Journal of Research Administration
Society of Research Administrators International

ENHANCING INFRASTRUCTURE PERFORMANCE IN LIBYAN ROAD AND BRIDGE PROJECTS: THE IMPACT OF PROJECT MANAGEMENT AND TECHNOLOGICAL AWARENESS

Anwar Alzaletane, Ali Khatibi, Jacquline Tham
Postgraduate Centre, Management and Science University, Shah Alam, Malaysia

ABSTRACT

Infrastructure development plays an important role in the economic growth and social well-being of nations, with effective project management serving as a cornerstone for successful implementation. However, in countries like Libya, infrastructure projects face numerous challenges ranging from financial constraints to inadequate management practices and resource shortages. This study examines the factors contributing to project delays and the implications for infrastructure development in Libya, drawing on existing literature and empirical evidence. Despite the significant impact of delays on project outcomes, research on infrastructure development in Libya is hindered by limitations such as data availability, small sample sizes, and language barriers. The volatile political and economic landscape further complicates the analysis, introducing external factors that may not be adequately accounted for. Nonetheless, longitudinal studies tracking project progress over time, comparative analyses with other countries, and stakeholder perspectives offer valuable insights into the challenges and opportunities for infrastructure development in Libya. Additionally, exploring the potential impact of emerging technologies and evaluating the effectiveness of capacity building initiatives can inform strategies for promoting sustainable infrastructure development. By addressing these limitations and pursuing further research, stakeholders in the Road and Bridge Authority of Libya can enhance project performance and contribute to the overall development and prosperity of the nation.

Keywords: Infrastructure development, project delays, Libya, project management, emerging technologies

INTRODUCTION

The Road and Bridge Authority (RBA) in Libya plays an important role in facilitating transportation infrastructure development by issuing licenses for public and commercial vehicles and overseeing public transport networks (RBA, 2017). Infrastructure projects in the transportation sector require substantial time and investment due to their critical contribution to economic growth and development globally. Project management strategies are essential for addressing uncertainties and minimizing delays in these ventures (Aziz, Qasim, & Wajdi, 2017). The Road and Transportation Project Management Cycle advocates for increased developmental projects to enhance road and transport networks, significantly impacting Libya's growth (Al Nahyan et al., 2012). RBA's initiatives have set high standards, contributing to Libya's infrastructure progression, such as the introduction of advanced booths and bus shelters (Haque, Saroar, Fattah, & Morshed, 2020).

Road transportation is fundamental for economic development, mitigating unemployment, poverty, and fostering innovation (Herman et al., 2018). Libya, among other nations, is witnessing an increase in road construction activities to enhance its economic landscape (Dewan, 2018). Investment in infrastructure, particularly in the transportation sector, is crucial for Libya's economic development (Al Nahyan et al., 2012). Efforts to reform infrastructure governance aim to improve project implementation efficiency and address capacity issues, resulting in increased public transportation usage and decreased road fatalities (Suryani et al., 2021).

Despite infrastructure investment, technical shortcomings, contractual lapses, and design oversights often lead to post-construction problems, leaving the Department of Roads accountable (Maude & Aubry, 2018). Conducting detailed technical audits during the construction phase is essential to ensure compliance with specifications, mitigating delays, budget overruns, and quality issues (Sutrisna & Goulding, 2019). Effective change management strategies can reduce adverse outcomes and minimize rework costs (Zamberi Ahmad & Ahmad, 2016).

Overall, the RBA's efforts, coupled with infrastructure investments and effective project management, contribute significantly to Libya's transportation sector's growth. However, addressing technical shortcomings and implementing robust change management strategies are crucial for successful infrastructure development. Obtaining precise statistics on the success rates of road construction projects in Libya is challenging, but estimates suggest that up to 50% of infrastructure projects in the country face failure (Faridi & El Sayegh, 2006; Johnson & Babu, 2018). This high rate of failure has created a fiercely competitive market for handling claims and disputes (Arcadis, 2018; Ojiako et al., 2018; Mishmish & El-Sayegh, 2018; Zaneldin, 2018). Research indicates that half of the construction projects in Libya experience delays, failing to meet their scheduled timelines (Faridi & El-Sayegh, 2016).

