this research and on evidence from previous credible studies, this thesis demonstrates that very limited research has been done on Project Management Resources (Collaborative Social Resources and Team Resources) as a driver of ESG outcomes. The study sheds light on how Project Management Resources influence ESG Performance, and examines how artificial intelligence (AI) adoption and Stakeholder Engagement contribute to the ESG performance of IT projects.

1.7 Operational Definition of Key Variables

1.7.1 Project Management Resources

Project management resources are the team knowledge, process practices, tools, and organisational supports utilised to deliver programs/projects and sustain outcomes. They are considered strategic resources under a resource-based approach and VRIO logic (Mathur et al., 2013; Shah et al., 2021).

1.7.2 ESG Performance

ESG performance is an aggregate of firm activities, policies, and outcomes covering environmental, social, and governance domains that are assessed by ESG scoring systems or specific performance indicators (Rajesh and Rajendran, 2020). Environmental: aspects included in the ESG domain set that address the use of natural resources, pollution and emissions, and environmental management (Rajesh and Rajendran, 2020). Social: aspects including human resource management, community relations, and labour practices (Rajesh and Rajendran, 2020). Governance: aspects covering disclosure practices, risk supervision, board composition, and compliance (Rajesh and Rajendran, 2020).

1.7.3 Adoption of Artificial Intelligence

AI (in organisational studies) is defined as an organisational capability reflecting the extent to which an organisation has adopted AI technologies, developed internal AI skills and processes, and integrated AI into routines that enable innovation and performance outcomes (Gazi et al., 2024).

1.7.4 Stakeholder Engagement

In this study, stakeholder engagement describes how extensively, through which channels, and how well a firm interacts with its internal and external stakeholders in order to gather their views, collaborate with them, or answer to them. It is generally treated as a measurable organisational practice (Esposito et al., 2024).

Chapter 2

Literature Review

2.1 Project Management Resources and Project Sustainability ESG Performance

The Resource-Based View holds that valuable organisational resources underpin a lasting competitive advantage (Barney et al., 2001). Within this logic, a leadership team drawn from different cultural backgrounds can be treated as a strategic asset, since it brings a wider pool of knowledge, experience, and viewpoints to the firm (Paolone et al., 2024). Such diversity helps executives notice and respond to the varied expectations of stakeholders (Khan et al., 2024) and enlarges the set of ideas that feed into strategic decisions (Al-Hiyari et al., 2023). As globalisation advances and sustainability pressures grow, ESG performance has become a key gauge of how competitive and legitimate a company is perceived to be. It captures the extent to which firms build environmental responsibility, social commitment, and sound governance into everyday business practice (Aliani et al., 2024; Vasenin et al., 2026; Khlifi et al., 2026). The ESG concept has been reflected in several important trends that have evolved over the past two decades. First, the UN Sustainable Development Goals have spurred global non-financial reporting initiatives that raise stakeholder awareness of corporate responsibility (Vasenin et al., 2026). For example, companies are widely involved in non-financial reporting initiatives,

publishing data on employee training, charity, investment in environmental infrastructure, and the development of new management approaches to ensure the harmonious social, environmental, and financial development of the firm (Kaiser, 2020).

The ESG agenda provides a conceptual framework for bringing together the hierarchically organised departments of companies in the process of managing social, environmental, and financial risks (Arvidsson and Dumay, 2022; De Spiegeleer et al., 2023), and is increasingly seen as a strategic shell for a range of management practices, playing a role alongside the mission of the company and its long-term development objectives.

Among the positive signals for the market are corporate social responsibility practices that develop the human resources of the local community beyond the boundaries of company ownership. Education, philanthropy, improved working conditions, respect for rights, and the creation of human capital are integral components of long-term economic growth, so signals of such business practices reduce perceived risk and attract additional capital to the company (Dam and Scholtens, 2015).

Practices of corporate responsibility towards people have evolved over recent decades into complex forms of social partnership aimed at investing in human capital over the long term; the practice of these years has shown that it is especially important to support social programs in regions that exploit natural resources, such as the social paternalism of mining companies common in Russia and China (Belyaeva and Kazakov, 2015).

Gupta (2011) asserts that tacit knowledge is context-specific, hard to formalise or record (Hirai et al., 2007), and frequently retained in the minds of individuals and groups. This kind of knowledge can only be transmitted through direct human interaction and participation (Nonaka, 1994), and, according to Gamble and Blackwell (Gamble and Blackwell, 2001), such implicit knowledge is beneficial and fosters organisational innovation. Tacit knowledge resources in project management include team project management skills, information-sharing procedures, and the exchange of best practices (Jugdev and Thompson, 2011).

A study found that an organisation's high performance and competitive advantage are greatly influenced by the effective acquisition and utilisation of knowledge resources (Drucker, 1993). In private-sector organisations, previous studies have identified a range of resources that support effective project management, including professional skills, management methodologies, informal knowledge-sharing, orientation programmes, peer learning, workplace training, and mentoring (Dainty et al., 2005; Ofori, 2014; Jugdev and Mathur, 2006a; Mathur et al., 2013; Jugdev and Mathur, 2006b).

Jugdev and Mathur (2006b) categorised project management team resources into explicit and tacit components. Explicit resources comprise formally documented and codified knowledge, including professional certifications, project records, and other documented project management practices (Mathur et al., 2013).

In contrast, tacit resources are developed through informal interactions, mentoring, case-based learning, brainstorming, job shadowing, and knowledge exchange, enabling project team members to transfer experiential knowledge within project-based organisations (Jugdev and Mathur, 2006b).

Nanthagopan et al. (2016) further extended the concept of project management resources by examining collaborative social resources and distinguishing between explicit and tacit forms. Explicit social resources include guidance from government agencies and donors, consultations within and across consortiums, formal information dissemination, joint activities, and structured opportunities for interaction. Tacit social resources, on the other hand, encompass joint initiatives, informal communication, stakeholder collaboration, relationships among project participants, and social marketing through online networks. Evidence from Sri Lankan NGOs demonstrates the importance of these resources in strengthening project-related capabilities. Previous research has similarly emphasised capacity development as a means of improving organisational effectiveness and sustainability. Some studies have focused on strengthening organisational management through appropriate procedures, structures, and institutional practices (Lusthaus, 2002; Okorley and Nkrumah, 2012), whereas others have highlighted the importance of personnel communication, leadership capabilities, community participation, and technical

competencies (Jamal et al., 2014; Stavros, 1998). Other scholars have emphasised strategic leadership and effective governance (Ronggui et al., 2014), continuous development of managerial and leadership capabilities and relationships (Lusthaus, 2002), as well as external networking and stakeholder engagement as mechanisms for enhancing organisational effectiveness (Ronggui et al., 2014).

Overall, the literature suggests that the availability and effective utilisation of project management resources can strengthen organisational capabilities and contribute to improved environmental, social, and governance (ESG) performance.

Accordingly, Project Management Resources are expected to have a positive influence on project sustainability in terms of ESG Performance.

H1: Project Management Resources will have a positive impact on the sustainability of a project in terms of ESG Performance.

2.2 Project Management Resources and Artificial Intelligence Adoption

Bodea et al. (Bodea et al., 2020) conducted a systematic literature review of 365 publications from IEEE and Scopus databases and established that machine learning is the most widely adopted AI technology in project management, significantly improving resource allocation, predictive analytics, and risk mitigation across multiple industries. The study developed a synthesis framework guided by five research questions addressing AI technologies, project management tasks, and requirements for successful adoption, offering a structured roadmap for organizations building effective AI integration strategies. Findings confirmed that AI improves project management by providing strategic decision support insights that enable project managers to analyze historical data and make more informed choices about resource allocation and risk mitigation in complex environments. However, the study relied solely on a literature review methodology and did not empirically validate the proposed framework through primary data collection, limiting the confirmatory strength of conclusions drawn about AI's positive impact

on project management resources. Taboada et al. (Taboada et al., 2023) conducted an extensive review of AI applications in project environments and reported that AI-enabled technologies can strengthen project planning, scheduling, risk assessment, and resource allocation through the analysis of historical and real-time project information. Across different industries and project settings, these capabilities support more accurate forecasting and facilitate timely responses to emerging risks, thereby improving project performance in terms of time, cost, and quality.

The authors further emphasised the importance of AI-based resource management in dynamic project environments, where frequent changes in project scope, financial constraints, and stakeholder expectations require rapid and adaptive decision making. Nevertheless, the study identified algorithmic bias and limited transparency of advanced AI models as significant challenges, particularly when AI-supported resource allocation requires accountability and stakeholder confidence.

Snider et al. (2022) examined the effectiveness of reinforcement learning algorithms in dynamically reallocating resources across 35 software development projects and found that AI-driven resource allocation reduced idle time by 22% compared to static resource plans, demonstrating a practically significant improvement in project resource utilization. The study highlighted that AI systems learn from past resource allocation decisions and continuously improve their recommendations over time, making them increasingly effective at optimizing project resource utilization as project data accumulates.

The authors argued that AI's capacity to simulate various project scenarios and dynamically adjust resource assignments in real-time provides project managers with a significant strategic advantage in managing uncertainty in fast-moving development environments. However, the study was limited to 35 software development projects and lacked cross industry validation, meaning that generalizability to construction, healthcare, or manufacturing project environments remains uncertain.

Felicetti et al. (2024) empirically investigated how project managers adopt generative AI tools, specifically ChatGPT, for enhanced project oversight using an

online survey of 34 project managers across IT, industrial, and service sector organizations. The study employed Adaptive Structuration Theory and found that AI adoption fundamentally reshapes resource management workflows by improving sprint planning, early risk detection, optimized resource allocation, and greater responsiveness to dynamic project demands.

Findings revealed that a majority of project managers have a strong intention to incorporate AI systems into their workflows in the near future, reflecting growing recognition of AI's potential to transform traditional project management resource practices.

However, the study was limited by a relatively small sample of 34 respondents focused on a single AI tool, which may not fully represent the diversity of AI adoption experiences and resource management impacts across different organizational and project contexts.

Diaz Ferrera (2024) explored AI's impact on project management across manufacturing, technology, and construction industries and found that 46% of participants primarily use AI for task automation, which significantly boosts project efficiency and team productivity across all three sectors studied.

The research indicated that AI adoption leads to measurable improvements in resource management, communication efficiency, and strategic decision-making, enabling project teams to redirect human resources from routine tasks toward higher-value analytical activities.

Key findings demonstrated a strong positive correlation between AI usage and perceived productivity gains, underscoring AI's potential for project resource optimization, while also identifying lack of training and high initial costs as critical adoption barriers.

However, the study acknowledged that these barriers prevent many organizations from fully leveraging AI's positive impact on project management resources, particularly in smaller firms with limited financial and technical capacity.

Lokhande (2022) examined AI smart tools in project management and confirmed their positive contribution to resource optimization, scheduling accuracy, and

project control, finding that AI tools enhance precision in resource planning through data-driven insights that improve predictions about requirements, timelines, and potential bottlenecks. The research highlighted that AI smart tools are particularly effective at integrating information from multiple project data sources to provide project managers with a real-time and comprehensive view of resource utilization, enabling more proactive management of project constraints.

However, the study noted that legacy system incompatibility presents a significant integration challenge for large enterprises, as traditional project management software may not be fully compatible with modern AI technologies and data architectures.

The research lacked longitudinal empirical depth needed to assess the sustained impact of AI smart tools across multiple project cycles and organizational learning stages, and future research was recommended to address this gap.

Wachnik (2022) analyzed AI use in project management and found measurable improvements in decision making quality and resource management efficiency when AI tools are systematically integrated into project workflows across organizations of varying sizes and industry backgrounds. The study demonstrated that AI adoption supports more accurate workload distribution, better identification of resource constraints, and improved forecasting of project outcomes, collectively contributing to higher levels of project performance and stakeholder satisfaction.

Findings further indicated that AI's positive impact on project management resources is strongly conditioned by data infrastructure quality, with firms possessing richer and more structured project data experiencing significantly greater resource management benefits. However, the study emphasized that skill gaps among project managers remain a persistent barrier to realizing AI's full potential, and without adequate investment in training and data governance, organizations risk underutilizing AI tools and failing to capture expected resource management improvements.

Li et al. (2025a) investigated the relationship between AI adoption and corporate ESG performance using panel data from Chinese A-share listed firms covering the period from 2015 to 2023. Their findings demonstrate that AI adoption contributes

significantly to improved ESG performance through three main mechanisms: reducing financing constraints, strengthening external monitoring, and enhancing the quality of information disclosure. Drawing on the Resource-Based View and stakeholder theory, the study further demonstrates that AI has evolved beyond its traditional role as an operational efficiency tool and can function as a strategic organisational resource. By facilitating the development of dynamic capabilities, AI enables firms to integrate technological capabilities with broader sustainability objectives.

Heterogeneity analysis revealed that positive impacts are more pronounced in non-state-owned enterprises, high-polluting industries, and high-tech sectors, reflecting important ownership based and sectoral variation in AI-driven sustainability outcomes. However, the study was geographically limited to China and may not transfer directly to Western or developing market environments where ESG regulatory frameworks and firm ownership structures differ significantly.

(Chen and Zhang, 2025) provided robust empirical evidence from an emerging market context linking AI development to improved ESG performance, with absorptive capacity identified as the key mediating mechanism through which AI adoption translates into enhanced sustainability outcomes. The study adopted a text-based AI adoption measure as an innovative approach to quantifying organizational AI integration, offering a more precise alternative to traditional keyword or patent-based proxies that often conflate AI intent with actual implementation.

Findings demonstrated that firms with greater absorptive capacity are better positioned to leverage AI capabilities for environmental stewardship, social responsibility, and governance improvements, reinforcing the strategic importance of knowledge assimilation in the AI ESG relationship. However, the study acknowledged that common AI proxies used across prior studies may understate adoption in service sectors, limiting cross-study comparability and measurement accuracy.

