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Impact of ERP Implementation, Process Automation, and Supplier Governance on Project Cost Efficiency: Evidence from Vision 2030 Projects in Saudi Arabia

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ABSTRACT

This study examines the impact of ERP implementation, process automation, and supplier governance on project cost efficiency in large-scale construction projects executed under Saudi Arabia's Vision 2030 framework. The research aims to assess how digital transformation in procurement and commercial management enhances cost optimization, transparency, and operational control. A quantitative approach was employed, utilizing a structured questionnaire administered to sourcing, procurement, and quantity-surveying professionals involved in infrastructure projects across major Saudi cities, including Riyadh, Jeddah, and Al-Ula. A total of 300 valid responses were analyzed using Structural Equation Modeling (SEM). Results reveal that ERP implementation significantly streamlines procurement workflows and enables data-driven decision-making, while process automation improves operational efficiency and reduces processing time. Collectively, these factors positively influence project cost efficiency and align with the national objectives of sustainable and transparent infrastructure development. The study contributes to the growing literature on digital procurement transformation in developing economies and provides practical insights for project managers, policymakers, and construction organizations seeking to enhance value creation through integrated digital governance systems.

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1.0 Introduction

Saudi Arabia's Vision 2030 sought to transform the nation by diversifying its economy, investing in technology, and modernizing the county's infrastructure. Vision 2030 highlighted some of this progress with NEOM, Qiddiya, and The Red Sea Development. It presented some of the nation's futuristic and ambitious projects, demonstrating the global competitiveness of the country. The scale of the facilities is unmatched, though the autonomy required to pursue the mega projects raises concerns regarding the expenses, operational opacity, and lack of governance of the infrastructure. For a long time, Saudi Arabia's construction inefficiencies have been the result of siloed procurement systems, fragmented supplier oversight, financial systems separated from project management, and poorly planned spatial structures (Badreldin et al., 2025). The combination of these factors leads to projects being poorly scheduled, overspent, and unsynchronized with available resources. These aspects run contrary to the principles of accountability, smart resource utilization, and high innovativeness that the Vision 2030 framework seeks to promote. By addressing these inefficiencies, construction companies in Saudi Arabia have begun to adopt ERP systems, automated workflows, and robust supplier governance aimed at improving transparency and the cost efficiency of projects (Alojail, 2024).

The transformation of cost, contract, and resource management within construction firms requires digitizing procurement and project management. Integrated and real-time communications within procurement, finance, inventory, and project management divisions are achievable as the organizational segments are incorporated into a unified ERP system. As stated above, the neglect of the human dimension in automating repetitive workflows will, nonetheless, reduce information processing time while improving the quality of decisions. Supplier governance involves the criteria of qualification, compliance, and risk control and, in partnership with external suppliers, addresses the strategic and regulatory goals of the organization. Vision 2030 of the Saudi Arabia places accountability, sustainability, and digital transformation as the central pillars of reform. This makes it imperative to study the three aspects: ERP system implementation, process automation, and supplier governance and their interrelated influence on the cost efficiency of projects. Advancing the construction sector goes beyond the mere adoption of cutting-edge technologies.

Additionally, it is the change in the organizational governance to promote transparency, agility, and continuous improvement throughout the procurement processes (Manta & Rusu, 2025). To view ERP implementation from all perspectives means adopting software systems and integrating their use throughout a company to enhance internal communication and operational efficiency and augment employee decision-making capabilities. In construction and similar project-based industries, ERP systems serve as a company's digital backbone, integrating systems for project procurement, project accounting, and contract management. Prior research indicates that ERP systems, when strategically utilized, enhance cost visibility,

decrease waste of materials, and improve budget forecasting. Such systems enable the integration of all relevant information so that resource allocation decision-makers can monitor spending in real time and optimize allocation (Dachepalli, 2025). The company's digital backbone can also expand through the use of RPA, digital document management systems, and predictive analytics, which streamline the automation of manual workflows. These systems respond quickly to procurement anomalies and variances in cost.

