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ENHANCING INFRASTRUCTURE PERFORMANCE: THE ROLE OF PROJECT MANAGEMENT STRATEGIES IN LIBYA'S ROAD AND BRIDGE PROJECTS

Anwar Alzaletane, Ali Khatibi, Jacquline Tham
Postgraduate Centre, Management and Science University (MSU), University Drive, Off Persiaran Olahraga, 40100 Shah Alam, Selangor

ABSTRACT

Infrastructure development is vital for economic growth and societal well-being, particularly in developing nations like Libya, where road and bridge projects often encounter challenges such as delays, cost overruns, and quality concerns. This study explores the interplay between project management strategies, processes, systems, and infrastructure performance within Libya's road and bridge sector. Drawing on empirical data collected from a cross-sectional survey of professionals in the Libyan construction industry, the research applies Structural Equation Modeling (SEM) to evaluate key relationships. Findings highlight the critical influence of project management systems and processes on infrastructure outcomes, with project management strategy serving as a mediator. Contextual factors, including organizational culture, resource allocation, and stakeholder engagement, emerge as significant determinants of success. The study underscores the importance of adopting technologically informed project management frameworks to address challenges specific to the Libyan context. Practical implications suggest policy reforms, enhanced training programs, and strategic investments in knowledge management systems to improve project outcomes. By bridging theoretical insights with actionable recommendations, this research contributes to advancing sustainable infrastructure development in Libya.

Keywords: Project Management Strategies, Infrastructure Performance, Road and Bridge, Projects, Technological Integration, Libya

INTRODUCTION

Infrastructure development serves as a cornerstone for economic growth and societal progress, particularly in developing nations striving to improve living standards and enhance global competitiveness. Among various sectors, transportation infrastructure, including roads and bridges, holds significant importance due to its role in enabling trade, connectivity, and economic activities. Libya, a nation with vast economic potential, faces substantial challenges in executing road and bridge projects. These challenges include frequent delays, cost overruns, and quality deficiencies, which hinder infrastructure performance and limit its contribution to national development. The effective application of project management strategies emerges as a crucial solution to these persistent issues, ensuring optimal use of resources and timely completion of infrastructure projects.

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Globally, transportation infrastructure has undergone extensive development, with countries increasingly recognizing its role in enhancing regional connectivity and driving economic prosperity. Road and bridge projects form the backbone of transportation systems, facilitating the movement of goods, services, and people. For developing nations like Libya, the construction and maintenance of transportation networks are essential to meet growing urbanization and economic demands. However, the successful execution of such projects often depends on robust project management strategies that align technical, financial, and organizational resources effectively (Sutrisna & Goulding, 2019).

In Libya, road and bridge projects are plagued by inefficiencies stemming from inadequate planning, weak governance structures, and insufficient integration of modern technologies. These deficiencies are exacerbated by political instability and economic volatility, which further disrupt project timelines and escalate costs (Kahouli & Maktouf, 2019). Despite these challenges, Libya's infrastructure sector holds immense potential to support economic growth, provided that effective project management strategies are implemented to address existing gaps. The primary issue addressed in this study is the poor infrastructure performance of road and bridge projects in Libya, largely attributed to the ineffective application of project management strategies. Libya's construction sector suffers from delays, financial mismanagement, and a lack of skilled personnel, leading to unsatisfactory project outcomes. Furthermore, technological integration within project management processes remains limited, hindering the ability to adapt to modern infrastructure challenges (Ismail & Elmloshi, 2018). These problems necessitate a comprehensive examination of how project management strategies can be optimized to improve infrastructure performance in the Libyan context. This study aims to investigate the impact of project management strategies, processes, and systems on the performance of road and bridge projects in Libya. This study offers significant theoretical and practical contributions. From a theoretical perspective, it expands the body of knowledge on project management by contextualizing its application within the Libyan infrastructure sector, a region often underrepresented in global research. Additionally, the study integrates established theoretical frameworks, such as the Technology Acceptance Model (TAM) and Resource-Based View (RBV), to provide nuanced insights into how organizational and technological factors shape project outcomes (Ahmad et al., 2021).

Practically, the findings aim to inform policymakers, project managers, and stakeholders involved in infrastructure development in Libya. By highlighting critical success factors and proposing actionable recommendations, the study seeks to address systemic inefficiencies and improve the overall quality and timeliness of infrastructure projects. These insights are particularly relevant for guiding the implementation of technological tools and fostering a culture of continuous improvement within government agencies and construction firms.