Li et al. (2026) drew on 23,094 firm-year observations of Chinese A-share listed companies between 2009 and 2021 and reported that AI raises firm ESG performance, which they linked to technological progress improving environmental efficiency and governance transparency. Their mechanism tests indicated that AI

eases financing constraints, strengthens internal controls, and lifts overall firm performance, and that these channels jointly improve ESG outcomes over time. The effect was stronger in privately owned firms than in state-owned ones, pointing to ownership-related differences in how AI supports sustainability across institutional settings. However, the study did not sufficiently examine how project-level resource management practices mediate or moderate the AI–ESG relationship, leaving an important gap for future research to address. Alghalayini (Alghalayini, 2026) argued that AI-assisted monitoring significantly improves the accuracy and timeliness of environmental reporting, with the strongest effects observed in energy intensive sectors where precision in emissions tracking and resource consumption measurement is most critical for ESG compliance. The study drew on multi-country panel evidence and found that firms adopting AI-driven reporting systems show measurable improvements in ESG disclosure quality, particularly in the environmental dimension which has historically suffered from inconsistency in corporate sustainability reporting. The authors connected their findings to the broader digital infrastructure literature, suggesting that AI capacity serves as a prerequisite for effective sustainability reporting, particularly in economies where ESG regulatory frameworks are still developing and standardization remains incomplete. However, cross country variation in ESG reporting standards was not adequately controlled, which may have introduced measurement inconsistencies that limit the precision of cross-national comparisons in their analysis. Li (Li, 2026) investigated the mediating role of digital transformation in the AI ESG relationship across Chinese manufacturing firms and found that AI adoption is positively associated with ESG performance, with digital transformation serving as a key organizational channel that partially mediates this relationship. The study revealed that environmental and social dimensions showed stronger responsiveness to AI adoption compared to governance, suggesting that AI's contribution to corporate governance requires additional organizational enablers to fully materialize. However, the study excluded financial and high-tech firms due to distinct regulatory structures, which limits the generalizability of findings across all industrial sectors.

Future research was recommended to extend the analysis to cross-country settings and examine how governance specific ESG dimensions respond differently to AI adoption across diverse institutional environments. Khlifi et al. (2026) analyzed 122 European firms listed on the STOXX 600 index and revealed that AI adoption positively and significantly mediates the relationship between executive cultural diversity and ESG performance through enhanced transparency, innovation, and stakeholder trust.

The study employed structural equation modelling and found that culturally diverse executive teams are more inclined to champion AI-driven initiatives that indirectly enhance sustainability outcomes across environmental, social, and governance dimensions.

However, the study was restricted to a relatively short three-year panel, which may not fully capture the long term dynamics of how AI-mediated cultural diversity translates into sustained ESG improvements.

The authors acknowledged that sector-specific variations in the mediation effect were not sufficiently explored and called for longitudinal studies with broader industrial and geographical coverage. Shen et al. (2025) built an improved measure based on a large language model to capture genuine AI adoption, and found that such adoption is strongly and positively tied to ESG outcomes, mainly through green innovation and better internal control quality.

Rather than using the usual keyword-count proxies, the authors applied a domain-adapted model that separates substantive AI deployment from rhetorical references in annual reports, which addresses the long-standing gap between what firms say and what they do about AI. The relationship was stronger in large, technology-intensive firms, where AI is embedded in operations, underlining the importance of organisational readiness in turning AI capability into sustainability gains. The sample was limited to Chinese A-share firms, however, and the authors called for cross-country studies to check whether the findings hold under other institutional and regulatory conditions.

H2: Project Management Resources will have a positive impact on Adoption of AI.

2.3 Mediating Effect of Adoption of AI between Project Management Resources and Project Sustainability in terms of ESG Performance

The contemporary business landscape is characterised by increasing complexity, rapid technological advancement, and intensified competitive pressures, making the effective acquisition and utilisation of knowledge essential for organisational success. Firms are required to continually develop their knowledge base and capabilities as markets evolve and innovative products and services emerge at an accelerating rate (Tortorella et al., 2023).

At the same time, organizations operate under considerable uncertainty arising from external disruptions, including the COVID-19 pandemic, geopolitical instability, and fluctuations in energy prices, which have increased the need for organizational adaptability and resilience (Penco et al., 2023). Parallel to these developments, digital technologies, particularly mobile Internet and artificial intelligence (AI), have expanded considerably beyond their traditional organizational applications and have become integral to both business operations and everyday activities (Bajpai and Misra, 2024; Yu et al., 2025).

AI refers broadly to computational approaches that enable machines to emulate selected aspects of human intelligence. Through the processing and learning of large volumes of data, AI-based systems can undertake cognitive tasks including image and pattern recognition, speech processing, and decision making (Dhamija and Bag, 2020; Wamba-Taguimdje et al., 2020; Zhang and Yang, 2024; Yu and Shi, 2025). Beyond conventional measures of financial performance, contemporary organisations are increasingly expected to pursue growth that is sustainable, socially responsible, and supported by effective governance.

In this context, environmental, social, and governance (ESG) considerations have become increasingly important for maintaining organisational resilience, stakeholder confidence, and long-term competitiveness. The expanding capabilities of AI provide organisations with opportunities to strengthen their ESG practices by

supporting data-driven analysis, improving managerial decision processes, identifying emerging patterns, and responding more effectively to changing stakeholder expectations (Li et al., 2025b; Ferrigno et al., 2025). From a social perspective, AI-enabled systems can assist organisations in identifying and monitoring issues across business networks, including labour-related conditions within supply chains (Ameen et al., 2021). From a governance perspective, the application of AI can facilitate greater transparency, enhance risk identification and assessment, and support regulatory compliance, thereby contributing to improved organisational governance and overall ESG performance (Reddy et al., 2020). The empirical literature increasingly provides evidence of a relationship between AI adoption and corporate sustainability outcomes. Yu et al. (Yu et al., 2025), for instance, reported that AI capabilities contribute significantly to ESG performance among Chinese A-share listed companies. Consistent with this finding, Chen et al. (2024a, 2024b) identified beneficial effects of AI on ESG outcomes, with comparatively stronger effects observed among non-state-owned enterprises and firms operating in high-technology sectors. More recently, Li et al. (Li et al., 2026) provided further evidence that AI adoption is associated with enhanced ESG scores and highlighted the potential of AI to support broader transformations towards sustainable business practices. Building on this body of evidence, the present study proposes that AI adoption may serve as an important mechanism through which project management resources contribute to project sustainability.

The preceding studies establish that AI adoption is associated with stronger ESG outcomes. However, the present study positions AI adoption not only as a predictor but as a mediating mechanism that transmits the effect of organisational resources to performance. This mediating logic is well supported in the resource-based and IT-capability literature. Mikalef and Gupta (Mikalef and Gupta, 2021), drawing on the resource-based view, argued that AI creates value when AI-specific resources are combined into an organisational AI capability, and showed empirically that this capability enhances organisational creativity and firm performance. In this view, resources do not generate outcomes on their own; they become productive when they are converted into AI-enabled capabilities. This is precisely the

role assigned to AI adoption in the proposed framework, where Project Management Resources are the underlying resource base and AI adoption is the capability through which they are converted into ESG performance.

Evidence from the information systems literature points in the same direction. Wamba-Taguimdje et al. (2020) examined the business value of AI-based transformation projects using the theory of IT capabilities, and reported that AI improves performance at both the organisational and process levels. In a related study grounded in the resource-based view and dynamic capabilities, the same authors found that firms improve their performance when they use AI capabilities to reconfigure their process-oriented dynamic capabilities, which establishes a mediating pathway between AI and firm performance Wamba-Taguimdje et al. (2020). These studies support the view that the performance benefits of AI are realised through organisational processes and capabilities, rather than through the technology alone.

Studies that test AI adoption explicitly as a mediator are more recent and come mainly from SME and sustainability contexts. In Pakistani manufacturing ul Haq and Mohd Suki (2024) integrated the technology–organisation–environment framework, the resource-based view and diffusion of innovation theory, and found that trading partnerships, change management capability and leadership vision were the main drivers of AI adoption. They further reported that AI adoption mediated the relationship of trading partnerships and competitive pressure with SME performance.

This is relevant to the present study for two reasons: it shows that internal organisational capabilities and relationships shape AI adoption, and it was conducted in the same national context. In the sustainability domain, Li and Jin (2024) showed that AI adoption intensity improves corporate sustainability performance across economic, environmental and social dimensions, and that organisational change acts as a mediator in this relationship, with digital capability strengthening the effect. Taken together, these findings indicate that the link between AI adoption and sustainability outcomes depends on the organisational conditions that surround it, which is consistent with positioning AI adoption within a

resource-based mediation model. The project management literature offers further support, although mostly at the conceptual or review level. In a systematic review of 61 peer-reviewed articles, Su and Ayob (2025) concluded that AI technologies influence several project success dimensions, including time, cost, quality, risk management, stakeholder management and decision-making support, while noting that the maturity of AI integration differs across industries and project types. Bushuyev et al. (2025) similarly proposed AI-based tools to support sustainable development projects in complex and uncertain environments. These studies suggest that AI can strengthen project planning, monitoring, risk identification and resource allocation, which are the functions that Project Management Resources are expected to support.

Despite this evidence, two gaps remain. First, most mediation studies treat AI adoption as a link between firm-level technological, organisational or environmental factors and general firm performance, rather than ESG performance.

Second, studies of AI in project management focus largely on conventional success criteria such as time, cost and quality, and rarely model AI adoption as the mechanism that converts project management resources into sustainability outcomes. To the best of the researcher's knowledge, this mediating role has not been tested in IT projects with an ESG-based outcome. The present study addresses this gap.

Taken together, this evidence positions AI adoption as a plausible route through which project management resources contribute to project sustainability. The following hypothesis is therefore advanced:

H3: The Adoption of AI mediates the relationship between Project Management Resources and Project Sustainability in terms of ESG Performance.

Li et al. (2025b) conducted a large-scale empirical investigation using panel data from Chinese A share listed companies from 2015 to 2023 and confirmed that AI adoption significantly enhances corporate ESG performance through financing constraint alleviation, external oversight enhancement, and information disclosure improvement. The study integrated resource-based view and stakeholder theory and argued that AI technologies evolve from efficiency-enhancing tools into

strategic resources enabling firms to develop dynamic capabilities aligned with sustainability objectives across environmental, social, and governance dimensions. Heterogeneity analysis revealed that positive impacts are more pronounced in non-state-owned enterprises, high polluting industries, and high tech sectors, reflecting important ownership based and sectoral variation in how AI drives ESG outcomes. However, the study was geographically limited to China and findings may not transfer directly to Western or developing market environments where ESG regulatory frameworks and institutional structures differ significantly.

As noted earlier, evidence from Chinese listed firms points consistently in the same direction: AI adoption is associated with stronger ESG outcomes, with the effect varying by firm size, ownership, and technology intensity However, the study did not examine how project-level resource management practices moderate the AI–ESG relationship, leaving an important gap for future research particularly in linking operational AI use to broader sustainability performance metrics (Shen et al., 2025; Li et al., 2026).

Li (Li, 2026) documented that AI adoption is positively associated with ESG performance with substantially larger effects in manufacturing, and that digital transformation serves as a key mediating mechanism that embeds AI into auditable operational routines, strengthening its sustainability impact. The study confirmed that environmental and social pillars of ESG respond more strongly to AI adoption compared to governance, suggesting that AI's contribution to corporate governance transparency requires additional regulatory and organizational enablers beyond technology adoption alone. Findings were based on a comprehensive panel of Chinese A-share firms from 2007 to 2023 and an instrumental variables strategy was employed to establish causal evidence, enhancing the credibility and reliability of the reported AI–ESG relationship. However, the exclusion of financial and high-tech industries limits generalizability and the authors recommended future research to examine AI-driven ESG improvements across a broader range of institutional and industrial contexts.

Liu et al. (2024) provided empirical evidence from an emerging market context linking AI development to improved ESG performance with absorptive capacity

identified as the key mediating mechanism through which AI adoption translates into enhanced sustainability outcomes across environmental, social, and governance dimensions.

The study introduced a text-based AI adoption measure as an innovative approach to quantifying organizational AI integration, offering greater precision compared to traditional keyword or patent-based proxies that frequently conflate AI intent with actual operational implementation.

Findings demonstrated that firms with greater absorptive capacity are better positioned to leverage AI for environmental stewardship and governance improvements, reinforcing the strategic importance of knowledge assimilation and organizational learning in the AI–ESG relationship. However, the study acknowledged that common AI proxies may understate adoption in service sectors and called for more refined measurement approaches to improve cross-study comparability and strengthen the empirical foundation of AI–ESG research. Shen et al. (2025) confirmed that stronger AI adoption is consistently associated with higher green innovation efficiency across industries, finding that AI techniques systematically lower the cost and uncertainty of environmentally oriented research and development by enabling firms to simulate lifecycle impacts and accelerate discovery of sustainable materials.

The study drew on a large panel of firm-level data and demonstrated that AI's contribution to green innovation is particularly strong in technology-intensive sectors where AI is more deeply integrated into research, development, and operational decision-making processes. Findings provided important empirical support for the hypothesis that AI adoption positively influences ESG performance through its capacity to foster environmentally oriented innovation that reduces emissions, optimizes resource use, and strengthens firms' sustainability profiles. However, the study did not sufficiently address how sectoral differences moderate the strength of the AI–green innovation–ESG relationship, and future research was recommended to examine industry-specific pathways through which AI drives sustainability performance improvements. Vinuesa et al. (2020) demonstrated that machine learning models accelerate discovery of sustainable materials and lower the cost of

environmentally oriented research and development, arguing that AI techniques systematically reduce the uncertainty of experimentation and increase the productivity of sustainability-focused innovation processes. The study provided a broad interdisciplinary review of AI's potential to support the United Nations Sustainable Development Goals, finding that AI can enable progress across all three ESG dimensions through applications in climate modeling, supply chain optimization, and corporate governance analytics. However, the authors cautioned that without proper governance frameworks and ethical guidelines, AI may also generate unintended negative sustainability consequences including algorithmic bias, energy intensity, and displacement of human workers in sustainability-focused roles.

The study recommended that future research develop more robust governance mechanisms and cross-disciplinary collaboration frameworks to ensure that AI's deployment in ESG contexts remains transparent, accountable, and genuinely aligned with long-term sustainability objectives.