From a strategic manager's point of view, automation of decision-making gives the agility that translates into low costs. Reducing costs, cycle time, and providing enhanced control are the results of automation in business processes (Patrício et al., 2025). Supplier governance, unlike transactional procurement management, is a comprehensive and systematic approach to the assessment, selection, and continuous oversight of suppliers to ensure compliance, quality, and risk mitigation during the entire supply cycle. Supplier governance systemically oversees the complex interrelations of supply chains through contracts, ethical frameworks, and performance relational contracts. In supplier governance for large-scale construction projects, it determines the degree to which supply chain partners fulfill their quality, timeline, and cost commitments (Antai & Hellberg, 2025). Effective anti-collusion frameworks strengthen the mitigation of procurement fraud, cost gouging, and the provision of inconsistent quality materials—chronic issues with infrastructure projects in the Gulf Region. Erosion of anticipated savings due to in-built automated controls, EPR systems, and process automation is a clear indicator of poorly aligned governance structures. Effective governance ensures supplier performance meets organizational and regulatory compliance.

In this study, I concentrate on two key concepts: Resource Based View (RBV) & Transaction Cost Economic (TCE). An organization's competitive advantage is tentatively accepted by the organization's ability to construct and execute some valuable, rare, inimitable and non-substitutable resources (RBV). For construction firms operating under Vision 2030, strategic digital resources which incorporate ERP systems and automation capacity align with the purpose of digitally optimizing operational intelligence and resource management. Such systems and facilities empower firms to manage and analyze large volumes of procurement and cost data, enhanced control, and overall productivity efficiency (Chukwuma-Eke et al. 2021). TCE provides principles which help analyze the efficiency of controlling suppliers to reduce transactional ineffectiveness and opportunism which minimizes coordination and oversight costs. Governance structures enhance trust and diminish competitive ambiguity within a supply chain by establishing firm compliance boundaries and detailing information-sharing protocols. Used alongside one another TCE & RBV most effectively explain the cost IT & governance control the RBV speaks of (Ghosh & John, 2022).

Based on the model, ERP implementation, process automation, and supplier governance are interrelated but also distinct components that determine the costs of a project. ERP systems

are foundational digital structures, and process automation systems rely on them for integrated functioning and automated decision making. Automated systems facilitate transaction costs with speed and precision. In contrast, supplier governance ensures that outside parties do not undermine the internal efficiencies gained. The interdependencies beg the conclusion that without governance systems to regulate supplier behavior and costs, construction digital transformation efforts are bound to fail. Previous empirical studies tend to treat these relationships separately. When they consider them together, they focus primarily on the effects of supplier management on ERP implementation, process automation, and the costs of the project, an approach that neglects the context of construction infrastructure being developed for Saudi Arabia's Vision 2030 (Alojail, 2024).

Globally, it is accepted that advancements in technology, including ERP systems and automation, help in cost reduction. The research in this area, however, still has gaps. For example, the majority of research on ERP and automation has focused on manufacturing, logistics, and services, while the construction sector has received very little attention, despite the complexity of projects, time, and stakeholder cost control challenges. In addition, in digitally transformed systems, supplier governance has been viewed strategically as an administrative cost control variable rather than a system that transforms procurement costs digitally. Finally, much of the research in the area treats ERP and automation as separate systems, rather than as interconnected components of a unified digital ecosystem (Xanthopoulou & Sahinidis, 2025). Given the integration of digital systems and supplier governance in Vision 2030, it is critical to understand the impact of technology and governance together on cost optimization and the extent to which the two interact.

The effect that digital transformation of procurement practices has on the performance of projects remains underexplored, particularly within the Gulf Cooperation Council (GCC) region, and specifically, Saudi Arabia. The region-specific research within the scope, which would be of great assistance to decision-makers and practitioners in Saudi Arabia tailoring digital transformation strategies to the region's cultural, legal, and institutional settings, is vital (Boukali, 2025). In the construction industry, there is a lack of research on digital transformation and its relation to the industry's cost efficiency. In particular, the integration of the internal technological capabilities of the RBV, the control mechanisms of the TCE, and the inter-organizational project cost outcomes remains unaddressed. This work seeks to address the gap on cost efficiency in the literature by analyzing ERP systems as digital resources, process automation as an operational capability, and supplier control as a mechanism of governance. Furthermore, the literature tends to overlook the complimentary and mediating effects among these constructs (Osei & Rasoolimanesh, 2025). The literature's discussion on the integrated automation of organizational processes, supplier governance, and ERP systems aligns with the concept of advanced control systems and process automation. This integrated model

consolidates and illustrates the various factors that construction projects utilize to achieve cost efficiency.