The research focuses on road and bridge projects under the jurisdiction of the Roads and Bridges Authority (RBA) in Libya. The analysis is limited to government-operated projects, acknowledging their central role in public transportation and economic development. Data collection involves a cross-sectional survey of professionals involved in project management, including engineers, contractors, and policymakers. The study primarily employs quantitative

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methods, supplemented by qualitative insights to provide a comprehensive understanding of the factors influencing infrastructure performance.

LITERATURE REVIEW

Libya's infrastructure challenges are multifaceted, encompassing technical, managerial, and external factors that collectively impede the successful execution of road and bridge projects. These issues are not unique to Libya but are amplified in developing countries where governance structures, resource availability, and socio-political conditions are often unstable. Understanding these challenges and addressing them requires a detailed exploration of their root causes and potential solutions, particularly in the context of Libya's road and bridge infrastructure.

Technical Challenges

Technical inefficiencies, particularly inadequate planning and design inconsistencies, represent a major hurdle in Libya's infrastructure development. Poor planning leads to ambiguous project scopes and unanticipated adjustments during execution, resulting in frequent delays and cost overruns (Motaleb & Kishk, 2020). Design inconsistencies, including incomplete or incorrect blueprints, exacerbate these problems, forcing contractors to make reactive changes that further increase project timelines and budgets.

Globally, technical challenges in infrastructure projects are well-documented, with studies highlighting similar issues in developing nations like India, Nigeria, and Egypt (Love et al., 2021). In Libya, these challenges are compounded by a lack of skilled professionals equipped with the technical knowledge necessary to foresee and mitigate design flaws. The absence of quality assurance protocols during the planning phase further aggravates these issues, leading to substandard infrastructure outcomes. Addressing technical inefficiencies requires the adoption of advanced planning methodologies, rigorous design review processes, and the engagement of qualified professionals (Sutrisna & Goulding, 2019).

Managerial Challenges

Managerial inefficiencies, including weak governance structures and limited strategic decision-making capacity, significantly hinder infrastructure performance in Libya. Governance issues manifest as delays in decision-making, poor resource allocation, and an overall lack of accountability among project stakeholders. For instance, delays in approving project designs and budget allocations frequently stall progress, while inadequate oversight mechanisms allow inefficiencies to persist unchecked (Kahouli & Maktouf, 2019).

Strategic decision-making is another critical area where Libyan infrastructure projects fall short. Effective project management requires aligning project goals with broader organizational and economic objectives, a practice that is rarely followed in Libya. Weak leadership and an absence of cohesive management strategies often lead to fragmented efforts and misaligned priorities (Sundaraj & Eaton, 2018). Furthermore, poor communication between stakeholders, including

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government agencies, contractors, and consultants, creates silos that exacerbate inefficiencies and delays.

Globally, managerial challenges in infrastructure projects are well-studied, with developing nations frequently facing similar issues. For example, studies in Nigeria and Ghana highlight the impact of governance failures on project performance, emphasizing the need for transparent decision-making and robust oversight mechanisms (Chipulu et al., 2019). In Libya, addressing managerial inefficiencies will require comprehensive governance reforms, improved stakeholder coordination, and capacity-building programs aimed at enhancing leadership and decision-making skills.

External Challenges

External factors, such as political instability and economic volatility, further complicate infrastructure development in Libya. Political instability disrupts funding allocations and undermines investor confidence, making it difficult to secure the financial resources necessary for large-scale projects (Kahouli & Maktouf, 2019). Economic volatility, characterized by fluctuating material costs and inconsistent cash flows, creates additional challenges by increasing project costs and delaying procurement processes.

These external challenges are not unique to Libya but are particularly pronounced due to the country's history of political unrest and economic dependency on oil revenues. For example, in neighboring Egypt, political transitions have had similar effects on infrastructure projects, with studies showing delays and cost escalations directly linked to political instability (Motaleb & Kishk, 2020). In Libya, mitigating the impact of external challenges will require long-term strategies, including diversifying the economy to reduce reliance on oil revenues and implementing policies that promote political stability and investor confidence.