H4: Adoption of AI will have a positive impact on Project Sustainability in terms of ESG Performance.

2.4 Moderating Role of Stakeholder Engagement in the Relationship between Project Management Resources and Project Sustainability in terms of ESG Performance

The strength of the relationship between Project Management Resources and project sustainability outcomes is unlikely to be uniform across all project contexts; rather, it depends on the extent to which stakeholders are actively engaged throughout the project life cycle.

Stakeholder theory holds that stakeholders are not simply instrumental to project aims but are valuable in their own right, and that a project's orientation should be shaped to accommodate the interests of the many groups it affects (Eskerod and

Huemann, 2013). Building on this premise, the project management literature increasingly frames stakeholder engagement not as a standalone predictor of project outcomes but as a contingency factor that conditions how effectively other project resources translate into sustainable results. A systematic review of the project sustainability literature similarly identifies stakeholder-oriented strategies as one of the principal mechanisms through which project and host organisations pursue high-level sustainability goals (Aarseth et al., 2017), reinforcing the view that the presence and depth of stakeholder engagement shapes how project-level resources are converted into sustainability outcomes rather than acting independently of them.

When stakeholder engagement is high, the collaborative social resources and team resources that constitute Project Management Resources are more likely to be directed toward outcomes that stakeholders value, reinforcing transparency, trust, and legitimacy in ways that strengthen the resource sustainability link.

Empirical evidence supports this contingent view: stakeholder engagement, alongside knowledge management, has been shown to exert a significant positive influence on sustainability in project management and on overall project success (Blak Bernat et al., 2023). At the same time, the same study found that a contextual factor the virtuality of the project team did not significantly alter the strength of this relationship, suggesting that while stakeholder engagement effects can be robust across some project conditions, their moderating influence may still be sensitive to the specific boundary condition being examined.

Taken together, this body of literature suggests that stakeholder engagement can amplify or attenuate the extent to which Project Management Resources translate into stronger ESG Performance, depending on how deeply stakeholders are drawn into the project's governance and decision-making processes.

Stakeholder theory (Freeman, 1984) provides further support for the relationship between organisational capabilities and sustainability outcomes. From this perspective, leadership diversity can enhance an organisation's ability to recognise and respond to the expectations of multiple stakeholder groups, including investors, employees, communities, and regulatory institutions. The diverse experiences and

perspectives of executives can also facilitate the incorporation of ESG considerations into strategic decision making (Liang & Renneboog, 2020).

Stakeholder theory maintains that organisations should address the interests and expectations of a broad range of stakeholders, including investors, creditors, government institutions, employees, communities, and regulators (Mbithi et al., 2020).

Consequently, firms have increasing incentives to communicate relevant financial and non-financial information to stakeholders to strengthen transparency and accountability (Khlifi et al., 2026).

The long-term viability of an organisation is closely associated with its ability to establish and maintain effective relationships with its stakeholders.

This requires firms to recognise and communicate their economic, social, and environmental impacts to relevant stakeholder groups.

Consistent with stakeholder theory, organisational decisions should therefore account for stakeholder interests rather than concentrating exclusively on shareholder returns (Chouaibi et al., 2024).

In this context, AI can strengthen stakeholder trust and accountability by improving transparency, traceability, and the reliability of transaction records, thereby reducing information asymmetry and supporting more equitable decision making (Khilfi & Zouari, 2025).

Moreover, AI-enabled systems can assist organisations in responding to increasingly demanding ESG expectations by facilitating the monitoring and disclosure of sustainability-related information.

Thus, AI can support the integration of diverse stakeholder interests into organisational practices and contribute to sustainable outcomes through enhanced transparency and traceability (Li et al., 2024b; (Zhang and Yang, 2024)). Thus:

H5: Stakeholder Engagement moderates the positive relationship between Project Management Resources and Project Sustainability in terms of ESG Performance.

2.5 Research Framework

The research framework sets out the conceptual basis for the relationships tested in this study. It shows how Project Management Resources feed into ESG Performance, with AI adoption as a possible pathway, and adds Stakeholder Engagement as a factor that may alter the strength of that link. Two theories underpin the framework, the Resource-Based View (RBV) and Stakeholder Theory (Freeman, 1984; Barney, 1991), which together explain the roles of internal resources, technological capability, stakeholder relationships, and sustainability outcomes examined here. The RBV in particular explains why Project Management Resources and AI Adoption matter within the proposed model. According to RBV, organizations can achieve sustained competitive advantage and improved performance by developing and effectively utilizing valuable resources and capabilities that are difficult for competitors to replicate (Barney, 1991). In the context of the present study, Project Management Resources represent organizational resources that enable project teams to plan, coordinate, execute, monitor, and control project activities effectively. These resources provide the organizational foundation through which sustainability objectives can be incorporated into project processes. Recent research also emphasizes that sustainability needs to be embedded into project-level processes, decision-making, governance, and performance measurement rather than being treated as an additional activity outside project management (Dessi et al., 2026). Therefore, effective Project Management Resources are expected to contribute positively to ESG Performance.

The framework further considers AI Adoption as an important organizational capability through which Project Management Resources can contribute to ESG Performance. AI technologies provide organizations with enhanced analytical, predictive, automation, and decision-support capabilities.

From an RBV perspective, the strategic value of AI is not derived merely from possessing the technology but from the organization's ability to integrate it with existing human, organizational, and knowledge-based resources. Recent empirical

evidence demonstrates that AI adoption can improve ESG performance by enhancing organizational capabilities, productivity, innovation, and sustainability-oriented decision-making (Zhang and Yang, 2024; Chen et al., 2024).

Similarly, AI applications have been found to positively influence ESG performance through improvements in internal control and information environments (2024). Consequently, the research framework proposes that AI Adoption mediates the relationship between Project Management Resources and ESG Performance.

The mediating role of AI Adoption is particularly important because Project Management Resources alone may not fully explain how organizations achieve improved ESG outcomes in an increasingly digital business environment.

Project teams with appropriate knowledge, collaboration capabilities, technological readiness, and organizational support may be better positioned to adopt and utilize AI-based technologies. Once adopted, AI can improve project decision-making, resource allocation, risk identification, monitoring, operational efficiency, and sustainability-related analysis.

Evidence from recent studies indicates that AI adoption significantly enhances environmental and social performance and can improve overall ESG outcomes through organizational capabilities and innovation mechanisms ((Zhang and Yang, 2024); (Li et al., 2026)). Thus, AI Adoption is conceptualized as a mechanism that transforms organizational project resources into enhanced sustainability performance.

The framework also incorporates Stakeholder Theory to explain the role of Stakeholder Engagement. Stakeholder Theory argues that organizations should consider the interests and expectations of multiple stakeholder groups, including employees, customers, investors, suppliers, regulators, communities, and other parties affected by organizational activities (Freeman, 1984). Within the context of ESG, stakeholder relationships are particularly important because environmental, social, and governance performance reflects an organization's responsibilities toward a broad range of stakeholders. Recent research demonstrates that stakeholder engagement is closely connected with sustainability performance and ESG-related practices, although its effectiveness may depend on governance, communication,

and organizational conditions (Nursida et al., 2025). Stakeholder Engagement is therefore incorporated into the research framework as a moderator of the relationship between Project Management Resources and ESG Performance. The rationale is that project resources may produce stronger sustainability outcomes when organizations actively communicate with and involve relevant stakeholders in project-related decisions. Stakeholder participation can provide organizations with information regarding environmental concerns, social expectations, governance requirements, and project impacts. Through effective engagement, stakeholder expectations can be incorporated into project planning and resource allocation, potentially strengthening the contribution of Project Management Resources to ESG Performance. Recent empirical research similarly shows positive associations between stakeholder engagement and ESG performance reporting (2025). The combination of RBV Theory and Stakeholder Theory provides a comprehensive theoretical explanation of the proposed research model. RBV emphasizes the internal side of the organization by explaining how Project Management Resources and AI capabilities can create value and improve ESG outcomes. Stakeholder Theory complements this perspective by explaining the external dimension of sustainability, particularly how stakeholder relationships and engagement can influence the extent to which organizational resources are translated into sustainable outcomes. Recent sustainability research also demonstrates the usefulness of combining RBV and stakeholder-oriented perspectives when examining ESG and organizational performance (Tutar et al., 2025). The research framework consequently proposes that Project Management Resources have a positive direct relationship with ESG Performance. At the same time, Project Management Resources are expected to contribute to AI Adoption, which subsequently enhances ESG Performance, establishing a mediating mechanism. AI Adoption is also expected to positively influence Project Management Resources, reflecting the potential of AI technologies to strengthen project planning, coordination, knowledge management, decision-making, and resource utilization. Furthermore, Stakeholder Engagement is expected to strengthen the positive relationship between Project Management Resources and ESG Performance by ensuring that project resources and decisions are aligned with stakeholder expectations and sustainability requirements. The

proposed relationships are summarized in the research model presented in Figure 2.1

2.6 Research Model

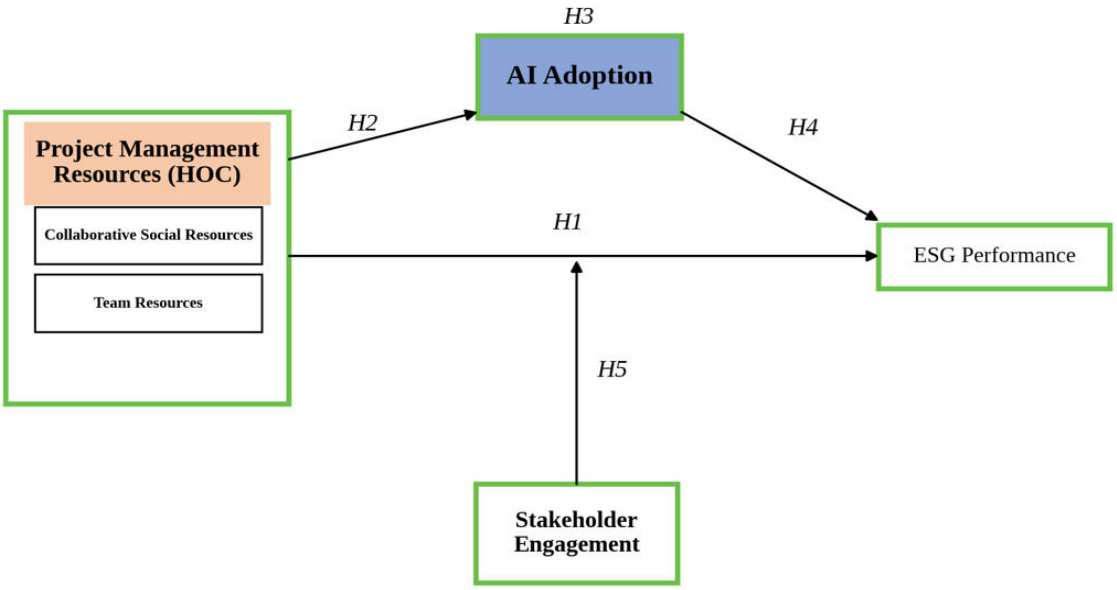


FIGURE 2.1: Research Model

2.7 Hypotheses

H1: Project Management Resources will have a positive impact on the project sustainability in terms of ESG Performance.

H2: Project Management Resources will have a positive impact on AI Adoption.

H3: The relationship between Project Management Resources and Project Sustainability in terms of ESG Performance will be mediated by the Adoption of AI.

H4: Adoption of AI will have a positive impact on the Project Sustainability in terms of ESG Performance.

H5: Stakeholder Engagement moderates the positive relationship between Project Management Resources and Project Sustainability in terms of ESG Performance

Chapter 3

Research Methodology

3.1 Research Design and Method

This study adopted a quantitative research design to collect and analyse empirical data. Data were obtained primarily through a structured questionnaire developed based on relevant constructs and measurement items identified from existing scholarly literature. The questionnaire was formulated through a systematic review of published research articles and related academic sources to ensure that the selected items were consistent with the objectives of the study. Following its development, the questionnaire was converted into an online survey using Google Forms to facilitate efficient data collection from the targeted respondents.

3.2 Research Philosophy

This study is grounded in the positivist research philosophy, which emphasises objective measurement, empirical observation, and systematic analysis of research phenomena. The positivist approach is appropriate for examining relationships between variables and assessing potential cause-and-effect associations using measurable evidence. Consistent with this philosophy, the study adopts a quantitative approach in which numerical data are collected and statistically analysed to identify patterns, relationships, and effects among the variables under investigation.

Furthermore, a descriptive research design is employed to examine and report the characteristics of the phenomena as they occur naturally, without manipulating the study variables. This methodological approach promotes objectivity, consistency, and replicability, allowing the findings to be evaluated on the basis of empirical evidence and observed realities.

3.3 Population of the Study

The information technology (IT) sector in Pakistan has experienced substantial growth in recent years, accompanied by the establishment and expansion of organisations across several major cities. These firms serve both domestic and international markets and provide a broad range of technological services, including front-end and back-end development, database management, and other IT-related solutions.

The target population of this study comprised project managers and team leaders involved in managing projects within the Pakistani IT sector. A convenience sampling technique was employed to select respondents based on their accessibility and willingness to participate. This approach enabled the study to obtain relevant empirical insights into the practices, challenges, and dynamics associated with IT project management within the Pakistani context.

3.4 Sample Selection

G*Power 3.1.9.4 was employed to determine the minimum sample size required for the study. The software provides statistical power analysis to estimate the number of observations necessary to detect an expected effect under specified statistical conditions. For the proposed model comprising four predictors, the analysis indicated that a minimum sample of 85 respondents was required to achieve a statistical power of 0.80 assuming a medium effect size. The corresponding power analysis and minimum required sample size are presented in Figure 3.1. A further G*Power analysis indicated that 129 respondents would be required to achieve a

statistical power of 0.95, as illustrated in Figure 3.2. Although 85 respondents represented the minimum sample required at 80% power, the study targeted a substantially larger number of participants to improve the reliability and robustness of the empirical findings. Accordingly, 300 respondents were approached to participate in the survey.