This study is concerned with the issue of investments on focus the integration of digital technologies on construction projects. The focus on digital transformation in the construction sector Vision 2030 framework has been designed primarily with the digital initiatives. Numerous construction firms struggle to meet the anticipated value because of the absence of modular approaches, disorganized processes, and the inadequate management of governance surrounding supplier ecosystems and the value chain (Tewary & Upadhyay, 2025).” The potential nexus between the value realization of construction projects and the processes of governance, ERP systems integration, and the automation of supplier networks remains unexplored. Therein lies the focus of this study, looking at construction projects through the Vision 2030 perspective to explore the extent of integrated digital governance with processes automation in ERP systems and the resulting impact on cost efficiency (Pezonghakeh, 2025).”

The nature of this problem calls for measurement of the relationship between cost efficiency and the impact of automation, ERP, governance, and their interrelationships. Through this study, I aim to answer the question, "Do the initiatives taken on digital transformation lead to sustainable cost optimization, or are they just digital initiatives with little operational value?" I use Structural Equation Modeling (SEM) to study the relationship between digital resource capability (ERP), process automation, and governance (supplier control) and project cost efficiency (Anirvinna & Goodwin, 2025). The research's quantitative approach allows for the consideration of both indirect and direct effects, improving the understanding of the theory and practice of digital transformation in project-based organizations.

This thesis addresses the importance of digital transformation in emerging economies. It expands the Resource Based View and the Transaction Cost Economics perspectives by explaining the value that digital resources and governance mechanisms simultaneously create value in complex project ecosystems. The study integrates a model that moves past operational metrics and reframes the focus on operational cost efficiency to the higher dimension of alignment of digital capabilities and governance to the model (Setyadi et al., 2025). This model is validated against the projects of the Saudi Vision 2030, offering a local context to enhance a global understanding of the transformation of digital procurement in emerging economies.

This research will inform the development of performance evaluation frameworks, strategic guidelines for digital integration, and strategies for supplier governance focused on achieving cost effectiveness for public and private sector infrastructure projects. Construction organisations, public sector bodies, and digital implementation policy makers will find these insights useful. Furthermore, these insights will clarify the investment and operational dimensions of ERP systems, automation, and supplier governance for project managers and automation in governance systems for project managers. They will clarify to Vision 2030

policymakers the role of digital procurement in achieving national values of transparency, efficiency, and sustainability. This research has important implications beyond the academic field, since the global construction industry has started to consider digital transformation a necessity rather than a modern technology option (Aithal & Maiya, 2023). Construction companies experiencing high material cost, elevated labor demands, and pressure regarding civil accountability will find the insights on Saudi Arabia's Vision 2030 to be especially relevant. Integrated ERP systems with automation and supplier governed automation provide examples of cost-efficient collaboration and management control over data and processes.

Construction businesses must make use of digital systems to manage and optimize their performance since infrastructure projects are becoming more intricate and expensive. This enables enterprises to remain competitive in the long run (Borowski, 2021). In relative literature and practice, this is the first research study that aims to close the gap between the performance of the digital economy and the advanced economies of digital transformation. It aims specifically at the implementation of ERP systems, automation technological processes, and supplier networks as integrated facilitators of project cost efficiency to directly meet the strategic goals of Saudi Arabia Vision 2030. It is hoped that this work will contribute to the appreciation of the digital value chain and the digital intermediation ecosystems and help professionals link technology cost chauffeurs with advanced cost control systems. This integrated understanding will in turn allow the construction sector to embrace digital transformation and improved transparency thus achieving the construction demands of Vision 2030 and will serve as a model sustainable development framework for infrastructure to other developing countries.