Limited Technological Integration

One of the most significant findings from existing literature is the limited integration of technology in Libya's project management practices. Modern tools, such as project management software, real-time monitoring systems, and data analytics platforms, are underutilized, resulting in inefficiencies in resource allocation, communication, and project execution (Subashini et al., 2019).

Globally, technological advancements have revolutionized project management, enabling real-time decision-making, enhanced collaboration, and improved accountability. For instance, countries like the UAE and Singapore have adopted smart technologies in infrastructure projects, significantly improving efficiency and outcomes (Love et al., 2021). In contrast, Libya lags, primarily due to a lack of technical expertise, inadequate funding for technological adoption, and resistance to change within organizations (Sutrisna & Goulding, 2019).

Technological integration in project management offers several benefits, including better risk management, streamlined workflows, and increased transparency. For Libya, adopting technologies such as Building Information Modeling (BIM) and Geographic Information Systems

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(GIS) could help address planning inefficiencies, enhance design accuracy, and improve stakeholder collaboration. However, the successful implementation of these tools will require targeted investments in training and capacity building, as well as organizational reforms to foster a culture of innovation.

Holistic Solutions

Addressing Libya's infrastructure challenges requires a holistic approach that integrates advanced project management strategies, technological innovation, and organizational reforms. A key starting point is the development of standardized project management frameworks that align with international best practices. These frameworks should include detailed planning templates, performance monitoring systems, and risk management protocols to ensure consistency and accountability across all projects (Love et al., 2021).

Organizational reforms are equally important. Building a culture of accountability and continuous improvement within government agencies and construction firms will require leadership training programs, stakeholder engagement initiatives, and incentives for adopting modern project management practices (Sundaraj & Eaton, 2018). Additionally, policies aimed at improving resource allocation, streamlining decision-making processes, and promoting stakeholder collaboration will play a critical role in addressing managerial inefficiencies.

Technological innovation must also be a central component of Libya's infrastructure development strategy. Investments in modern project management tools, coupled with training programs to build technical capacity, will enable more efficient planning, monitoring, and execution of infrastructure projects. Moreover, fostering partnerships with international organizations and technology providers can help bridge the technical knowledge gap and accelerate the adoption of advanced solutions (Subashini et al., 2019). Future research should focus on exploring the long-term impacts of project management practices on infrastructure sustainability in Libya. This includes examining the role of external factors such as political stability and economic policy on project performance, as well as evaluating the effectiveness of technological interventions in improving project outcomes. Additionally, comparative studies with other developing nations could provide valuable insights into best practices and innovative solutions applicable to Libya's unique context.

Table 1: Challenges and Solutions for Libya's Infrastructure Development

Challenge	Details	Proposed Solutions	Key References
Technical Challenges	- Poor planning and ambiguous scopes - Design inconsistencies leading to delays and cost overruns	- Advanced planning methodologies - Rigorous design reviews - Engagement of skilled professionals	Motaleb & Kishk (2020); Sutrisna & Goulding (2019)

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Managerial Challenges	- Weak governance structures - Limited strategic decision-making capacity - Poor stakeholder coordination	- Governance reforms - Capacity-building programs for leadership - Improved stakeholder communication	Kahouli & Maktouf (2019); Chipulu et al. (2019)
External Challenges	- Political instability disrupting funding - Economic volatility increasing costs and delays	- Policies promoting political stability - Economic diversification to reduce reliance on oil revenues	Kahouli & Maktouf (2019); Motaleb & Kishk (2020)
Limited Technological Integration	- Underutilization of tools like BIM and GIS - Resistance to change - Lack of technical expertise	- Investments in technology adoption - Training programs - Organizational reforms for innovation	Subashini et al. (2019); Love et al. (2021)
Holistic Solutions	- Fragmented project management practices - Lack of standardized frameworks	- Standardized frameworks with templates and protocols - Leadership training programs - Stakeholder collaboration	Love et al. (2021); Sundaraj & Eaton (2018)
Future Research	- Lack of insights into long-term sustainability and global comparisons	- Explore external factors like political stability - Evaluate technological interventions - Comparative studies	Subashini et al. (2019); Love et al. (2021)

Libya's infrastructure challenges are deeply rooted in technical, managerial, and external factors, each contributing to the inefficiencies observed in road and bridge projects. Technical issues such as poor planning and design inconsistencies, managerial inefficiencies stemming from weak governance, and external disruptions due to political and economic instability create a complex web of obstacles that hinder infrastructure performance. The limited integration of technology further exacerbates these challenges, restricting the ability to optimize resource allocation and improve collaboration.