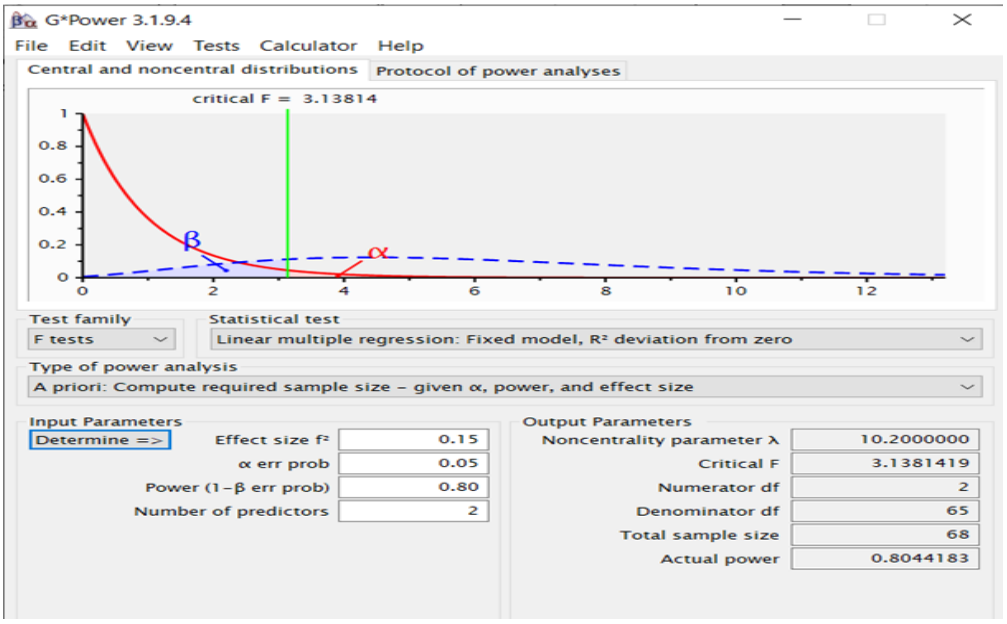


FIGURE 3.1: Minimum Sample Size for 80% Power

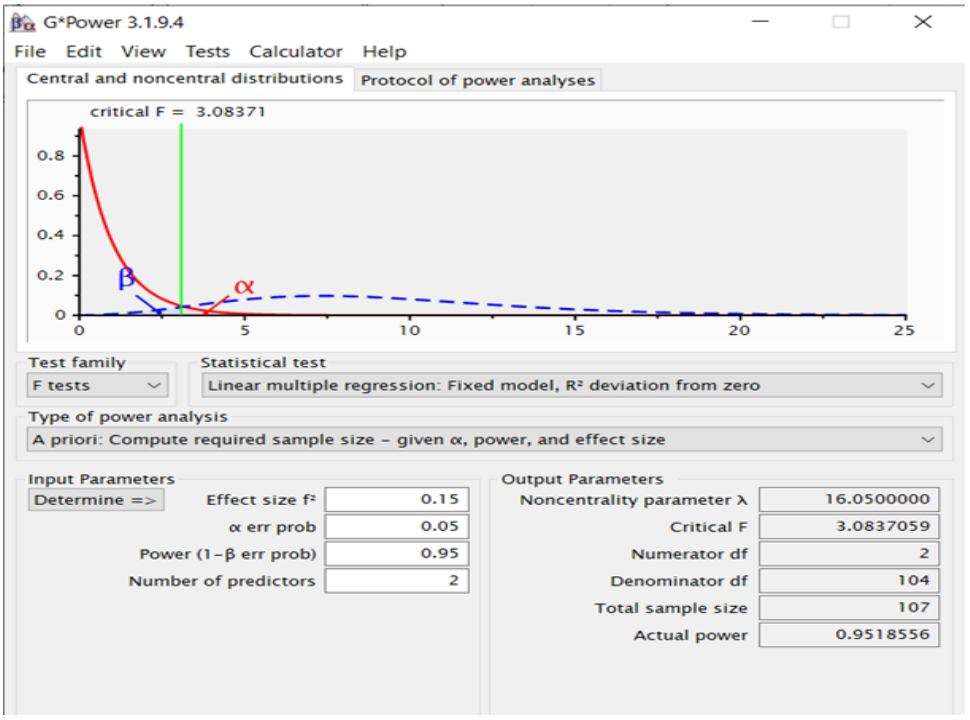


FIGURE 3.2: Required Sample Size for 95% Power

3.5 Sampling Technique

Convenience sampling, a non-probability technique that draws on respondents who are easy to reach and willing to take part, was used in this study. It suited the study given its time and resource constraints, because data could be gathered quickly from accessible participants and the logistical and administrative effort of more elaborate sampling designs was avoided.

3.6 Unit of Study

The individual respondent served as the unit of analysis. Given the study objectives and the kind of data collected, each participant was treated as an independent source of information.

3.7 Type of Study

The study followed a hypothetico-deductive approach, testing the hypothesised cause-and-effect relationships among the variables with empirical evidence from an objective, observational standpoint.

No variable was manipulated; data were collected and analysed systematically to evaluate the hypotheses and explain the patterns observed.

3.8 Scale of Constructs

Table 3.1 lists the measurement scale used for each construct together with its source. .

TABLE 3.1: Measurement Constructs and Sources

Construct	No. of Items	Source
Collaborative Social Resources	11	Din et al. (2025)
Team Resources	7	Jugdev and Mathur (2006b)
Adoption of AI	9	Xiao and Xiao (2025)
Stakeholder Engagement	10	Mitchell et al. (1997); Olander and Landin (2005); Pinto et al. (2009)
ESG Performance	9	Popova and Strikh (2022)

3.9 Data Collection and Methods

A structured questionnaire was used to collect data on how Project Management Resources affect ESG Performance in IT projects, with AI adoption as the mediating variable and Stakeholder Engagement as the moderating variable. A quantitative methodology was adopted because responses were measured numerically and tested statistically against the proposed relationships.

3.10 Data Collection Procedure

Responses were gathered through Google Forms, an online tool that makes it straightforward to administer structured surveys. The questionnaire was distributed through several channels, including professional networking platforms such as LinkedIn, IT organisations operating in Pakistan, and the researcher's professional and personal networks. Using multiple distribution channels enabled the study to reach a broader pool of relevant respondents and obtain diverse perspectives. The online format also provided convenient access to the questionnaire, as participants could complete the survey through a shared link using their preferred devices. This approach facilitated efficient data collection while maintaining the confidentiality and privacy of the respondents.

3.11 Data Analysis Methods

A mix of statistical techniques was used to examine the links among Project Management Resources, AI Adoption, Project Sustainability (ESG Performance), and Stakeholder Engagement. SPSS Version 27 handled data screening, descriptive statistics, normality checks, and correlations, while SmartPLS 4 was used to assess the measurement and structural models. Combining the two tools allowed the hypotheses to be examined systematically and gave a firm footing for interpreting the findings in the context of IT sector projects.

Chapter 4

Data Analysis and Results

This chapter reports the empirical results used to test the research hypotheses and meet the stated objectives. Data from 300 respondents were analysed in SPSS to examine the associations among Project Management Resources (a higher-order construct made up of Collaborative Social Resources and Team Resources), AI Adoption, Stakeholder Engagement, and ESG Performance in IT projects. Furthermore, in the current study, SmartPLS was also utilised to examine the structural model and evaluate the measurement model using a two-stage higher-order construct (HOC) approach, assessing reliability, convergent validity, discriminant validity (HTMT), path coefficients and R^2 values. This method has been used to test both the direct and indirect effects of the relationships among the study variables. The findings of the research are systematically presented and described with respect to each research objective, in order to demonstrate statistical evidence to accept or reject the stated hypotheses.

4.1 Descriptive Statistics

Descriptive statistics summarise the basic characteristics of the data for each construct. The four key constructs (Project Management Resources, AI Adoption, Stakeholder Engagement, and ESG Performance) were examined using 300 valid responses. Every construct was rated on a five-point Likert scale from 1 (Strongly Disagree) to 5 (Strongly Agree).

As shown in Table 4.1, Project Management Resources — comprising Collaborative Social Resources (M = 1.74, SD = 1.005) and Team Resources (M = 1.69, SD = 0.999), with an overall composite mean of M = 1.72 and SD = 1.002 — was rated relatively low by respondents. This suggests that, on average, respondents did not strongly perceive their organisations as being well-resourced in terms of collaborative and team-based project management support. The comparatively high standard deviation indicates a fair degree of variability in how respondents experienced the availability of these resources across different IT projects.

AI Adoption recorded a mean of M = 1.68 (SD = 0.954), the lowest of the four main constructs. This relatively low mean, together with a standard deviation close to 1, implies that the adoption of AI-based tools and practices within project management processes is still limited among the sampled organisations, and that perceptions of AI adoption vary considerably from one respondent to another.

Stakeholder Engagement showed a mean of M = 1.71 (SD = 0.990), indicating a similarly modest level of perceived stakeholder involvement in project decision-making, communication, and feedback processes. The standard deviation suggests moderate variation in engagement practices across the different projects represented in the sample. Finally, ESG Performance — comprising Environmental Performance (M = 1.75, SD = 1.000), Social Performance (M = 1.75, SD = 0.999), and Governance Performance (M = 1.72, SD = 1.005), with an overall composite mean of M = 1.74 and SD = 1.001 — was also rated on the lower end of the scale. This indicates that respondents generally perceive limited integration of environmental, social, and governance considerations into the sustainability outcomes of their IT projects. The consistency of the standard deviations across the E, S, and G sub-dimensions suggests a broadly similar spread of opinion across all three pillars of ESG performance. Overall, the descriptive results suggest that, within the sampled organisations, project management resources, AI adoption, stakeholder engagement, and ESG-oriented sustainability practices are all perceived at relatively low-to-moderate levels, with fairly wide variation in responses. This pattern provides an important empirical basis for the subsequent correlation, reliability, and factor analyses presented later in this chapter.

TABLE 4.1: Descriptive Statistics of Study Variables

Variables	**N**	**Min**	**Max**	**Mean**	**Std. Dev.**
Project Management Resources	300	1.00	5.00	1.7200	.10024
Collaborative Social Resources	300	1.00	5.00	1.7418	.10045
Team Resources	300	1.00	5.00	1.6857	.09991
AI Adoption	300	1.00	5.00	1.6767	.09537
Stakeholder Engagement	300	1.00	5.00	1.7120	.09901
ESG Performance	300	1.00	5.00	1.7411	.10011
Environmental Performance	300	1.00	5.00	1.7533	.09997
Social Performance	300	1.00	5.00	1.7467	.09990
Governance Performance	300	1.00	5.00	1.7233	.10047

TABLE 4.2: Descriptive Statistics of Demographic Variables

Variables	**N**	**Min Size**	**Max Size**	**Mean**	**Std. Deviation**
Gender	300	1	2	1.23	.422
Age	300	1	4	1.10	.393
Income	300	1	5	3.51	.990
Education	300	2	5	3.13	.420

4.2 Correlation Analysis

A Pearson correlation analysis was conducted to examine the strength and direction of the linear relationships between the study variables prior to proceeding with the reliability, validity, and factor analyses. The variables examined were Collaborative Social Resources, Team Resources, AI Adoption, Stakeholder Engagement, and ESG Performance, each based on responses from 300 participants. As Table 4.3 shows, all pairwise correlations among the five study variables were positive and significant at $p < .001$, with coefficients between $r = .875$ and $r =$

.933. This points to a very strong and consistent association among the constructs: respondents who rated one construct highly tended to rate the others highly too. These results are in line with the hypothesised relationships, but correlations this uniformly high (all above .85) also raise a possible concern about multicollinearity and common method bias, which the later Communalities, Normality, and Exploratory Factor Analysis sections address. (all above .85) also signals a potential concern regarding multicollinearity and common method bias, which is addressed further in the Communalities, Normality, and Exploratory Factor Analysis sections below. *Note. 1 = Collaborative Social Resources; 2 = Team Resources; 3*

TABLE 4.3: Pearson Correlation Matrix of Study Variables

Variables	**1**	**2**	**3**	**4**	**5**
Collaborative Social Resources	1	.875	.888	.912	.892
Team Resources		1	.902	.917	.891
AI Adoption			1	.933	.910
Stakeholder Engagement				1	.931
ESG Performance					1

*= AI Adoption; 4 = Stakeholder Engagement; 5 = ESG Performance. N = 300. **. Correlation is significant at the 0.001 level (2-tailed).*

4.3 Communalities – Key Constructs

Communalities analysis was conducted through Principal Axis Factoring (PAF) to examine the extent of variance in each item that is explained by the extracted factors. The initial communalities represent the total variance associated with each item before extraction (assumed to be 1.000 for individual items), while the extraction communalities represent the proportion of variance in each item that is accounted for by the retained factors.

As shown in Table 4.4, which reports the average initial and extraction communalities across the items making up each construct, all seven constructs recorded extraction communalities well above the generally accepted minimum threshold

of 0.40–0.50. Stakeholder Engagement recorded the highest average extraction communality (0.694), followed by Team Resources (0.665) and Governance Performance (0.680), while AI Adoption recorded the lowest, though still acceptable, average extraction communality (0.627).

These results indicate that a substantial proportion of the varianceThese values show that a large share of each item's variance is accounted for by the factors extracted from the data. The items are therefore broadly suitable for factor analysis, although, as the Exploratory Factor Analysis section shows, the emerging factor structure did not fully match the five theorised constructs.

Table 4.4: Communalities

Construct	Initial	Extraction
Collaborative Social Resources	0.724	0.653
Team Resources	0.730	0.665
AI Adoption	0.718	0.627
Stakeholder Engagement	0.766	0.694
Environmental Performance	0.753	0.673
Social Performance	0.741	0.633
Governance Performance	0.762	0.680

4.4 KMO and Bartlett's Test of Sampling Adequacy

Before the Exploratory Factor Analysis, sampling adequacy was checked with the Kaiser-Meyer-Olkin (KMO) measure and Bartlett's Test of Sphericity. A KMO above 0.60 and a significant Bartlett's test ($p < .05$) are generally treated as the minimum conditions for proceeding. Table 4.5 reports a KMO of 0.978, which Kaiser (1974) would classify as "marvellous" and which is far above the 0.60 cut-off. Bartlett's test was significant ($X2 = 15560.325$, $df = 1035$, $p < .001$), so the correlation matrix is not an identity matrix and the items share enough common

variance to justify factor analysis. The dataset is therefore well suited to the Exploratory Factor Analysis and Harman's Single-Factor Test reported next. *Note.*

Table 4.5: KMO and Bartlett's Test

Measure	Value
Kaiser-Meyer-Olkin Measure of Sampling Adequacy	0.978
Bartlett's Test of Sphericity – Approx. Chi-Square	15560.325
df	1035
Sig.	$< .001$

Extraction Method: Principal Component Analysis, based on all 46 items across the study's measurement model.