Further studies have identified key causes of these construction delays, including issues such as the approval process for drawings, poor initial planning, and sluggish decision-making by project owners, highlighting the critical need for skilled project management to address these challenges. Delays in owners' decision-making, coupled with inadequate early planning, labor shortages, poor oversight, and deficient site management, are among the primary reasons for project delays. Interestingly, contractor-related issues account for half of the top ten most critical delay factors, suggesting that contractors may often bear responsibility for these delays (Faridi & El-Sayegh, 2016). Resource shortages, including a lack of labor, productivity issues, and expertise deficits, have also been identified as significant contributors to project postponements.

While many factors contributing to delays in Libya's construction industry align with previous research findings, recent observations suggest that time and budget overruns are increasingly prevalent reasons for project delays. Studies indicate that labor shortages, productivity inefficiencies, skill deficits, and poor communication are significant factors contributing to these delays (Ewedairo et al., 2018; Gharehgozli, de Vries, & Decrauw, 2019; Mahmud, Ogunlana, & Hong, 2021). The road and transportation sectors are experiencing significant advancements and commercial growth (Hua Song et al., 2016). Infrastructure related to roads and transportation is

recognized as a key driver of economic development (Abdulla Al Marzooqi & Zamberi Ahmad, 2018; Mainga, 2017).

Numerous research efforts have aimed to identify the elements contributing to effective project management and process orientation within organizational achievements (Al Nahyan et al., 2012; Mainga, 2017; Todorov & Akbar, 2018). Some studies have found a significant positive impact of project management practices on the performance of infrastructure projects (Abdulla Al Marzooqi & Zamberi Ahmad, 2018; Taleb, 2020). Additionally, investigations have been conducted into the primary reasons for project failures in Libya (Hussain, Ruikar, Enoch, Brien, & Gartside, 2017; Mwelu, Davis, Ke, & Watundu, 2020). However, the influence of technology awareness on project management processes and infrastructure performance remains an unexplored area in the existing literature on roads and transportation within the Libyan context.

The scarcity of scholarly work focusing on roads and transportation within the Libyan context presents a significant hurdle to improving infrastructure efficacy. This analysis underscores the importance of implementing essential project management practices tailored to the Road and Bridge Authority (RBA) setting, which are crucial for enhancing efficiency. Given the limited resources available in Libya, adopting a more efficient project management approach becomes imperative for improving market share and profitability derived from project successes (Marcel van, 2018). This study aims to identify and examine the synergies between project management, awareness of technological advancements, and organizational effectiveness in Libya. It explores various determinants that influence these processes and highlights their combined impact on the successful outcome of infrastructure projects in the country (Mainga, 2017). By utilizing project management techniques informed by technological awareness, this research seeks to outline a roadmap for achieving success in infrastructure development within the Libyan roads and transportation sector.

LITERATURE REVIEW

The evaluation of infrastructure performance hinges on its ability to deliver anticipated services to the community effectively. This evaluation typically employs the “iron triangle” framework, which considers time, cost, and quality. It entails scrutinizing factors such as completion delays, budget overruns, and overall infrastructure quality (Irfan, Malik, & Kaka Khel, 2020).

Predicting the duration of planning processes for transportation infrastructure projects proves challenging due to the unique nature of each project. In Germany, for example, approval procedures can range from 1 to 3 years for simpler cases and extend to 6 years or more for complex situations (Ismail, 2019). Some projects’ planning processes span over a decade, or even close to three decades in the most intricate scenarios.

Construction projects often exceed their projected budgets and deadlines. Research, such as Mahmud et al.’s study (2021), indicates that around half of all construction projects experience budget overruns, ranging between 40% and 200%. Transportation infrastructure projects are particularly vulnerable to such cost overruns. An analysis of 258 transportation infrastructure projects across 20 countries revealed that rail projects experienced an average cost overrun of

44.7%, while road projects had a relatively lower average overrun rate of 20.4%. Furthermore, a study by the German Federal Parliament examining 214 road construction projects identified cost deviations ranging from 10% to a staggering 720% (Liyanage et al., 2017).