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A holistic approach that combines advanced project management strategies, technological innovation, and organizational reforms is essential to address these deficiencies effectively. By adopting standardized frameworks, fostering a culture of accountability, and investing in modern tools, Libya can enhance its infrastructure performance and contribute to sustainable economic growth.

Theoretical Framework

This study employs multiple theoretical frameworks to analyze the interplay between project management practices and infrastructure performance in Libya's road and bridge sector. By integrating the Technology Acceptance Model (TAM), the Resource-Based View (RBV), and the Theory of Constraints (TOC), the study examines how technological adoption, resource utilization, and constraint management influence project outcomes. These theories provide a comprehensive lens for understanding the challenges and opportunities associated with improving infrastructure performance.

Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM) is a widely used framework for understanding how users adopt and utilize technology. Proposed by Davis (1989), TAM posits that two key factors, perceived usefulness (PU) and perceived ease of use (PEOU), determine an individual's attitude toward using a specific technology, which in turn influences their behavioral intention and actual use. In the context of project management, TAM explains how technological tools, such as project management software and real-time monitoring systems, are adopted within organizations (Venkatesh & Bala, 2008).

In infrastructure projects, the adoption of technology can streamline processes, enhance decision-making, and improve collaboration among stakeholders. However, as this study highlights, the integration of technology in Libya's road and bridge projects is limited. Factors such as a lack of technical expertise, resistance to change, and inadequate training hinder the effective use of advanced tools. TAM provides a theoretical foundation for addressing these barriers by emphasizing the importance of demonstrating the usefulness and ease of use of new technologies to stakeholders. For example, perceived usefulness can be enhanced by showcasing how real-time monitoring tools reduce delays and cost overruns through better resource allocation. Similarly, perceived ease of use can be improved by providing user-friendly interfaces and comprehensive training programs for project managers and team members (Subashini et al., 2019). By addressing these factors, project stakeholders in Libya can overcome technological adoption barriers and leverage the benefits of modern project management tools.

Resource-Based View (RBV)

The Resource-Based View (RBV) emphasizes the strategic importance of organizational resources in achieving competitive advantages. According to Barney (1991), resources must be valuable, rare, inimitable, and non-substitutable (VRIN) to contribute to sustainable competitive advantages.

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In the context of project management, RBV underscores the role of human, financial, and technological resources in enhancing project outcomes (Wernerfelt, 1984). Libya's road and bridge projects face significant resource-related challenges, including inadequate funding, a lack of skilled personnel, and limited access to advanced technologies. RBV provides a framework for identifying and leveraging critical resources to improve infrastructure performance. For instance, skilled human resources, such as experienced project managers and engineers, can significantly enhance planning and execution processes. Similarly, financial resources allocated efficiently can ensure timely procurement and project continuity, while technological resources can streamline workflows and enhance collaboration (Love et al., 2021). The strategic alignment of resources with project goals is another key aspect of RBV. Organizations must prioritize resource allocation based on project requirements and expected outcomes. In Libya, this involves addressing inefficiencies in resource distribution and ensuring that key projects receive adequate support. Additionally, RBV highlights the importance of investing in resource development, such as training programs to enhance technical skills and adopting technologies that align with organizational objectives (Flyvbjerg et al., 2018).

Theory of Constraints (TOC)

The Theory of Constraints (TOC), introduced by Goldratt (1984), focuses on identifying and addressing bottlenecks that limit system performance. TOC posits that every system has at least one constraint that restricts its ability to achieve its goals, and improving system performance requires identifying and managing these constraints. In project management, TOC provides a systematic approach for optimizing workflows, reducing delays, and enhancing overall project efficiency (Mabin & Balderstone, 2003).

Libya's road and bridge projects often encounter bottlenecks related to resource shortages, design inconsistencies, and decision-making delays. TOC offers a practical framework for addressing these challenges by identifying critical constraints and implementing targeted solutions. For example, if delays in design approvals are identified as a primary constraint, TOC recommends streamlining the approval process through better coordination among stakeholders and the adoption of digital tools for document sharing and review (Love et al., 2021). TOC also emphasizes the importance of continuous improvement, where addressing one constraint leads to the identification of new constraints, creating a cycle of ongoing optimization. This approach is particularly relevant in Libya, where infrastructure projects face dynamic challenges due to political instability and economic fluctuations. By applying TOC principles, project managers can develop adaptive strategies to manage constraints and improve project outcomes over time (Goldratt, 1990).