4.5 Harman's Single-Factor Test Common Method Bias

Because every construct was captured by one self-administered questionnaire completed by the same respondents at a single point in time, Harman's single-factor test was run to gauge how far common method bias (CMB) might have influenced the results. All 46 items across the six constructs were entered into an unrotated principal component analysis, and the variance explained by the first factor was examined. CMB is considered a serious concern when one factor explains most of the covariance among the items, typically more than 50% of total variance (Podsakoff et al., 2003). As Table 4.6 shows, three factors had eigenvalues above 1 and together explained 72.334% of the total variance. The first unrotated factor alone explained 61.151%, which exceeds the 50% threshold and is far larger than the second (6.647%) and third (4.536%) factors. This suggests that common method bias is a substantial concern in this dataset, which is consistent with the very high inter-construct correlations in Table 4.3 and the near-total single-factor loading seen in the broader Exploratory Factor Analysis. As discussed in Section 4.7.2, discriminant validity was otherwise well established across the conceptually distinct constructs, with the sole exception of the CSR-PMR pair, which reflects

the two-stage higher-order construct approach used to model Project Management Resources rather than a genuine validity concern. This limitation of elevated common variance among the study's items is addressed transparently in the discussion of the study's findings.

TABLE 4.6: Harman's Single-Factor Test — Total Variance Explained (Unrotated, Factors with Eigenvalues

Factor	**Eigenvalue**	**% of Variance**	**Cumulative %**
1	28.130	61.151	61.151
2	3.058	6.647	67.798
3	2.086	4.536	72.334

Only factors with eigenvalues above 1 are displayed. The first unrotated factor explained 61.151% of total variance, above the 50% threshold used to flag common method bias.

4.6 Normality Test

The Kolmogorov-Smirnov and Shapiro-Wilk tests were applied to check the normality of the data for all five key constructs: Collaborative Social Resources, Team Resources, AI Adoption, Stakeholder Engagement, and ESG Performance (Environmental, Social, and Governance Performance), using their constituent items (Table 4.7).

For every item across all seven constructs, both tests were significant ($p < .001$), indicating that the data are not normally distributed.

Nonetheless, given the relatively large sample size ($N = 300$), these tests are highly sensitive to even minor departures from normality, and parametric tests are generally resistant to normality violations in large samples.

Hence, further statistical processing — including correlation, reliability, and factor analysis — can be carried out with confidence, consistent with common practice in survey-based project management and ESG research.

TABLE 4.7: Tests of Normality – Key Constructs (Range of Item-Level Values)

Construct	No. of Items	K-S Statistic Range	K-S Sig.	S-W Statistic Range	S-W Sig.
Collaborative Social Resources	11	0.253–0.443	$< .001$	0.579–0.775	$< .001$
Team Resources	7	0.309–0.366	$< .001$	0.648–0.738	$< .001$
AI Adoption	9	0.271–0.365	$< .001$	0.641–0.743	$< .001$
Stakeholder Engagement	10	0.271–0.350	$< .001$	0.677–0.749	$< .001$
Environmental Performance	3	0.288–0.320	$< .001$	0.705–0.745	$< .001$
Social Performance	3	0.274–0.315	$< .001$	0.716–0.743	$< .001$
Governance Performance	3	0.290–0.333	$< .001$	0.695–0.734	$< .001$

4.7 Smart PLS 4 Analysis

After the preliminary SPSS analysis, the measurement and structural models were assessed in SmartPLS 4. Construct reliability and convergent validity were examined with Cronbach's Alpha, Composite Reliability, and Average Variance Extracted (AVE), alongside outer loadings, and discriminant validity was checked using the Fornell-Larcker criterion. Multicollinearity was tested with Variance Inflation Factor (VIF) values, and the structural model was evaluated through R2 values and path coefficients. These steps follow the PLS-SEM guidelines of Hair et al. (2021). A two-stage higher-order construct (HOC) approach was applied to Project Management Resources, comprising Collaborative Social Resources and Team Resources.

4.7.1 Construct Reliability and Convergent Validity

Reliability and convergent validity were evaluated with Cronbach's Alpha, Composite Reliability (a and c), and AVE, against the thresholds set by Hair et al. (2021): 0.70 or higher for Alpha and Composite Reliability, and 0.50 or higher for AVE. Table 4.8 shows that all six constructs had Alpha and Composite Reliability (c) values well above 0.90, indicating very high internal consistency. AVE values likewise exceeded the 0.50 threshold for every construct, ranging from 0.525

(Project Management Resources) to 0.853 (Team Resources), confirming that convergent validity is established across the measurement model. Project Management Resources (PMR), modelled as a higher-order construct (HOC) using the two-stage repeated-indicators approach with Collaborative Social Resources and Team Resources as its lower-order components, recorded the lowest AVE (0.525) and a notable gap between ρ_a (0.970) and ρ_c (0.943). This pattern is expected for HOCs estimated via the repeated-indicators approach, where the higher-order construct aggregates indicators from its lower-order dimensions, and does not indicate a reliability or validity concern.

TABLE 4.8: Construct Reliability and Convergent Validity

Construct	**Alpha**	**CR (ρ_a)**	**CR (ρ_c)**	**AVE**
AI Adoption	0.956	0.958	0.962	0.740
CSR	0.982	0.983	0.984	0.851
ESG Performance	0.977	0.977	0.980	0.845
PMR	0.936	0.970	0.943	0.525
SE	0.979	0.979	0.982	0.842
Team Resources	0.971	0.978	0.976	0.853

Note: CR = Composite Reliability; AVE = Average Variance Extracted; CSR = Collaborative Social Resources; PMR = Project Management Resources; SE = Stakeholder Engagement.

4.7.2 Discriminant Validity (Heterotrait-Monotrait Ratio)

Discriminant validity was assessed using the Heterotrait-Monotrait Ratio of Correlations (HTMT), which Henseler et al. (2015) recommend as a more reliable criterion than the traditional Fornell-Larcker approach. An HTMT value below 0.90 (liberal threshold) or 0.85 (conservative threshold) indicates that two constructs are empirically distinct. As shown in Table 4.9, all HTMT values among the distinct constructs fall below the conservative 0.85 threshold, with the exception of the CSR-PMR pair (0.893). Because Collaborative Social Resources is one of the two lower-order components used to form the Project Management Resources higher-order construct under the two-stage repeated-indicators approach, a degree of shared variance between CSR and PMR is expected by construction and is consistent with Hair et al. (2021) guidance on interpreting HOC discriminant

validity; it does not reflect a lack of discriminant validity between conceptually distinct constructs. The next highest value, between Stakeholder Engagement and ESG Performance (0.831), remains below the conservative threshold. Overall, the results support discriminant validity across the study's distinct constructs.

TABLE 4.9: Discriminant Validity - Heterotrait-Monotrait Ratio (HTMT)

	AI	**CSR**	**ESG**	**PMR**	**SE**	**Team**	**SE × PMR**
AI	1						
CSR	0.565	1					
ESG	0.550	0.595	1				
PMR	0.635	0.893	0.590	1			
SE	0.515	0.535	0.831	0.590	1		
Team	0.312	0.085	0.179	0.614	0.274	1	
SE × PMR	0.273	0.340	0.421	0.297	0.422	0.027	1

Note: AI = AI Adoption; CSR = Collaborative Social Resources; ESG = ESG Performance; PMR = Project Management Resources; SE = Stakeholder Engagement; Team = Team Resources.

4.7.3 Measurement Model (Graphical Representation)

Figure 4.1 presents the full measurement and structural model as estimated in SmartPLS 4, showing the outer loadings of the observed indicators on their respective first-order reflective constructs, together with the R^2 values of the endogenous constructs and the path coefficients linking the model's constructs. All indicator outer loadings exceed the 0.70 threshold recommended by Hair et al. (2021): Collaborative Social Resources items load between 0.901 and 0.934, Team Resources items between 0.906 and 0.946, AI Adoption items between 0.849 and 0.883, Stakeholder Engagement items between 0.889 and 0.937, and the Environmental, Social, and Governance indicators of ESG Performance between 0.884 and 0.937. Together with the reliability and AVE results reported in Table 4.8, this confirms that each first-order construct is well represented by its indicators. At the structural level, Collaborative Social Resources ($\beta = 0.968$) and Team Resources ($\beta = 0.335$) load onto the higher-order Project Management Resources construct, which in turn predicts AI Adoption ($\beta = 0.596$, $R^2 = 0.355$) and ESG Performance both directly ($\beta = 0.597$) and indirectly through AI Adoption ($\beta = 0.533$ for the

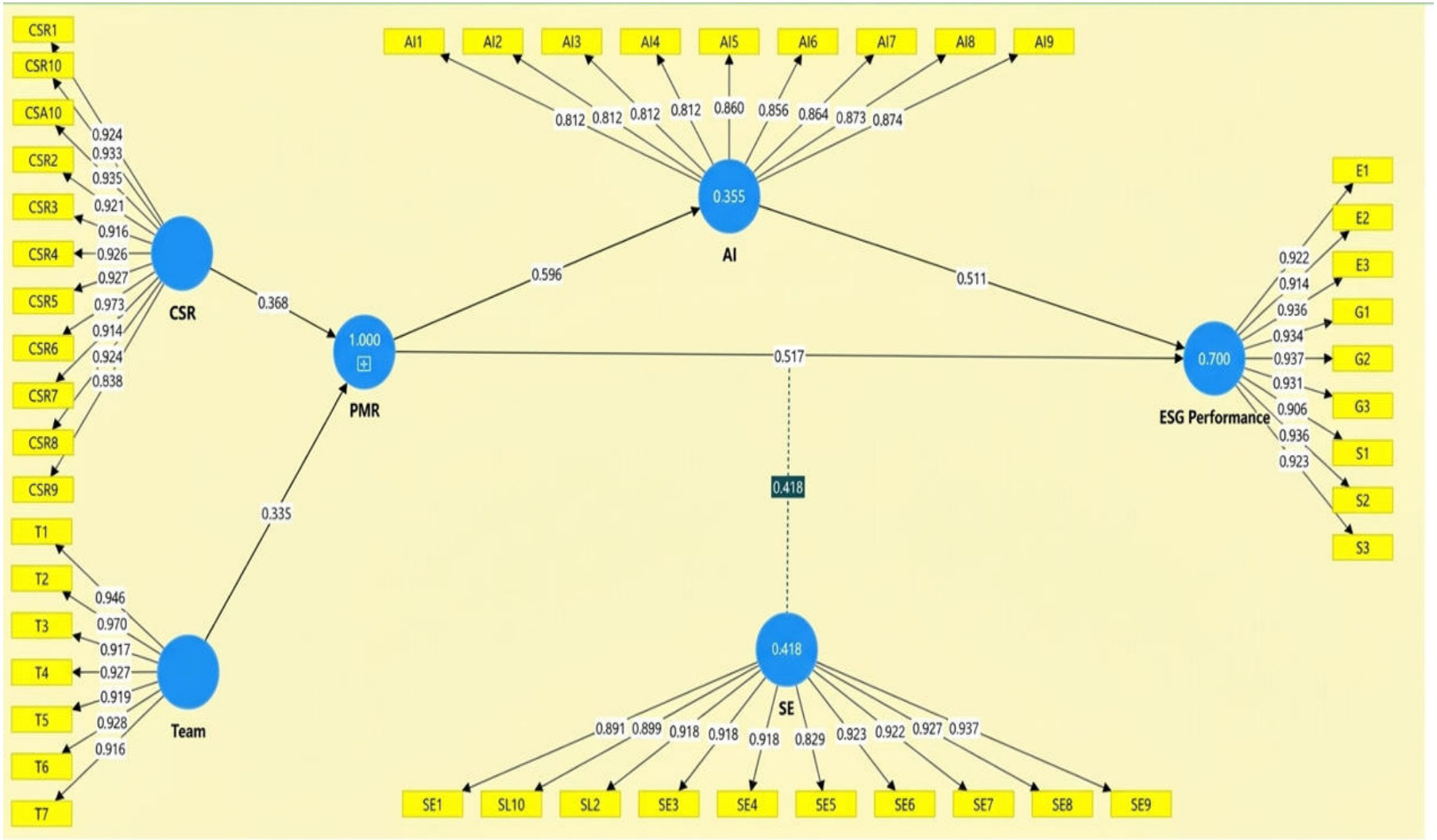


FIGURE 4.1: Measurement Model

AI Adoption → ESG Performance path), with Stakeholder Engagement additionally associated with the PMR → ESG Performance relationship ($\beta = 0.418$). The model explains 70.0% of the variance in ESG Performance ($R^2 = 0.700$).

These figures are the algorithm (model-level) estimates produced when the measurement and structural model are first run. The corresponding bootstrapped estimates, together with t-values, p-values, confidence intervals, and the formal hypothesis testing results (H1-H5), are reported in the Path Coefficient Analysis and Hypothesis Testing section.

4.7.4 Structural Model Assessment

Structural model assessment looks at the links between the latent constructs and judges the explanatory and predictive power of the research model. In PLS-SEM this involves the coefficient of determination (R2), adjusted R2, predictive relevance (Q2), path coefficients (β), and the significance of the hypothesised paths. These indicators show how well the endogenous constructs are explained and whether the model predicts well. Here, the structural model was evaluated in SmartPLS 4 once the measurement model had been confirmed, with attention to how much variance the constructs explain in the endogenous variables and whether predictive relevance is achieved. The assessment also provides the basis for evaluating the hypothesised relationships among Project Management Resources, AI Adoption, Stakeholder Engagement, and ESG Performance. The R^2 and adjusted R^2 values were examined to determine the explanatory power of the model, whileQ^2 predict values were used to assess its predictive relevance. The subsequent path coefficient and bootstrapping analyses were used to determine the direction, magnitude, and statistical significance of the hypothesised relationships.