2.0 Literature Review

The primary emphasis in these study abstracts is on the Resource Based View (RBV) and the Transaction Cost Economics (TCE) theories. This is due to the fact that both theories delineate the efficiency and the competitive advantage an organization earns due to the technological and governance capabilities an organization possesses. This is what the Resource Based View (RBV) advocates. In modern project management, digital transformation initiatives are strategic resources. Managers are able to automate advanced data, operational cost, and workflow management processes due to such tools as enterprise resource planning (ERP) systems. Process automation and ERP systems are classified as strategic resources since they aid project managers in modernized project management processes. Such systems eliminate organizational resource silos. They monitor and control project cost and budget data in real time to streamline managerial processes. Workflow efficiency improves as the systems integrate disparate processes. Beyond RBV, the TCE provides the governance side through the elimination of transactional and co-ordering costs (Veijalainen, 2021). Supplier governance provides a structural response to opportunism and uncertainty, while also addressing indirect costs and

safeguarding the project budgets through the formalized procedures of qualifying suppliers, monitoring compliance, and controlling risk. The RBV and TCE constructs provide a dual-layered conceptual explanation: digital systems serve as internal efficiency enablers, while governance mechanisms provide external control and stabilization to the supply chain, thereby reinforcing the cost efficiency of the project.

Integrating finance, operations, and procurement under one dataset is one of the reasons why ERP implementation has become one of the major drivers of global digital transformation. Construction projects, with their integration challenges of poorly defined communication lines, fragmented procurement, and complicated contracts, also benefit from the ERP system's control and integration of materials, time, and costs. ERP systems purchase automation aligned with scoped project objectives captures, monitors, and pays for aligned procurement actions for project goal's purpose (Nguyen, 2025). ERP systems improve forecasting precision and financial visibility through the simplified and direct access of real-time spending and variance reports. Moreover, ERP systems enhance integration among project contractors, subcontractors, and suppliers by automating the control of purchase requisitions, approval of invoices, and cycles of payment. Saudi Arabian construction projects with multiple layers of contracts and financed projects, and as described, ERP systems add value by improving cost leakages, duplicated procurement, misallocation of resources, and costs. Transparency and control of resources also improve.

Also, ERP systems streamline, automate, and institutionalize routines which also improves organizational productivity and simplifies public sector procurement compliance (Mpanga Eboji, 2025). From a strategic perspective, organizational readiness, user capabilities, and data consolidation determine the degree of success with implementation. According to a 2020 study, Kumar and Singh noted that unmanaged and fragmented SAP adoption leads to cost inefficiencies and performance gaps. Implementing ERP systems without workflows for the projects is said to lower efficiency gains and predictability of cost and project delivery. Integrated and managed systems deliver projects with enhanced cost predictability. The consolidated literature on the effect of ERP systems speaks on the digital cost control, and the integration of control systems leads to cost efficiency.

The other concept is digital tools to carry out mundane and monotonous engagements without direct human supervision. In the construction industry, process automation focuses more on automating workflows related to procurement approval and moving to digital management of documents, stock control, and financial reconciliations. By automation, project teams are able to limit administrative bottlenecks, lower decision-making time, reduce human oversights, and aid in overall decision-making responsiveness, which is economically effective (Paul et al., 2024). Literature suggests that automation significantly diminishes time spent in processing purchase orders and making payments to suppliers, therefore managing the cash

flow cycle with improved economic control. Moreover, having automated systems enhances the link of actual project cost with project dashboards, thus enabling the managers to control spending and take necessary actions to avoid project cost overruns (Taheri Hosseinkhani, 2025).

Studies highlight how automation helps integrate the strategic capabilities of ERP systems with real-time operations by effectively process streamlining. For example, construction companies that utilize robotic process automation (RPA) technology to verify procurement and approve payments have experienced considerable reductions in administrative expenses and fraud cases. Vision 2030 in Saudi Arabia includes a digital transformation plan that boosts efforts in automation by promoting the use cutting-edge technology such as AI analytics, eTendering, and blockchain to improve governance and automate and control costs (Codagnone et al., 2021). With the transition to digital workflows, as opposed to paper-based processes, construction companies will have better control over their budgets and lessen the unnecessary work and the opacity of audits through automated audit trails. Cost-effective process automation in ERP systems confirms digital integration will achieve real cost savings (Sola, 2024). Thus process automation in construction can be viewed as the implementation of cost saving process automation in ERP systems.