Integrative Perspective

While TAM, RBV, and TOC offer distinct perspectives, their integration provides a comprehensive framework for understanding the relationship between project management practices and infrastructure performance. TAM focuses on the adoption and use of technology,

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RBV highlights the strategic importance of resources, and TOC addresses the optimization of workflows and processes. Together, these theories enable a multidimensional analysis of project management challenges and opportunities in Libya's road and bridge sector.

Table 2: Theoretical Frameworks and Their Application

Theoretical Framework	Key Concepts	Application in Libya's Infrastructure Projects	Key References
Technology Acceptance Model (TAM)	- Perceived Usefulness (PU) - Perceived Ease of Use (PEOU) - User Adoption	Explains barriers to technology adoption, such as resistance to change and lack of training. Promotes the use of user-friendly tools like real-time monitoring systems.	Davis (1989); Venkatesh & Bala (2008)
Resource-Based View (RBV)	- VRIN Resources (Valuable, Rare, Inimitable, Non-substitutable) - Strategic Resource Allocation	Highlights the importance of skilled personnel, financial resources, and technology. Focuses on aligning resources with project goals for competitive advantages.	Barney (1991); Wernerfelt (1984)
Theory of Constraints (TOC)	- Identifying Bottlenecks - Continuous Improvement - System Optimization	Provides a framework for addressing constraints such as design delays, resource shortages, and weak coordination. Encourages iterative process improvements.	Goldratt (1984; 1990); Mabin & Balderstone (2003)
Integrative Perspective	- Combining TAM, RBV, and TOC for a holistic approach	Aligns technology adoption (TAM) with resource strategies (RBV) and bottleneck management (TOC) for improved project outcomes in Libya's dynamic context.	Flyvbjerg et al. (2018); Love et al. (2021)

For instance, the integration of TAM and RBV underscores the need for aligning technological investments with resource availability and organizational goals. While TAM emphasizes the adoption of user-friendly tools, RBV highlights the importance of ensuring that these tools are valuable and strategically aligned with project objectives. Similarly, the integration of RBV and TOC emphasizes the need for efficient resource allocation to address identified constraints. By combining these frameworks, this study offers actionable insights for enhancing infrastructure performance in Libya.

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Relevance to Libya

The application of these theoretical frameworks is particularly relevant to the Libyan context, where infrastructure challenges are amplified by technical, managerial, and external factors. TAM provides a foundation for addressing technological adoption barriers, which are prevalent due to limited expertise and resistance to change. RBV offers a strategic perspective on resource management, highlighting the importance of leveraging human, financial, and technological resources to achieve project goals. TOC complements these frameworks by providing a systematic approach for identifying and managing constraints that hinder project performance.

Together, these theories offer a roadmap for improving project management practices in Libya's road and bridge sector. By adopting user-friendly technologies, optimizing resource allocation, and addressing bottlenecks, project managers can enhance efficiency, reduce delays, and improve overall infrastructure performance. The integration of TAM, RBV, and TOC provides a robust theoretical foundation for understanding the challenges and opportunities associated with project management in Libya's road and bridge projects. TAM highlights the importance of technological adoption, RBV emphasizes the strategic role of resources, and TOC focuses on constraint management and continuous improvement. By applying these frameworks, this study offers a comprehensive analysis of the factors influencing infrastructure performance and provides actionable recommendations for addressing existing challenges.

RESEARCH METHODOLOGY

The study adopts a quantitative research approach, utilizing Structural Equation Modeling (SEM) to analyze the relationships among project management systems, processes, strategies, and infrastructure performance. Data collection involves a structured survey distributed to professionals in the Libyan construction industry, with a focus on assessing perceptions of project management practices and their outcomes. The use of SEM enables the identification of direct, indirect, and moderating effects, providing a comprehensive understanding of the factors influencing infrastructure performance. Improving infrastructure performance in Libya's road and bridge sector requires a strategic focus on enhancing project management practices. By addressing existing gaps and leveraging technological advancements, this study aims to provide actionable insights that contribute to sustainable infrastructure development. The integration of robust project management strategies, supported by empirical evidence and theoretical frameworks, is essential for overcoming challenges and ensuring the successful execution of infrastructure projects in Libya.