4.7.4.1 Coefficient of Determination (R^2)

The coefficient of determination (R^2) represents the proportion of variance in an endogenous construct that can be explained by its associated predictor constructs within the structural model. A higher R^2 value indicates stronger explanatory

capability, whereas the adjusted R^2 provides a more conservative estimate by accounting for the number of predictors incorporated into the model. As presented in Table 4.10, the endogenous constructs exhibit varying levels of explanatory power. Collaborative Social Resources (CSR) yielded an R^2 of 0.951 and an adjusted R^2 of 0.951. ESG Performance showed an R^2 of 0.702 and an adjusted R^2 of 0.697, whereas Team Resources recorded an R^2 of 0.094 and an adjusted R^2 of 0.091. These values are based on the SmartPLS output. The R^2 value of 0.951 indicates that 95.1% of the variance in CSR is explained by its predictors in the structural model. Similarly, 70.2% of the variance in ESG Performance is explained by the corresponding predictors, with the adjusted R^2 indicating an explanatory proportion of 69.7%. For Team Resources, the R^2 value of 0.094 indicates that the model accounts for 9.4% of its variance, while the adjusted R^2 indicates an explanatory proportion of 9.1%.

TABLE 4.10: Coefficient of Determination (R^2)

Construct	**R^2**	**Adjusted R^2**
Collaborative Social Resources (CSR)	0.951	0.951
ESG Performance	0.702	0.697
Team Resources	0.094	0.091

Note. R2 and adjusted R2 values as generated in the SmartPLS 4 algorithm output.

4.7.4.2 Predictive Usefulness or Predictive Relevance (Q^2)

Predictive relevance was assessed using theQ^2 predict statistic generated through the predictive assessment procedure in SmartPLS 4. TheQ^2 predict value provides an indication of whether the structural model has predictive relevance for an endogenous construct. A positiveQ^2 predict value indicates predictive relevance for the corresponding endogenous construct. As shown in Table **??**, theQ^2 predict value for AI Adoption is 0.354, which is greater than zero, indicating that the structural model possesses predictive relevance for AI Adoption. For ESG Performance, theQ^2 predict value is 0.675, which is also greater than zero and indicates predictive relevance for ESG Performance. The prediction error statistics are also reported in Table 4.11. For AI Adoption, the RMSE and MAE values are

0.814 and 0.546, respectively. For ESG Performance, the corresponding RMSE and MAE values are 0.574 and 0.346, respectively. These values are reported as generated in the SmartPLS output and provide additional information regarding the prediction errors associated with the endogenous constructs. Overall, theQ^2 predict results are positive for both AI Adoption and ESG Performance, indicating that the structural model demonstrates predictive relevance for these constructs. TheQ^2 predict value for ESG Performance is higher than that for AI Adoption, indicating greater predictive relevance for ESG Performance within the reported results.

TABLE 4.11: Predictive Relevance and Prediction Errors (Q^2 Predict)

Construct	Q^2 predict	RMSE	MAE
AI Adoption	0.354	0.814	0.546
ESG Performance	0.675	0.574	0.346

Note. Q2 predict, RMSE, and MAE values generated via the PLSpredict procedure in SmartPLS 4. A positive Q2 predict value indicates predictive relevance.

4.7.5 Path Coefficient Analysis and Hypothesis Testing

This section reports the structural model results obtained using SmartPLS 4. Path coefficients were estimated by bootstrapping with 5,000 subsamples. The hypotheses were tested using path coefficients (β), t-statistics, p-values, and bootstrapped confidence intervals. A relationship was treated as significant when p was below 0.05, t exceeded 1.96, and the confidence interval (lower limit LLCI to upper limit ULCI) excluded zero.

4.7.5.1 Direct Effects

Project Management Resources (PMR) has a significant positive effect on AI Adoption ($\beta = 0.605$, t = 13.952, $p < 0.001$, LLCI = 0.516, ULCI = 0.688), supporting the view that stronger project management resources go hand in hand with greater uptake of AI-based tools and practices in IT projects. AI Adoption in turn has a significant positive effect on ESG Performance ($\beta = 0.109$, t = 2.315, p

= 0.021, LLCI = 0.024, ULCI = 0.207); the coefficient shows that higher AI adoption goes with better ESG outcomes, although the effect is fairly modest. PMR also has a significant direct effect on ESG Performance (β = 0.125, t = 2.153, p = 0.031, LLCI = 0.016, ULCI = 0.249). This confirms that PMR contributes to sustainability outcomes independently of AI Adoption.

Stakeholder Engagement has the strongest direct effect on ESG Performance among the reported direct paths (β = 0.662, t = 9.864, p < 0.001, LLCI = 0.518, ULCI = 0.779). The result indicates that stakeholder engagement makes a substantial and statistically significant contribution to ESG Performance. In each of these direct relationships, the bootstrapped confidence interval does not include zero, reinforcing the statistical significance of the effects.

4.7.5.2 Mediation Analysis

AI Adoption was examined as a mediator of the relationship between Project Management Resources and ESG Performance through the indirect pathway PMR → AI Adoption → ESG Performance. The results show a strong positive relationship between PMR and AI Adoption (β = 0.605) and a significant positive relationship between AI Adoption and ESG Performance (β = 0.109). The analysis reports a significant indirect effect through this pathway.

Because the direct PMR to ESG Performance path remains significant (β = 0.125, p = 0.031, LLCI = 0.016, ULCI = 0.249), the mediation is partial: AI Adoption carries part of the effect of PMR on ESG Performance, while PMR keeps an independent direct influence on ESG outcomes.

4.7.5.3 Moderation Analysis

To test whether Stakeholder Engagement (SE) moderates the link between PMR and ESG Performance, the interaction term SE × PMR was added to the structural model. Bootstrapping shows that the interaction is not significant (β = 0.064, t = 1.244, p = 0.214, LLCI = -0.028, ULCI = 0.172): the p-value exceeds 0.05 and the interval spans zero. Within this model, SE therefore does not change the strength

or direction of the PMR to ESG Performance relationship. SE does contribute substantially on its own to ESG Performance ($\beta = 0.662$, $p < 0.001$), so it is best read as a parallel contributor rather than a boundary condition that strengthens or weakens the PMR effect.

4.7.5.4 Impact on ESG Performance

The structural model shows that ESG Performance is positively influenced by Project Management Resources, AI Adoption, and Stakeholder Engagement. Stakeholder Engagement has the largest direct effect ($\beta = 0.662$), followed by Project Management Resources ($\beta = 0.125$) and AI Adoption ($\beta = 0.109$). All three effects are significant, with p-values below 0.05 and bootstrapped confidence intervals that exclude zero.

The findings further show that PMR contributes to ESG Performance both directly and indirectly through AI Adoption. The significant PMR $\rightarrow$ AI Adoption path and the significant AI Adoption $\rightarrow$ ESG Performance path, together with the remaining significant PMR $\rightarrow$ ESG Performance direct effect, support the reported partial mediation. In contrast, the non-significant SE $\times$ PMR interaction indicates that Stakeholder Engagement does not significantly alter the PMR–ESG Performance relationship, despite its strong direct contribution to ESG Performance.

4.7.5.5 Path Coefficients and Statistical Values

Table 4.12 presents the complete bootstrapping results used for the assessment of the hypothesised structural relationships, including the original path coefficient, sample mean, standard deviation, t-statistic, p-value, and 95% bootstrapped confidence interval. The measurement model results presented earlier in this chapter provide the basis for interpreting the structural model findings. The reliability and convergent validity assessment showed that the study constructs satisfied the reported reliability and AVE requirements, while the HTMT assessment supported discriminant validity across the conceptually distinct constructs. The graphical

TABLE 4.12: Path Coefficients and Hypothesis Testing Results

H	Relationship	Original Sample (O)	Sample Mean (M)	STDEV	T Statistics	P Values	95% CI (LLCI–ULCI)
H1	PMR → AI Adoption	0.605	0.607	0.043	13.952	0.000	0.516–0.688
H2	AI Adoption → ESG Performance	0.109	0.110	0.047	2.315	0.021	0.024–0.207
H3	PMR → ESG Performance	0.125	0.129	0.058	2.153	0.031	0.016–0.249
H4	Stakeholder Engagement → ESG Performance	0.662	0.657	0.067	9.864	0.000	0.518–0.779
H5	SE × PMR → ESG Performance	0.064	0.065	0.051	1.244	0.214	−0.028–0.172

measurement model further showed that the reported indicator outer loadings exceeded the stated threshold. These results establish the adequacy of the measurement model before interpretation of the bootstrapped structural relationships.

At the structural level, the measurement and structural model presented earlier showed the relationships among Project Management Resources, AI Adoption, Stakeholder Engagement, and ESG Performance.

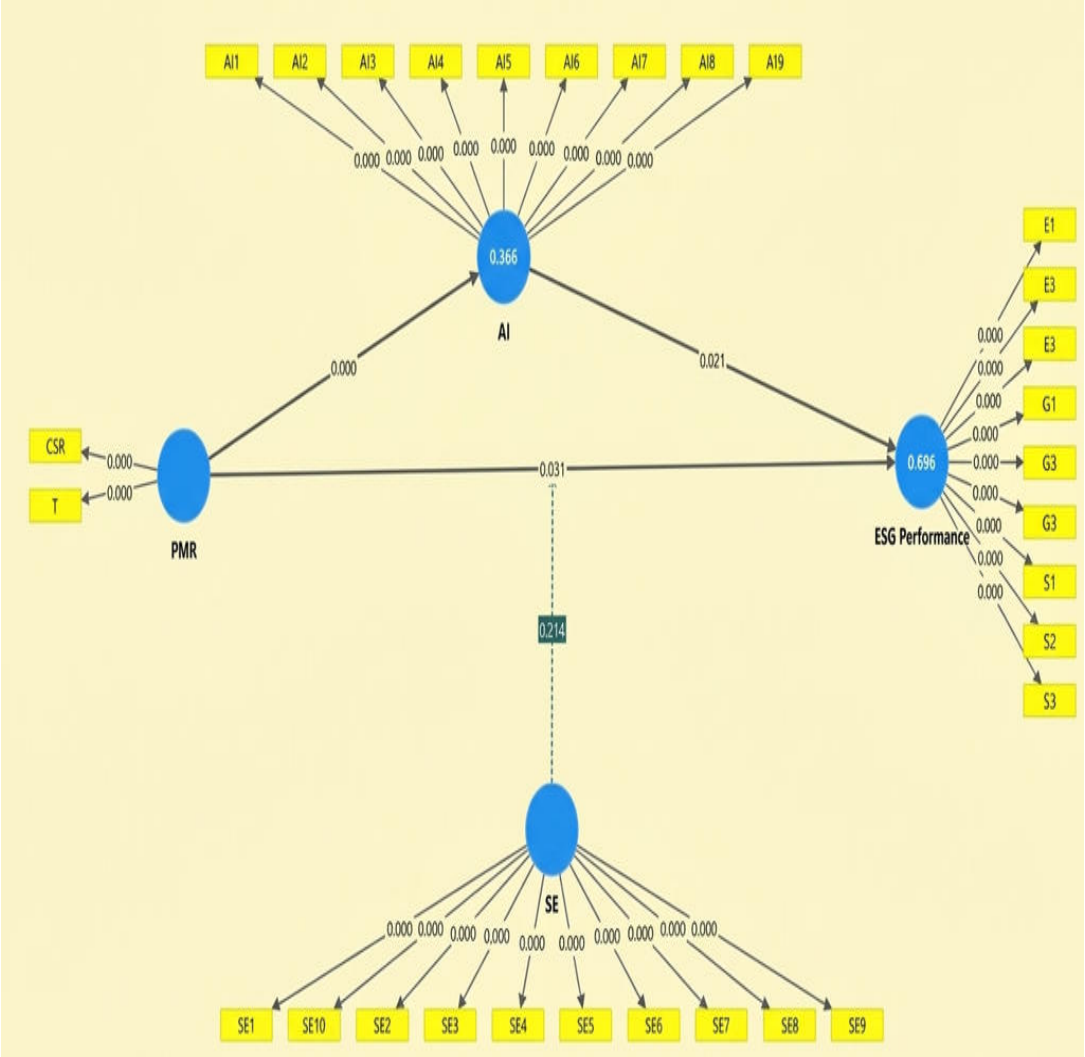
The bootstrapping results reported in Sections 4.7.5.1 to 4.7.5.5 provide the formal statistical assessment of those proposed paths.

4.7.5.6 Hypothesis Testing Summary

Table 4.13 summarises the results for the five hypotheses in the structural model. H1 to H4 are supported. H5 is not supported, because the SE × PMR interaction effect on ESG Performance is not statistically significant.

TABLE 4.13: Hypothesis Testing Summary

H	Hypothesis Statement	Result
H1	PMR → ESG Performance	**Supported**
H2	PMR → AI Adoption	**Supported**
H3	AI Adoption mediates PMR → ESG Performance	**Supported**
H4	AI Adoption → ESG Performance	**Supported**
H5	SE moderates PMR → ESG Performance	**Not Supported**



Chapter 5

Discussion and Conclusion

5.1 Introduction

This chapter interprets the findings for the five hypotheses in light of the theoretical framework and the literature on project management resources, artificial intelligence (AI), ESG, and stakeholder engagement. It takes the hypotheses one by one, then covers the theoretical and practical implications, the limitations of the study, recommendations for future research, and a closing summary of the main findings.

The study examined the relationships among Project Management Resources (PMR) — modelled as a higher-order construct comprising Collaborative Social Resources and Team Resources — AI Adoption, Stakeholder Engagement, and ESG Performance, drawing on survey data from 300 respondents involved in IT projects. Two tools were used so that the analysis would be thorough. SPSS handled the preliminary and exploratory work (descriptive statistics, correlations, KMO and Bartlett's tests, Harman's single-factor test, and normality tests), while SmartPLS 4 supported structural equation modelling, covering the measurement model (reliability, convergent validity, and discriminant validity) and the structural model (path coefficients, R2, and Q2). The discussion follows the hypotheses in order, from direct relationships to mediation and moderation, and interprets each using the SmartPLS 4 outputs.