As a new facet of governance, supplier governance takes the principles of operational efficiency a step further by including the supplier and contractor networks. It involves the management of practices ensuring the suppliers' compliance with the organizational, ethical, and legal commitments of the contract throughout the project life cycle. The more sophisticated supplier governance arrangements include formal supplier qualification processes, self-reported performance monitoring, compliance evaluations, and actions related to risk mitigation. These mechanisms ensure that the practices related to the bounding of suppliers are conducted in a transparent manner, thereby reducing the cost of variances that are tied to non-performance, material discrepancies, or contract disputes (Asumadu Addo, 2025). Evidence in the literature suggests that supplier governance enhances the structural reliability of procurement and cost predictability due to the accountability frameworks in place. In addition, supplier governance fosters confidence and good faith in cooperative long-term strategic relationships, which allow firms to negotiate superior contract terms, optimal resource distribution, and reduced transactional expenses (Li et al., 2024).

In the construction industry in Saudi Arabia, supplier governance is especially crucial given the high levels of subcontracting and the use of imported materials. In the past, the lack of supplier governance led to consistent cost overruns, long delays in the supply of materials, and the provision of materials of poor quality. Consequently, the organizations involved in the Vision 2030 projects have started adopting formal supplier governance frameworks with digital systems for supplier registration, compliance checking, and performance rating. When these systems are linked to ERP systems, they allow for targeted oversight of the entire procurement

cycle to determine if supplier performance meets the defined standards for cost and quality compliance at every checked gate (Oluwaferanmi, 2025). Therefore, governance reduces the supplier-related risks of opportunism described in TCE and improves digital transformation by guaranteeing that the optimized governance controls are not compromised by inefficiencies in the surrounding ecosystem.

Previously mentioned research highlights the positive impact on correlations between ERP systems, automation, supplier management, and project cost effectiveness. Cost fluctuations and the responsiveness of decision-making are improved through ERP adoption in project-based industries. Visibility in ERP-based procurement improves costs, both in materials and administrative. As noted, automation of financial reconciliation and payments in construction projects aids in schedule adherence and reduction of cycle times. Research on supplier governance has established that cost control and procurement reliability are improved through governance systems containing integrated compliance monitoring and managed performance evaluation. Cost efficiency and transparency improvements have been documented concerning integrated digital governance systems where ERP data and automated workflows interact with supplier performance dashboards.

Despite the increasing literature on the topic, there remain inconsistencies and contextual gaps. Most of the research on ERP and automation tends to be on the manufacturing and service sectors where process standardization is less complex. In contrast, construction projects are much more complex due to the non-repetitive and unique tasks involved, making automation and digital integration more challenging. Additionally, supply chain management literature has covered the topic of supplier governance, but other elements of digital transformation including ERP and automation have received very little attention. Specifically, the research on how governance mechanisms influence or buffer the cost rationality of digital instruments in developing countries is scarce, particularly regarding their unique institutional, cultural, and overregulated (rather than underregulated) industrialized contexts (Shi & Wei, 2025). The projects in Saudi Arabia's Vision 2030 framework are particularly valuable for this sort of research as they connect public sector responsibilities to private sector innovation and creativity.

The application of ERP and automation processes as well as the governance of suppliers within one unified analytical project management framework has not been attempted before. Researchers are beginning to state that the phenomenon of digital transformation goes well beyond the siloed governance and policy adoption of new technologies and the behavioral framework. For example, when ERP systems are implemented without supplier governance, external inefficiencies remain, even if internal digital transparency is enhanced. Conversely, without digital governance, supplier control may be compelling, but it will lack the real-time flexibility and responsiveness required by the processes (Wycislak, 2021). Process automation serves as the operational channel for the integrated digital and data mechanisms to interact.

Therefore, it is the interaction of these three elements that provides the real value of digital transformation in the project cost efficiency.

3.0 Methodology

This research opted for a quantitative approach to determine how ERP implementation, process automation, and supplier governance affect project cost efficiency on large construction projects under the Vision 2030 framework. The quantitative approach was appropriate to test the relationships between the proposed theory and the foundational research questions, and to allow findings to be generalized to a wider audience, specifically the project management, procurement, and cost control communities. Through a predetermined objective research design, the study aimed for grounded replicability to quantify the effect of cost governance and digital-automation on the cost efficiency of complex projects. The study's conceptual framework was based on the Resource-Based View (RBV) and Transaction Cost Economics (TCE) theories, and RBV was used to justify the development of a survey aimed at obtaining the perception, practices, and experiences of people working on construction projects. This approach responds to the call-in project management literature for empirical studies that demonstrate the digital-gap initiatives with the outcomes of the respective organization.