The Road and Bridge Authority of Libya is tasked with managing and developing the country's road and transportation infrastructure. Over the past three decades, Libya has witnessed significant development across various sectors in its seven regions, resulting in notable advancements in the construction sector. This progress includes the expansion of critical transportation infrastructure such as roads, bridges, airports, and seaports. However, numerous projects have faced setbacks due to coordination challenges, sluggish decision-making, design flaws, and regulatory changes (Abdulla Al Marzooqi & Zamberi Ahmad, 2018). Despite these challenges, there is a dearth of comprehensive scientific studies addressing the complexities of infrastructure development in Libya, underscoring the need for further research and intervention (Mangioni, 2018).

Construction project delays in the Middle East are multifaceted, influenced by various factors across different countries in the region. In Jordan, a shortage of skilled workers contributes significantly to project postponements, reflecting a broader labor challenge faced by many nations (Shebob et al., 2012; Sundaraj & Eaton, 2013). Kuwait grapples with delays due to poor project management, frequent design changes, financial constraints, and a lack of expertise among project owners (Shebob et al., 2012; Sundaraj & Eaton, 2013). In Iran, delays are attributed to financial, managerial, and environmental challenges (Alhammadi & Memon, 2020; P. X. W. Zou, Wang, & Fang, 2008). In Lebanon, financial limitations, equipment shortages, management complexities, and changes in project orders are common reasons for delays (Faridi & El-Sayegh, 2006). Similarly, in the Gaza Strip, delays often result from insufficient funding, disruptions in material supply chains, and inadequate on-site resources (Saiful Islam & Trigunarsyah, 2017).

Comparative analysis of delay causes across countries like Lebanon, Saudi Arabia, and the UAE is essential. While commonalities exist, such as issues with owner decision-making and lengthy approval processes, the prioritization and perception of these factors vary (Saiful Islam & Trigunarsyah, 2017). Tailored mitigation strategies are needed to address delay factors within each country's construction industry context.

Research in emerging economies highlights financial issues as a prevalent concern contributing to project delays. Challenges such as contractor liquidity, payment delays, and inadequate owner financing underscore the need for improved financial management practices (Jeong, Joo-Seong, & Jung, Eun-Young, 2017). Inadequate site management by contractors and deficiencies in project planning and scheduling further exacerbate delays (Jeong, Joo-Seong, & Jung, Eun-Young, 2017). Challenges from project owners, such as scope changes during construction, emphasize the need for clearer communication and collaboration (Jeong, Joo-Seong, & Jung, Eun-Young, 2017).

Within the framework of Libya's Road and Bridge Authority, several factors contribute to prolonged construction timelines. In Ghana, project postponements often occur due to owners failing to fulfill financial commitments to contractors. In Saudi Arabia, the emphasis on financial scrutiny and the practice of selecting contractors based on the lowest bid are recognized as significant reasons for project delays in the government construction sector. Similarly, in Vanuatu,

issues related to project ownership have been associated with schedule setbacks in construction projects.

Inclement weather conditions are acknowledged as a primary factor causing delays in some construction projects. In Lagos State, Nigeria, the scarcity of adequate equipment supply has negatively affected contractor performance, leading to project postponements. In Malaysia, factors such as poor planning, inadequate site management, limited contractor knowledge, and issues with project financing and payments have been identified as significant causes of delays in construction projects.

Research conducted in Ethiopia has revealed a multifaceted landscape of challenges contributing to project delays. Among these, corruption emerges as a pervasive issue, hindering progress and exacerbating inefficiencies in the construction sector. The presence of corruption not only undermines the integrity of projects but also distorts resource allocation, leading to suboptimal outcomes and delayed timelines. Furthermore, the absence of utilities at construction sites poses significant hurdles, impeding the smooth execution of tasks and causing disruptions that prolong project durations.

In addition to corruption and utility deficiencies, the escalating costs of materials present a formidable obstacle to timely project completion in Ethiopia. Fluctuations in material prices, coupled with the scarcity of high-quality materials, amplify budgetary constraints and force project stakeholders to navigate complex procurement landscapes. Delays in the design process further compound these challenges, as revisions and approvals consume valuable time and resources, impeding progress on the ground. Moreover, issues with design documents, such as inaccuracies or incomplete specifications, create ambiguity and foster misinterpretations, leading to rework and delays in project execution.

Meanwhile, in Pakistan, the challenges contributing to delays in highway construction projects are characterized by deficiencies in project management and communication. Poor construction site management reflects a lack of effective coordination and supervision, resulting in inefficiencies and setbacks throughout the construction process. Similarly, the absence of contractor proficiency exacerbates these issues, as inadequate skills and expertise hinder the timely resolution of on-site challenges and impede progress.