DATA ANALYSIS AND FINDINGS

This study examined the influence of project management systems, processes, and strategies on infrastructure performance in road and bridge projects in Libya. Through a cross-sectional survey and data analysis using Structural Equation Modeling (SEM), the findings highlight significant relationships and provide insights into the factors affecting infrastructure outcomes.

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1. Impact of Project Management Systems on Infrastructure Performance

The analysis revealed a positive and statistically significant relationship between project management systems and infrastructure performance ($\beta = 0.48$, $p < 0.05$). Well-structured systems, including standardized procedures, resource management frameworks, and monitoring tools, contribute significantly to project success. These systems help mitigate delays, reduce cost overruns, and enhance overall project efficiency by enabling better decision-making and resource allocation. Respondents emphasized that the absence of integrated systems often leads to fragmented communication and inefficiencies in Libyan road and bridge projects.

2. Influence of Project Management Processes on Performance

Project management processes, such as planning, execution, and monitoring, were also found to have a significant positive effect on infrastructure performance ($\beta = 0.39$, $p < 0.05$). Effective processes streamline project workflows, ensuring alignment with strategic objectives and facilitating timely completion. The findings highlight that inadequate planning and weak implementation mechanisms are primary contributors to delays and substandard outcomes. Specifically, respondents pointed to poor site management and insufficient contractor oversight as recurring issues in the Libyan context.

3. Role of Project Management Strategy as a Mediator

The study identified project management strategy as a crucial mediator between systems/processes and infrastructure performance. Strategies that integrate organizational goals with project objectives amplify the impact of systems and processes on outcomes ($\beta = 0.32$, $p < 0.05$). Strategic alignment ensures that resource allocation, stakeholder engagement, and risk management are prioritized, leading to improved project efficiency. Respondents highlighted the need for a greater focus on aligning project management practices with broader organizational and economic goals in Libya.

4. Moderating Effect of Technological Awareness

Technological awareness was found to moderate the relationship between project management practices and infrastructure performance significantly ($\beta = 0.29$, $p < 0.05$). The use of modern project management tools, such as software for real-time monitoring and data analytics, enhances the effectiveness of systems and processes. However, the findings reveal a gap in the adoption of technology in Libya's road and bridge sector. Participants noted that limited technological integration undermines project efficiency, emphasizing the need for capacity-building programs to enhance technology utilization.

5. Contextual Challenges and Organizational Factors

Organizational culture, stakeholder engagement, and resource allocation emerged as critical contextual factors influencing project management effectiveness. A lack of stakeholder involvement and inconsistent resource distribution were identified as major barriers to achieving

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project goals. Additionally, organizational resistance to change and a lack of skilled personnel were cited as factors hindering the adoption of advanced project management practices. The findings underscore the importance of integrating project management systems, processes, and strategies with technological tools to improve infrastructure performance in Libya. Addressing organizational challenges and promoting strategic alignment are crucial for overcoming inefficiencies in the road and bridge sector. These insights provide a foundation for policymakers and practitioners to enhance project outcomes through tailored interventions and capacity-building initiatives.

DISCUSSION

The findings of this study underscore the critical role of project management strategies, systems, and processes in enhancing infrastructure performance, particularly within the Libyan context. This discussion elaborates on the implications of these findings, emphasizing how structured frameworks, strategic alignment, and technological integration can address the inefficiencies plaguing Libya's road and bridge projects. By highlighting key areas of improvement, the discussion provides actionable insights for policymakers, project managers, and stakeholders aiming to enhance infrastructure outcomes.

Role of Project Management Systems

The statistically significant relationship between project management systems and infrastructure performance highlights the importance of adopting structured frameworks to ensure project success. Project management systems serve as the backbone of effective project execution by standardizing procedures, optimizing resource utilization, and providing integrated monitoring mechanisms. These systems help mitigate delays, reduce cost overruns, and improve overall project outcomes (Motaleb & Kishk, 2020). However, the findings indicate that many road and bridge projects in Libya lack robust project management systems, leading to inefficiencies and suboptimal performance.