5.2 Hypotheses Discussion

5.2.1 H1: Project Management Resources and ESG Performance

Hypothesis 1 proposed that Project Management Resources (PMR) would have a positive impact on Project sustainability in terms of ESG Performance. The SmartPLS 4 results give clear support for this hypothesis: the structural model shows a statistically significant positive direct effect of PMR on ESG Performance ($\beta = 0.125$, t = 2.153, p = 0.031, 95% CI = 0.016 to 0.249). Because the confidence interval excludes zero and the p-value is below the 0.05 threshold, the effect can be regarded as statistically significant.

This finding indicates that organisations possessing stronger project management resources encompassing both the collaborative social resources and team resources that jointly constitute the PMR higher-order construct tend to achieve better environmental, social, and governance outcomes in their IT projects, independent of any pathway through AI Adoption. This is consistent with a resource-based view of the firm, in which internally held, difficult-to-imitate resources such as collaborative capacity and team-level competencies translate into superior organisational performance, including non-financial and sustainability-related performance. This finding is consistent with recent empirical evidence from project-based organisations, which shows that project management resources and practices grounded in the resource-based and dynamic capabilities views positively predict ESG-related performance outcomes (Mariani et al., 2025).

5.2.2 H2: AI Adoption and Project Management Resources

The second hypothesis the Project Management Resources will have a positive impact on AI Adoption. The results show a strong, statistically significant positive relationship between these two constructs ($\beta = 0.605$, t = 13.952, $p < 0.001$, 95%

CI = 0.516 to 0.688), the strongest of all paths estimated in the structural model. On this basis of these reults, Hypothesis is supported. The analysis confirms a robust positive association between Project Management Resources and AI Adoption. Organisations with greater collaborative social resources and team resources are substantially more likely to adopt AI-based tools and practices within their IT projects. This is consistent with technology-organisation-environment perspectives on innovation adoption, in which organisational readiness — including team capability and collaborative culture is a key antecedent of new technology adoption, rather than adoption of a technology independently generating organisational resources. This finding also aligns with recent structural equation modelling evidence showing that organisational-level factors, including technical prerequisites, digital knowledge, and organisational maturity, are significant antecedents of AI adoption in project management contexts (Pînzaru et al., 2025).

5.2.3 H3: Mediating Role of AI Adoption

The third hypothesis proposed that the relationship between Project Management Resources and project sustainability in terms of ESG performance would be mediated by the Adoption of AI. The mediation effect was observed via Smart PLS-4. Project Management Resources was a important predictor of AI Adoption (β = 0.605, p $<$ 0.001), and AI Adoption in turn positively predicted ESG Performance (β = 0.109, p = 0.021), producing a significant effect.

As the direct effect of Project Management Resources on ESG Performance also remained significant after accounting for this indirect pathway (β = 0.125, p = 0.031), the results indicates AI Adoption mediates the influence of Project Management Resources on ESG Performance, and Hhypothesis is supported. This mediation is consistent with recent evidence that technology related capabilities, such as AI, can partially mediate the relationship between an organisational capability and ESG performance, with resource-based and absorptive mechanisms accounting for the remaining direct effect (Zhang and Yang, 2024).

Substantively, this suggests that AI adoption is one meaningful mechanism through which well-resourced project management functions translate into improved ESG outcomes.

5.2.4 H4: AI Adoption and ESG Performance

H4 proposed that the Adoption of AI would have a positive impact on ESG Performance. The structural model results show a statistically significant positive direct effect of AI Adoption on ESG Performance ($\beta = 0.109$, t = 2.315, p = 0.021, 95% CI = 0.024 to 0.207). H4 is therefore supported, although the magnitude of the effect is the smallest among the four supported direct paths in the model. This is consistent with a growing body of recent evidence linking AI adoption to improved ESG performance across a range of organisational settings (Tian et al., 2025; Xie et al., 2025).

This finding suggests that the adoption of AI-based tools and practices within IT projects makes a positive, but comparatively modest, independent contribution to ESG outcomes once the effects of Project Management Resources and Stakeholder Engagement are accounted for. This is plausible given that AI adoption is likely to affect ESG Performance primarily through operational and informational mechanisms — such as improved data-driven decision-making, predictive resource planning, or automated monitoring and reporting — rather than through the broader governance and relational mechanisms captured by PMR and Stakeholder Engagement, both of which recorded larger direct effects on ESG Performance in this study.

5.2.5 H5: Moderating Role of Stakeholder Engagement

The fifth hypothesis proposed that Stakeholder Engagement would moderate the positive relationship between Project Management Resources and project suatainability in terms of ESG Performance. This was tested by introducing an interaction term (SE $\times$ PMR) into the structural model.

The bootstrapping results show that the interaction effect is small and not statistically significant ($\beta = 0.064$, t = 1.244, p = 0.214, 95% CI =-0.028 to 0.172), as the confidence interval spans zero.Therefore Hypothesis 5 is not supported. This finding is broadly consistent with recent evidence that the moderating role of stakeholder engagement on ESG-performance relationships is not uniformly significant across organisational contexts, and may depend on additional boundary conditions not captured in the present model (Ho et al., 2024).

This result indicates that, within the sampled IT projects, the strength of the relationship between Project Management Resources and ESG Performance does not significantly depend on the level of Stakeholder Engagement.

It is important to note that this finding relates specifically to the interaction (moderating) effect and does not diminish the independent contribution of Stakeholder Engagement to ESG Performance: Stakeholder Engagement recorded the strongest direct effect on ESG Performance of any construct in the model ($\beta = 0.662$, $p < 0.001$.

These results suggest that Stakeholder Engagement operates in this model as a parallel, independent driver of ESG Performance rather than as a boundary condition that strengthens or weakens the effect of Project Management Resources.

A plausible explanation is that stakeholder engagement activities and project management resource capabilities influence ESG outcomes through largely separate organisational mechanisms through external legitimacy, transparency, and relationship management, and through internal planning, collaboration, and execution capability rather than through a single reinforcing pathway.

5.3 Implications

The findings of this study provide important implications for both theory and practice by demonstrating how Project Management Resources (PMR), AI Adoption, Stakeholder Engagement, and ESG Performance are interconnected within IT project environments. The results indicate that effective utilization of project

management resources can contribute to improved ESG performance, while AI adoption provides an important mechanism through which project management resources can be translated into sustainable outcomes. Furthermore, stakeholder engagement strengthens the relationship between project management resources and ESG performance, highlighting the importance of considering both organizational resources and stakeholder relationships when pursuing sustainable IT project outcomes. Based on these findings, the study contributes to the existing body of knowledge while also providing practical guidance for project managers, IT organizations, and other relevant stakeholders.

5.3.1 Theoretical Implication

The findings of this study provide important theoretical implications for the literature on project management, artificial intelligence, sustainability, and stakeholder management. The study integrates Resource-Based View (RBV) Theory and Stakeholder Theory to explain the relationships among Project Management Resources, AI Adoption, Stakeholder Engagement, and ESG Performance. The findings demonstrate that Project Management Resources can contribute to ESG Performance by providing organizations with the resources and capabilities required to manage projects effectively and incorporate sustainability considerations into project activities. From the perspective of RBV Theory, these resources can be considered valuable organizational capabilities that enable firms to achieve improved performance outcomes. Therefore, the findings extend the application of RBV from traditional organizational performance toward the context of ESG-oriented project management, demonstrating that effective project resources can contribute to environmental, social, and governance outcomes ((Barney, 1991); Khan et al., 2024).

The findings further demonstrate the importance of AI Adoption as an organizational capability within the relationship between project management and sustainability. The positive relationship between AI Adoption and ESG Performance indicates that AI can provide organizations with enhanced analytical, predictive, decision-support, monitoring, and resource-management capabilities.

This supports the RBV perspective that technological resources can generate value when they are effectively integrated with organizational capabilities. Recent studies have similarly found that AI adoption can improve ESG performance through enhanced productivity, innovation, information transparency, and organizational capabilities (Zhang and Yang, 2024; Chen et al., 2024).

Thus, the present study extends existing AI and ESG literature by demonstrating the relevance of AI Adoption specifically within the project management context.

A further theoretical contribution of the study is the mediating role of AI Adoption in the relationship between Project Management Resources and ESG Performance.

The findings indicate that project management resources can contribute to sustainability outcomes not only through their direct influence but also through the adoption and utilization of AI.

This provides a resource-to-capability-to-performance explanation in which Project Management Resources provide the organizational foundation, AI Adoption represents an enhanced technological capability, and ESG Performance represents the resulting sustainability outcome. This finding strengthens the RBV perspective by demonstrating how existing organizational resources can be transformed through technological capabilities into improved sustainability performance. Previous research has also identified AI as an important mechanism through which organizations can improve ESG-related outcomes (Zhang and Yang, 2024; Chen et al., 2024). The positive relationship between AI Adoption and Project Management Resources also provides an additional theoretical insight. Rather than viewing organizational resources and technology adoption as completely independent factors, the findings suggest that AI can contribute to strengthening project management capabilities. AI-supported project planning, data analysis, forecasting, risk identification, resource allocation, and decision-making can enhance the effectiveness of project management activities. This indicates a potentially reinforcing relationship between technological capabilities and organizational resources. Therefore, the findings contribute to the literature by suggesting that AI Adoption can both benefit from and strengthen project management resources, supporting the growing view that AI is becoming an important

capability within modern project management (Nenni et al., 2025). The study also contributes to Stakeholder Theory by examining Stakeholder Engagement as a moderating factor between Project Management Resources and ESG Performance. Although the proposed moderation relationship was not supported, this finding provides an important theoretical insight. The absence of a significant moderating effect indicates that Stakeholder Engagement did not significantly alter the strength of the relationship between Project Management Resources and ESG Performance within the context of this study. However, this does not imply that stakeholder engagement is unimportant for sustainability. Instead, the result suggests that stakeholder engagement may influence ESG outcomes through alternative mechanisms, such as direct relationships, governance practices, communication, stakeholder-specific interactions, or mediation.

This finding provides an opportunity for future studies to examine the role of stakeholder engagement using alternative theoretical relationships and research models. Consequently, the integration of RBV Theory and Stakeholder Theory provides a broader explanation of how internal resources, technological capabilities, and external stakeholder relationships can collectively influence sustainability outcomes.

5.3.2 Practical Implications

The findings of this study provide several practical implications for project managers, organizational managers, IT organizations, and other organizations seeking to improve ESG Performance. The positive relationship between Project Management Resources and ESG Performance indicates that organizations should strengthen the resources and capabilities available to project teams. Adequate managerial support, project knowledge, communication, collaboration, coordination, training, and resource allocation can enable project teams to incorporate environmental, social, and governance considerations into project activities. Organizations should therefore consider ESG objectives during project planning, execution, monitoring, and evaluation rather than treating sustainability as a separate organizational responsibility. The findings also highlight the practical importance

of strategic AI Adoption. Organizations should not consider AI solely as a technological investment but as an organizational capability that can support both project performance and sustainability objectives. AI can be incorporated into project risk assessment, resource allocation, scheduling, performance monitoring, decision-making, ESG data analysis, sustainability reporting, and forecasting. The positive relationship between AI Adoption and ESG Performance indicates that organizations can potentially improve their sustainability outcomes by integrating AI into existing project management and ESG processes. Recent research similarly demonstrates that AI can contribute to ESG performance through improvements in productivity, innovation, information quality, and organizational efficiency (Zhang and Yang, 2024; Chen et al., 2024). The findings further suggest that organizations should invest in developing AI-ready project teams. The adoption of AI technologies alone may not generate the expected benefits if project managers and employees lack the knowledge and skills required to use these technologies effectively. Organizations should therefore provide training in AI literacy, data interpretation, digital technologies, responsible AI use, and AI-supported decision-making. Project managers should also retain appropriate human oversight when using AI-based recommendations because project decisions frequently involve ethical, social, organizational, and stakeholder considerations that may not be fully captured by automated systems.

The mediating role of AI Adoption also has important practical implications because it indicates that organizations can use technology to convert project management resources into improved sustainability outcomes. Organizations should therefore establish a clear connection between project management development, digital transformation, and ESG strategies. Instead of implementing AI independently from project management activities, management should identify areas where AI can enhance existing project resources and contribute directly to ESG objectives. This integrated approach can improve resource utilization, project monitoring, decision-making, and sustainability-related performance. The findings concerning Stakeholder Engagement provide another important practical implication. Since the moderation hypothesis was not supported, organizations should not assume that simply increasing stakeholder engagement will automatically strengthen the

relationship between Project Management Resources and ESG Performance. Instead, organizations should focus on the quality and effectiveness of stakeholder engagement. Stakeholders should be meaningfully involved in project planning, risk identification, sustainability assessment, decision-making, and evaluation processes. Their feedback should be incorporated into actual project decisions rather than being collected only for consultation purposes.

Although Stakeholder Engagement did not significantly moderate the PMR–ESG relationship in this study, it can still contribute to transparency, accountability, communication, and sustainability reporting.

For IT organizations in particular, the findings suggest that project management, AI adoption, and ESG management should be treated as interconnected organizational activities. Project managers can use AI-based tools to improve planning, risk management, resource utilization, monitoring, and decision-making while simultaneously incorporating ESG objectives into these processes. Organizations can consequently move beyond traditional measures of project success, such as cost, time, and scope, toward a broader understanding of project success that includes environmental responsibility, social value, governance quality, and long-term sustainability.

Finally, senior management should provide adequate organizational support for project resource development, responsible AI adoption, and ESG integration. This requires investment in employee development, digital infrastructure, data governance, AI capabilities, sustainability measurement, and appropriate organizational policies.

For organizations operating in developing economies such as Pakistan, effective utilization of existing resources is particularly important. Organizations should therefore prioritize AI applications that address specific project management and sustainability challenges rather than adopting AI merely as a technological trend. Overall, the practical implications of this study indicate that organizations can improve ESG Performance by strengthening Project Management Resources, strategically adopting AI, and ensuring that sustainability considerations are integrated into project-level decision-making.