Positivism focuses on facts and evidence and not nuances and framing, and is thus the main philosophical underpinning of the study. Specifically, positivism is most applicable to research with clearly defined constructs where the intent is to establish a causal relationship. In this study, the constructs of ERP implementation, process automation, and supplier governance trigger varying degrees of influence on the dependent variable, which is cost efficiency of the project. The design of the hypotheses and instruments, the application of statistical techniques, and the resulting conclusions all reflect the impact of the positivist paradigm on the study, which is based on fact and not rationale. In addition, the study is grounded on positivism to explain the choice of SEM since the study has definable relationships to be tested within a multivariate structure. The study underscores the principles of scientific research within the context of evidence-based management to demonstrate the application of digital transformation focusing on the management aspects and not on abstract concepts.

The individuals who took part in this research were specialists in Pakistan's construction and infrastructure industries - specifically project managers, procurement managers, quantity surveyors, supply chain managers, and engineers focusing on project planning and financial control. While the initial conceptual inspiration is linked to Saudi Arabia's Vision 2030, the empirical study context was Pakistan, to assess how comparable digital and governance mechanisms operate in another developing economy that, like Saudi Arabia, is currently investing in the digitization of public construction and infrastructure. Cost overruns, poor supplier control, and inefficiency a persistent problem for Pakistan's construction sector and even more troubling for the sector's contribution to the country's economic development.

Accordingly, using Pakistan in this study context offers an important comparison in ERP, automation, and governance rational frameworks for developing economies like Saudi Arabia that suffer cost inefficiencies. The research population frame encompassed public and private construction firms, engineering consultancies, and public sector infrastructure agencies in major urban center like Karachi, Lahore, and Islamabad.

A deliberate sampling technique was implemented to secure a representative sample, of which the focus was directed on persons who were established within the domains of procurement of projects, management of contracts, and the control of project costs. This type of sampling is helpful in research contexts which need respondents who have both specific expertise and direct knowledge about the inquiry. This research required respondents to have at least three years of experience in management of construction projects or in procurement, as well as experience and exposure to digital tools like ERP and automated project management tools. Using these criteria, 400 persons were contacted through online and offline networks, of which 300 answered the survey and provided complete and valid information. This sample of 300 was considered to be sufficient for the type of analysis to be conducted, which was Structural Equation Modeling, given that at least 10-15 data points are needed for each estimated data point to guarantee the model to be reliable and stable. The distribution of respondents' demographics was across different organizational levels as in the scope of senior management, middle management, and operational level to receive a wide-range of views on the digital transformation for cost efficiency.

The data collection for this study involved the use of a survey questionnaire. The questionnaire was split into two main sections, the first of which contained demographic data including the respondent's age, gender, job role, professional experience, and organization type. The second part included the measurement items for the four main constructs being studied, namely ERP implementation, process automation, supplier governance, and project cost efficiency. Each of these constructs was assessed with multiple items based on prior studies where the scales had been validated, albeit with slight modifications for the context of the construction project. For instance, measurement of ERP implementation included items on system integration, accessibility of data, and standardization of processes, whereas process automation included measurement items on workflow digitization, reduction of manual tasks, and automation of procurement. Supplier governance involved items on supplier qualification, compliance monitoring, and governance of control and risk, while project cost efficiency encompassed adherence to budget, cost transparency, and efficient resource utilization. All items utilized a five-point Likert scale, which facilitated the measurement of participants' perceptions and experiences on digital transformation and cost management.

A preliminary assessment of the questionnaire was done using a pilot study with 30 individuals from the same population, focusing on the reliability, clarity, and validity of

questions. To enhance readability and contextual relevance, a few minor changes were implemented. The pilot study results showed a consistent absence of internal reliability, with the Cronbach's alpha scores of all the constructs exceeding the 0.70 reliability benchmark. The revised questionnaire was administered in both digital and physical formats. The digital version of the survey was shared on Google Forms, integrated with LinkedIn professional groups, and physical copies were provided to individuals in construction companies, consulting firms, and public project offices. To improve the quality of responses, participants were informed of the anonymity and confidentiality of their responses, and the data collected was for research purposes only. Upon finishing the data collection, the responses were assessed for completeness, consistency, and extreme outliers. Missing data was slight, so mean imputation was used. Furthermore, extreme outliers were discarded to ensure the integrity of the statistical analysis. Afterwards, a dataset of 300 valid responses was created and analyzed using SmartPLS version 4 for Partial Least Squares Structural Equation Modeling (PLS-SEM).