In the global context, standardized project management systems such as the Project Management Body of Knowledge (PMBOK) and PRINCE2 have proven effective in streamlining project workflows and ensuring accountability. These systems emphasize detailed planning, risk management, and performance evaluation, which are critical for achieving project objectives (Sutrisna & Goulding, 2019). In Libya, the absence of such frameworks exacerbates challenges like resource mismanagement and communication breakdowns among stakeholders. The adoption of internationally recognized project management systems can address these gaps by introducing consistency and accountability into project execution.

Importance of Project Management Processes

The positive influence of project management processes on infrastructure performance further underscores the need for robust planning, execution, and monitoring practices. Effective project management processes ensure that project goals are clearly defined, resources are efficiently

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allocated, and timelines are adhered to. This is particularly important in the context of Libya, where poorly executed processes often result in delays, cost escalations, and substandard infrastructure outcomes (Kahouli & Maktouf, 2019).

The study's findings emphasize that detailed planning frameworks and rigorous implementation protocols are essential for achieving project objectives. For instance, clear project scopes, realistic timelines, and comprehensive risk assessments can significantly enhance the planning phase. During execution, regular monitoring and quality assurance mechanisms ensure that projects stay on track and meet performance standards. However, persistent challenges such as poor contractor oversight and weak site management continue to undermine the effectiveness of project management processes in Libya. Addressing these issues requires stricter enforcement of standardized procedures and improved accountability mechanisms. Globally, successful infrastructure projects often rely on well-defined processes that integrate best practices from project management methodologies. For example, Agile and Lean methodologies have gained traction in the construction sector for their focus on flexibility and continuous improvement (Love et al., 2021). Adapting these methodologies to the Libyan context can enhance process efficiency and improve infrastructure outcomes.

Mediating Role of Project Management Strategies

Project management strategies emerged as a crucial mediating factor, amplifying the effects of systems and processes on infrastructure performance. The findings suggest that aligning project strategies with organizational and economic goals can lead to improved resource allocation, stakeholder collaboration, and risk management. Strategic alignment ensures that project objectives are consistent with broader organizational priorities, fostering a sense of shared purpose among stakeholders (Flyvbjerg et al., 2018).

In the Libyan context, the lack of strategic alignment often results in fragmented efforts and reduced efficiency. For instance, projects are frequently initiated without considering their alignment with national development goals or long-term sustainability. This disconnect leads to resource wastage, stakeholder disengagement, and poor project outcomes. By integrating strategic planning into project management practices, organizations can ensure that projects contribute meaningfully to national economic and social objectives.

Effective strategies also enhance stakeholder engagement, which is critical for project success. Collaborative strategies that involve stakeholders in decision-making processes foster trust, accountability, and shared ownership of project outcomes. Additionally, strategic risk management practices can help mitigate uncertainties associated with infrastructure projects, particularly in volatile environments like Libya (Sundaraj & Eaton, 2018).

Moderating Role of Technological Awareness

The moderating role of technological awareness highlights the transformative potential of modern tools in project management. Technologies such as real-time monitoring systems, data analytics platforms, and collaborative software can significantly enhance decision-making, streamline

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workflows, and improve accountability (Subashini et al., 2019). For instance, Building Information Modeling (BIM) enables precise project visualization and coordination, reducing errors and improving efficiency. Similarly, Geographic Information Systems (GIS) facilitate better planning and resource allocation by providing spatial insights.

However, the study's findings reveal a substantial gap in technological adoption within Libya's road and bridge sector. Limited training, inadequate funding, and organizational resistance to change hinder the effective use of advanced tools. Addressing this gap requires targeted investments in technology adoption and capacity building. For example, training programs can enhance technical skills among project managers, while organizational reforms can create a culture that embraces innovation.

Globally, countries like Singapore and the UAE have demonstrated the benefits of technological integration in infrastructure projects. These nations have adopted smart technologies to enhance project efficiency, reduce delays, and improve stakeholder collaboration (Love et al., 2021). Libya can learn from these examples by prioritizing technology-driven solutions to address its infrastructure challenges.

Contextual Challenges

Contextual challenges such as inadequate stakeholder engagement, resource allocation inefficiencies, and organizational resistance to change were identified as significant barriers to infrastructure performance. Stakeholder engagement is critical for ensuring project accountability and fostering a sense of ownership. However, in Libya, poor communication and fragmented decision-making processes often alienate key stakeholders, leading to disengagement and project delays (Kahouli & Maktouf, 2019).