5.4 Limitations of the Study

In spite of robustness of the design, and although the study forms a great source of insights, there are a number of limitations that need to be recognized. First, the research employed a cross-sectional survey, which gives only perceptions at that moment because it captures at a given time. This design limits the possibility of making casual relations of the relationships between project management resources, AI adoption, Stakeholder engagement and ESG performance. Future database research, including longitudinal research may offer more details about the relationship of those relationships as projects make their way through the project life cycle.

Secondly, only self-reported data was used in the study and data was obtained through the the use of structured questionnaires to project professionals e.g project managers IT managers. Even though these respondents are highly knowledge able and professionals working on the relevant projects such a method might add common method biased or social desirability bias. The subject of the study may have exaggerated the results on the sustainability i.e ESG performance under their own or organization pressure. Though Cronbach's alpha and analysis helped to define the reliability and validity of the instrument. Reliability could be enhanced with the incorporation of the multi-source data or trangulation which involves interviews and reviews of documents. Third, the study was conducted within IT projects in a single organisational and geographic context, which may limit the generalisability of the findings to other industries, project types, or national settings where project management practices, AI maturity, or stakeholder expectations differ. Therefore, one should be careful with applying the findings to other sector or industries unless they are presented with further contextual validations. Lastly, even though the the study had stakeholder engagement as a moderator, the fact that the moderating effect was not significant could have been a result of the operationalization of the construct or due to low familiarity of the respondents with the stakeholder engagement particularly at the implementation level. As a matter of stakeholder enagagement encompasses several elements i.e external legitimacy, transparency, and relationship management, and through internal

planning, collaboration, and execution capability. It is recommended that the research focuses on these components in future.

5.5 Future Research Directions

Building on the findings and results of the research , several avenues for future research are recommended First, future studies should adopt a longitudinal research design to examine how the relationships among project management resources, AI adoption, stakeholder engagement, and ESG performance develop over time. The cross-sectional design of the present study provides evidence based on respondents' perceptions at a particular point in time; however, IT projects evolve through different stages, including initiation, planning, execution, monitoring, and closure.

A longitudinal approach could therefore provide deeper insights into whether the effects of project management resources and AI adoption on ESG performance become stronger or weaker at different stages of the project life cycle. It would also allow researchers to examine temporal and causal relationships more effectively. Second, future research should extend the proposed framework through multi-sectoral studies. The current study focuses on IT projects within a specific organizational and geographic context, and therefore future researchers could test the framework across sectors such as telecommunications, banking, healthcare, manufacturing, construction, public-sector projects, and software development.

Comparative studies across industries and countries would help determine whether project management resources, AI adoption, and ESG performance demonstrate similar relationships under different organizational, technological, regulatory, and cultural conditions. Such research could improve the generalizability of the proposed framework and identify sector-specific factors that influence sustainable project performance.

Third, future research should adopt a multi-dimensional approach to the constructs included in the research framework. In particular, project management

resources could be examined through more specific dimensions such as human resources, technological resources, financial resources, knowledge resources, collaborative capabilities, and team capabilities. Similarly, AI adoption could be investigated through dimensions such as AI readiness, technological infrastructure, AI capability, employee competency, and the actual intensity of AI utilization. ESG performance could also be examined separately through environmental, social, and governance dimensions rather than relying only on an aggregated measure. A multi-dimensional approach would provide a more detailed understanding of which specific resources and capabilities have the strongest influence on individual dimensions of sustainability.

Fourth, future research should reconsider and expand the role of stakeholder engagement within the proposed framework. Although stakeholder engagement was examined as a moderator in the present study, its moderating effect was not significant.

Rather than treating stakeholder engagement as a single aggregated construct, future studies could examine specific dimensions such as stakeholder communication, stakeholder participation, transparency, trust, collaboration, relationship management, and stakeholder influence. Moreover, stakeholder engagement could be incorporated together with other organizational and contextual factors, such as organizational support, stakeholder trust, project governance, communication quality, organizational culture, and leadership support.

Examining stakeholder engagement in combination with these factors may provide a more comprehensive explanation of the conditions under which stakeholder engagement contributes to sustainable project outcomes. Future researchers could also test stakeholder engagement as a mediator, moderator, or even a sequential mechanism depending on the theoretical framework and research context.

Finally, a particularly promising direction for future research is to develop an integrated AI-enabled ESG project sustainability framework by incorporating organizational capabilities, stakeholder factors, and project governance mechanisms.

The present study establishes an important relationship between project management resources, AI adoption, and ESG performance; however, future research

could examine whether AI maturity or AI capability acts as a boundary condition that determines how effectively project management resources are converted into sustainable outcomes.

5.6 Conclusion

This study was conducted to examine the impact of Project Management Resources on IT project sustainability through an ESG-based framework, while also investigating the role of AI Adoption as a mediating mechanism and Stakeholder Engagement as a moderating factor. The study was developed on the basis of Resource-Based View Theory and Stakeholder Theory to provide a comprehensive understanding of how organizational resources, technological capabilities, and stakeholder-related factors contribute to sustainable project outcomes.

The findings provide meaningful insights into the growing importance of integrating sustainability considerations into contemporary IT project management. The findings demonstrate that Project Management Resources play an important role in improving ESG Performance. The results indicate that effective utilization of project resources, particularly collaborative social resources and team resources, can contribute to stronger environmental, social, and governance outcomes.

This finding highlights that sustainability in IT projects is not dependent solely on technological solutions but also on the organization's ability to effectively coordinate people, knowledge, collaboration, and project-related capabilities. From the perspective of Resource-Based View Theory, the findings reinforce the importance of developing and utilizing valuable organizational resources to achieve improved and sustainable performance.

The study further establishes the importance of AI Adoption within the proposed framework. The findings indicate that AI Adoption has a positive relationship with Project Management Resources and ESG Performance and provides an important mechanism through which organizational resources can contribute to sustainable outcomes. The integration of AI into project management can enhance decision-making, resource utilization, monitoring, planning, and the management

of project-related information. These findings suggest that AI should not merely be considered an emerging technological tool but increasingly as an organizational capability that can enhance the effectiveness of existing project management resources and support sustainability objectives.

The study also examined Stakeholder Engagement as a moderating factor in the relationship between Project Management Resources and ESG Performance. Although the proposed moderating relationship was not statistically significant, the finding remains theoretically and practically relevant. It suggests that stakeholder engagement may not automatically strengthen the relationship between project resources and ESG performance and that its effectiveness may depend on how stakeholder engagement is operationalized, implemented, and integrated with other organizational processes.

This result provides an opportunity for future research to investigate the multidimensional nature of stakeholder engagement and examine whether factors such as stakeholder trust, communication, transparency, participation, organizational support, and project governance can enhance its contribution to sustainable project outcomes.

Overall, the study provides evidence that sustainable IT project performance requires more than the efficient completion of traditional project objectives. Organizations need to combine effective project management resources with technological capabilities such as AI while maintaining appropriate attention to ESG objectives.

The integration of Resource-Based View Theory and Stakeholder Theory provides a useful theoretical foundation for understanding these relationships by connecting internal organizational capabilities with stakeholder-oriented sustainability considerations.

From a practical perspective, the findings emphasize the need for IT organizations and project managers to invest in capable project teams, collaborative resources, AI-enabled project management practices, and ESG-oriented performance mechanisms. Organizations should also develop appropriate systems for measuring sustainability outcomes and ensure that ESG considerations are incorporated

throughout the project life cycle rather than being treated as an isolated organizational objective. At the same time, meaningful stakeholder participation, transparent communication, and effective governance should be encouraged to create an environment in which project resources and technological capabilities can generate sustainable value. In conclusion, this study contributes to the understanding of IT project sustainability by proposing and empirically examining an ESG-based framework that connects Project Management Resources, AI Adoption, Stakeholder Engagement, and ESG Performance. The findings demonstrate the strategic importance of organizational resources and AI capabilities in supporting sustainable project outcomes, while the non-significant moderating role of Stakeholder Engagement highlights the need for further investigation into the contextual and multidimensional nature of stakeholder relationships. The study therefore provides a foundation for future research to develop more comprehensive, longitudinal, multi-sectoral, and multi-dimensional models of IT project sustainability. Ultimately, organizations that successfully integrate project management capabilities, emerging AI technologies, and sustainability principles are better positioned to create long-term value and achieve more sustainable outcomes in an increasingly technology-driven business environment.

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Appendix-A

SURVEY INSTRUMENT

Section A: Demographic Information

Q1. Gender

Male	**Female**

Q2. Age Group

18–29 Years	**30–39 Years**	**40–49 Years**	**50–59 Years**	**Above 59 Years**

Q3. Income Per Month

Below 50K	**50–70K**	**71–90K**	**91–100K**	**Above 100K**

Q4. Education

Matric	**Intermediate**	**Graduate**	**Master**	**PhD**

Section B: Construct Items

Kindly indicate your level of agreement with each statement below: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree.

TABLE A1: Collaborative Social Resources

S/N	Items	SA	A	N	D	SD
CSR1	We receive support for our projects from government bodies in terms of technical support etc.	5	4	3	2	1
CSR2	Project donors support us through meetings, discussions, and standard manuals.	5	4	3	2	1
CSR3	Social enterprise intra forums and consortium meetings help us to share project experiences amongst the staff of not-for-profit social enterprises.	5	4	3	2	1
CSR4	Our project shares official information among the social enterprise through websites, social media, and/or other means.	5	4	3	2	1
CSR5	We have combined projects and programs with other organisations and share our program experiences through formal meetings.	5	4	3	2	1
S/N	**Items**	**SA**	**A**	**N**	**D**	**SD**
CSR6	Our joint project partner organisations promote informal discussions to generate appropriate solutions to program issues.	5	4	3	2	1
CSR7	We have joint discussions and meetings with project stakeholders for the effectiveness of the program.	5	4	3	2	1
CSR8	We have joint discussions and meetings with the project beneficiaries in program activities.	5	4	3	2	1
CSR9	Our project marketing events, such as program awareness and inauguration, help us to gather useful knowledge from the community for implementing projects and programs.	5	4	3	2	1
CSR10	We participate in our community of practice through online social networks (e.g., Twitter/websites) to discuss project issues.	5	4	3	2	1

CSR11	Our community-level advocacy increases awareness and resolves issues.	5	4	3	2	1

TABLE A2: Team Resources

S/N	Items	SA	A	N	D	SD
T1	We use brainstorming techniques to discuss and resolve issues.	5	4	3	2	1
T2	Field trips are engaged for hands-on experience for resources.	5	4	3	2	1
T3	On-the-job trainings are organised to make the resources well prepared.	5	4	3	2	1
T4	The team discusses success and failure stories for improvement in future.	5	4	3	2	1
T5	Problem-solving capability improves when collective planning takes place.	5	4	3	2	1
T6	Senior resources mentor the juniors, which builds trust and cohesion.	5	4	3	2	1
T7	Casual discussions and gatherings make the team stronger.	5	4	3	2	1

TABLE A3: Adoption of Artificial Intelligence

S/N	Items	SA	A	N	D	SD
AI1	The company utilises AI technology for risk management.	5	4	3	2	1
AI2	The company's decision-making process is transparent.	5	4	3	2	1
AI3	The company strictly adheres to laws and regulations.	5	4	3	2	1
AI4	The company uses AI technology to monitor and manage its environmental impact.	5	4	3	2	1
AI5	The company utilises AI technology to reduce waste and enhance resource efficiency.	5	4	3	2	1
AI6	AI technology has improved the company's environmental performance.	5	4	3	2	1
AI7	The company improves employee welfare through AI technology.	5	4	3	2	1
AI8	The company utilises AI technology to enhance the impact of its social responsibility initiatives.	5	4	3	2	1
AI9	The company ensures the fulfilment of social responsibility in supply chain management.	5	4	3	2	1

TABLE A4: Stakeholder Engagement

S/N	Items	SA	A	N	D	SD
SE1	Project stakeholders were formally identified.	5	4	3	2	1
SE2	Stakeholders were classified by their levels of influence, power, and interest in the project.	5	4	3	2	1
SE3	Stakeholders of the project, especially those with high power and influence, had their needs deployed in actions and activities throughout the life of the project.	5	4	3	2	1
SE4	Stakeholders were mapped by the level of urgency and legitimacy of the project.	5	4	3	2	1
SE5	Stakeholders of the project had their objectives reflected in actions and activities.	5	4	3	2	1
SE6	During the execution of the project, inclusions and/or changes in activities were planned to adapt to the identified needs of the stakeholders.	5	4	3	2	1
SE7	There has been frequent communication with the main stakeholders regarding the project.	5	4	3	2	1

S/N	Items	SA	A	N	D	SD
SE8	There were actions to engage the stakeholders throughout the life of the project.	5	4	3	2	1
SE9	There were actions to strengthen relationships with the stakeholders throughout the life of the project.	5	4	3	2	1
SE10	I believe that the stakeholders were engaged in the project.	5	4	3	2	1

TABLE A5: ESG Performance

S/N	Items	SA	A	N	D	SD
E1	The environmental responsibility policy is regularly updated and reviewed.	5	4	3	2	1
E2	The company annually introduces innovative solutions that correspond to green initiatives and increase environmental responsibility.	5	4	3	2	1
E3	Management pays due attention to climate change and the use of alternative energy sources and other key resources.	5	4	3	2	1
S1	The company adheres to the policy of raising wages above the average level for the industry/region as part of the personnel management policy.	5	4	3	2	1
S2	Workplace health and safety management issues are dealt with consistently and systematically.	5	4	3	2	1
S3	The company has implemented a formalised operational management system that considers the risks to employee well-being.	5	4	3	2	1
G1	In matters of corporate governance, the principles of independence in decision-making and collegiality in ensuring social and environmental responsibility are observed.	5	4	3	2	1
G2	The company has been certified according to standards that consider the principles of environmentally responsible production management.	5	4	3	2	1
G3	The company publishes external reporting on the management of social and environmental responsibility, which is available to all stakeholders.	5	4	3	2	1