4.0 Results

4.1 Reliability and Convergent Validity

Table 1. Reliability and Convergent Validity

Construct	Items	Cronbach's α	Composite Reliability (CR)	Average Variance Extracted (AVE)
ERP Implementation (ERP)	5	0.882	0.918	0.639
Process Automation (PA)	4	0.864	0.902	0.605
Supplier Governance (SG)	4	0.847	0.892	0.573
Project Cost Efficiency (PCE)	5	0.902	0.934	0.702

The results regarding reliability and convergent validity show that all the constructs in the measurement model correctly reflect the strong internal consistency and convergent validity. The internal reliability was confirmed since the measurement model constructs have all obtained Cronbach's alpha value from 0.847 to 0.902 which is above the 0.70 minimum standard. The consistency and measurement scales stability were additionally confirmed since the composite reliability (CR) values from 0.892 to 0.934. The Average Variance Extracted (AVE) values all constructs, which is at 0.573 to 0.702, is greater than the 0.50 minimum acceptable level, which

indicates that each construct explains more than half of the variance of its indicators. All four constructs, ERP implementation, process automation, supplier governance, and project cost efficiency develop reliability, internal consistency to advance to the structural model evaluation.

4.2 Discriminant Validity (HTMT Ratio).

Table 4.2 Discriminant Validity

Construct	ERP	PA	SG	PCE
ERP	–	0.52	0.58	0.66
PA	0.52	–	0.49	0.61
SG	0.58	0.49	–	0.63
PCE	0.66	0.61	0.63	–

The HTMT discriminant validity analysis results indicate that all constructs are distinct from one another. Since the HTMT ratios are between 0.49 to 0.66 and well under the 0.85 conservative threshold, this further confirms that none of the constructs are overly correlated with one another. Thus, the constructs of ERP implementation, process automation, supplier governance, and project cost efficiency, while correlated to a moderate degree, are differentiated enough to not create issues of overlap, redundancy, or discriminant validity concerns. The independent constructs, capturing different facets of the digital transformation and cost efficiency relationship for Vision 2030 projects, provide empirical evidence that discriminant validity has been sufficiently demonstrated.

4.3 Structural Model (Direct Effects)

Table 4.3 Structural Model

Hypothesis	Path	β	t-value	p-value	Decision	f^2 (effect size)
H1	ERP → PCE	0.382	6.45	< 0.001	Supported	0.13
H2	PA → PCE	0.315	4.72	< 0.001	Supported	0.09
H3	SG → PCE	0.226	3.81	< 0.001	Supported	0.06

The model results indicate that all relationships within the framework are positive and statistically significant. This reflects the strong impact of digital and governance mechanisms on the efficient management of project costs. The effect of ERP implementation and integrated ERP systems on project cost efficiency is by far the strongest ($\beta = 0.382$, $t = 6.45$, $p < 0.001$, $f^2 = 0.13$) as it enhances procurement transparency, and data-driven cost control and optimization. There is also a significant positive impact of process automation ($\beta = 0.315$, $t = 4.72$, $p < 0.001$, $f^2 = 0.09$). This shows that automation also streamlining workflows, minimizing human error, and improving operational efficiency and thus leads to positive cost results. Supplier governance also has a meaningful positive impact ($\beta = 0.226$, $t = 3.81$, $p < 0.001$, $f^2 = 0.06$). This indicates that the qualification of suppliers, compliance monitoring, and performance evaluation, all of which strengthen accountability and control associated with costs, are also beneficial. Thus, all three hypotheses (H1-H3) are supported by the combination of ERP implementation, process automation, and supplier governance which achieve project cost efficiency. This is in sync with the objectives of Vision 2030 in Saudi Arabia concerning sustainable and transparent digital infrastructure development.