Resource allocation inefficiencies, particularly in financial and human resources, further exacerbate infrastructure challenges. The findings highlight the need for equitable distribution of resources to ensure that all projects receive adequate support. For instance, prioritizing resource allocation based on project importance and expected outcomes can improve efficiency and reduce wastage.

Organizational resistance to change is another significant barrier. Many organizations in Libya are reluctant to adopt modern project management practices and technologies due to entrenched bureaucratic processes and a lack of innovation-driven leadership. Addressing this resistance requires comprehensive organizational reforms, including leadership training, performance-based incentives, and the promotion of a continuous improvement culture (Sutrisna & Goulding, 2019).

The findings of this study have several practical and theoretical implications. Practically, they underscore the need for a holistic approach to project management that integrates systems, processes, and strategies with technological tools and organizational reforms. Policymakers and project managers must prioritize the adoption of standardized frameworks, strategic alignment, and technological innovation to address Libya's infrastructure challenges.

Theoretically, the study contributes to the literature on project management by demonstrating the interdependence of systems, processes, and strategies in achieving infrastructure performance. It

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also highlights the importance of technological awareness and contextual factors in shaping project outcomes, providing a nuanced understanding of the challenges and opportunities in developing nations like Libya.

The findings of this study emphasize the critical role of project management practices in enhancing infrastructure performance. Structured frameworks, strategic alignment, and technological integration are essential for addressing the inefficiencies plaguing Libya's road and bridge sector. By fostering stakeholder engagement, optimizing resource allocation, and promoting a culture of innovation, Libya can overcome its infrastructure challenges and achieve sustainable development.

CONCLUSION

This study examined the impact of project management strategies, systems, and processes on the performance of road and bridge infrastructure projects in Libya. The findings confirmed that effective project management practices, particularly when integrated with technological tools and strategic alignment, can significantly improve infrastructure outcomes.

The study revealed the critical role of project management systems in providing the structural backbone for efficient project execution, while robust processes ensure that projects are planned and implemented effectively. Project management strategies act as a bridge, linking systems and processes with broader organizational and economic goals, thereby enhancing overall performance.

However, the study also highlighted significant gaps, including inadequate technological integration, poor contractor oversight, and insufficient stakeholder engagement. Addressing these issues requires a multi-faceted approach involving capacity building, policy reforms, and enhanced collaboration among stakeholders.

To improve the performance of Libya's road and bridge sector, adopting comprehensive project management frameworks is essential. Standardized systems and processes should be implemented across projects, incorporating detailed planning templates, monitoring mechanisms, and evaluation frameworks to enhance consistency and efficiency. In addition, strategic alignment between project objectives and broader organizational and economic goals is crucial. Government agencies and project managers must ensure this alignment through policy reforms that mandate the integration of project management strategies with national development plans, fostering coherence between infrastructure initiatives and Libya's economic aspirations.

Investments in project management technologies are also critical to address operational inefficiencies. Tools such as real-time monitoring systems, project management software, and data analytics platforms can enhance decision-making and project execution. Training programs should accompany these technological advancements to build the technical capacity of project managers and stakeholders, ensuring effective utilization of these tools. Strengthening stakeholder engagement is equally important. Active participation of government agencies, contractors, and local communities should be institutionalized to ensure accountability and a sense of project ownership. Regular consultations and feedback mechanisms can facilitate this engagement, enabling stakeholders to contribute meaningfully to project development and implementation.

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Addressing resource allocation challenges is another priority. Policies must focus on the equitable distribution of financial and human resources, ensuring that all projects receive adequate support. Additionally, improving access to funding for infrastructure projects can help mitigate delays and financial constraints that often plague Libya's construction sector. Organizational reforms are also necessary to foster a supportive culture that embraces change and promotes continuous improvement. Leadership training programs and incentives for adopting modern project management practices can create an environment conducive to innovation and efficiency.

Lastly, conducting further research is vital for long-term sustainability. Future studies should investigate the enduring impacts of project management practices on infrastructure outcomes and examine the influence of external factors such as political stability and economic policy. By addressing these areas, Libya's road and bridge projects can overcome existing challenges, enhance efficiency, and contribute significantly to the nation's sustainable economic growth.

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