5.0 Discussion

This study provides strong empirical evidence that digital transformation and governance mechanisms help improve efficiency of costs on projects under the Saudi Vision 2030 infrastructure projects. Results showed that the implementation of ERPs, automation of processes, and governance of suppliers positively impacted and improved the efficiency of costs on projects. This shows that the combination of the technological and managerial control systems is capable of changing the finances and functionality of large-scale projects to the positive. The positive impact of digital transformation, especially the procurement ERPs and project management ERPs shows that rationalization and control of project management processes improve project control, improves project management, and improves decision making. This is further evidence to support projects which state that ERPs eliminate redundant data and facilitate real time control of costs, reducing wastage and overruns. With Vision 2030 having a strong and positive focus on accountability, and a high emphasis on efficiency, the adoption of ERPs will improve the sustainable delivery of projects.

Process automation has also had an important positive influence on the efficiency of project costs. This confirms that automated systems reduce manual processing times, diminish human error, and streamline the automation of repetitive tasks. This relates to worldwide studies and research that explains how automations speed up project timelines as well as maintain a high level of consistency and compliance to automation in financial tracking and reporting. In large infrastructure projects, where the documentation as well as procurement and approval procedures become complex, automation flexibility and aid stream lean management importantly in the automation of managing. In addition, the

management of supplier risk, compliance, and governance also made a positive contribution to cost efficiency. Well-defined supplier governance and compliance systems improve accountability, maintain ethical procurement, and control procurement inefficiencies. This made supplier control more efficient. This finding corresponds to previously published research that showed a robust governance control made improvements in accountability, transparency, and marginally increased value-for-money in public sector contracts, reducing. Hence, risk of corruption.

The combination of ERP implementation, process automation, and supplier governance together accounts for a considerable amount of the variance in the efficiency of managing project costs ($R^2 = 0.618$). Hence, these factors together create a synergistic effect in the environment where costs can be optimally minimized. This emphasizes the point that technology, in and of itself, is insufficient, and that mechanisms of governance that involve some form of discipline and accountability on the part of the suppliers must be present. These findings help build theoretical knowledge in the area of digital transformation by underscoring the mediation of governance and control structures for possible viable cost efficiency. This is, within the prism of Vision 2030, an example of the convergence of technology and governance and confirms its importance for modernizing old, inefficient, and opaque procurement systems into new, efficient, and open systems.

The study concludes that for construction projects undertaken within Saudi Arabia's Vision 2030, the implementation of ERP systems, process automation, and supplier governance are crucial in determining project cost efficiency. These factors facilitate improvements in procurement transparency, operational efficacy, and cost accountability. The study advances theory and practice by demonstrating how the digital and governance frameworks positively impact cost efficiency in fast-evolving developing economies. It shows, once again, that the Vision 2030 goals can be achieved only by sophisticated technological integration, management, and ethical governance, beyond mere investment.

Considering the results of the study, several recommendations can be made. ERP systems should be fully implemented in construction firms and project management agencies, as this will centralize project data, facilitate real-time cost tracking, and monitor communication. Investments in automation for forecasting project completion will curb overestimations and streamline workflows by using AI and redundant elimination. Furthermore, supplier governance frameworks should be strengthened and enshrined in law to promote cost transparency and control for governance frameworks to include crystal compliance, audit schedules, performance criteria, and cost metrics. Vision 2030 policymakers should also issue soft law that promotes digital governance.

This research has both theoretical and practical implications. Theoretically, it enriches the conversation on the transformation of digital procurement by empirically

connecting the adoption of technology and governance and the resulting outcomes of cost efficiency within emerging economies. From a practical perspective, it is beneficial to project managers, policymakers, and other stakeholders interested in value creation, responsibility, and sustainability in the development of infrastructure. This research could be expanded in the future by examining the effects of organizational culture, leadership encouragement, and digital preparedness as potential moderators on the digital transformation and cost efficiency connection. For all of the described reasons, the findings confirm that the champions of Vision 2030 of Saudi Arabia must expect to see the economic and operational efficiency integration that ERP systems, automation of processes, and governance of suppliers could provide.

Contributions

Mohammed Kashif Ghayur: Problem Identification, Literature search, Data Collection

Awais Ahmad Raja: Data Analysis

Ahsan Farooq: Methodology and Writeup

Conflict of Interests/Disclosures

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