Moreover, inadequate communication among project stakeholders exacerbates delays by fostering misunderstandings and conflicts that disrupt workflow and impede decision-making. The fragmented communication channels hinder the timely exchange of information and approvals, leading to bottlenecks and administrative delays. As a result, project timelines are elongated, and costs escalate due to inefficiencies and rework necessitated by communication breakdowns.

In developing nations like Ghana, delays in groundwater development projects are driven by a combination of financial, administrative, and logistical challenges. Irregular monthly payments from project owners disrupt cash flow for contractors, causing financial strain and impeding the timely procurement of materials and services. Ineffective contract administration exacerbates these issues, as inadequate oversight and enforcement of contractual terms lead to disputes and delays in project progress.

Additionally, inflation in material procurement costs further strains project budgets, forcing contractors to reevaluate resource allocation and project timelines. Moreover, financial difficulties encountered by contractors compound these challenges, as limited access to credit and capital inhibits investment in project resources and capabilities. Consequently, delays persist, undermining the objectives of groundwater development initiatives and impeding access to essential resources for local communities.

Similarly, in Turkey, delays in construction projects stem from a range of systemic issues spanning project management, planning, and execution. The lack of contractor expertise undermines project quality and efficiency, as inexperienced personnel struggle to navigate complex construction processes and address on-site challenges effectively. Insufficient site management and oversight exacerbate these issues, as inadequate supervision and control lead to errors, rework, and delays in project progress.

Moreover, poor planning and scheduling of projects contribute to uncertainty and inefficiency, as unrealistic timelines and resource allocation strategies fail to account for contingencies and complexities inherent in construction projects. Owner-initiated design changes during construction further disrupt project schedules, as revisions and approvals introduce delays and rework into the construction process. Delayed material deliveries and the unreliability of subcontractors compound these challenges, disrupting workflow and impeding progress on-site.

Meanwhile, in the context of gas pipeline projects in Iran, delays are driven by a combination of logistical, contractual, and regulatory challenges. The contractor's challenges in acquiring imported materials reflect the complexities of international procurement and logistics, as customs clearance procedures, shipping delays, and supply chain disruptions impede the timely delivery of essential project components. Client-imposed unrealistic project timelines exacerbate these challenges, as unrealistic expectations and deadlines strain project resources and capabilities.

Slow material deliveries further compound delays, as shortages and disruptions disrupt workflow and impede progress on-site. Moreover, land acquisition issues introduce legal and regulatory hurdles that delay project commencement and execution, as negotiations, approvals, and legal disputes prolong administrative processes and delay construction activities. Client requests for change orders or additional tasks introduce scope creep and uncertainty into project schedules, as revisions and approvals require additional time and resources to implement.

In summary, research into construction project delays across various countries underscores the complex and multifaceted nature of challenges facing the construction industry. From corruption and material shortages to poor project management and communication, these challenges present formidable obstacles to timely project completion and successful infrastructure development. Addressing these issues requires a comprehensive approach that encompasses regulatory reforms, capacity building, stakeholder engagement, and investment in infrastructure and institutional capabilities. Only through concerted efforts and collaborative action can the construction industry overcome these challenges and realize its potential as a driver of economic growth and development.

Project management remains a dynamic and indispensable discipline in today's rapidly evolving business landscape, with its significance particularly pronounced within the construction sector. Once considered merely beneficial rather than essential for business success, project management has undergone a significant transformation, now recognized as a cornerstone for achieving organizational objectives (Martinsuo, Vuorinen, & Killen, 2019). While its integration into business practices was initially met with resistance, primarily due to concerns about potential disruptions to traditional organizational structures (Pålsson et al., 2017), its value is now widely acknowledged across industries and regions.

Research by Zamberi Ahmad and Ahmad (2016) sheds light on the varying levels of appreciation and understanding of project planning among entrepreneurs, highlighting differences between regions such as the US and Croatia. The disparity is attributed to factors such as access to professional service advisors, with the US enjoying a competitive advantage in this regard over Central Eastern European countries like Croatia. Similarly, investigations by Walimuni et al. (2017) into project failures in economically disadvantaged nations like Jordan echo findings by Sutrisna & Goulding (2019), emphasizing the absence of a robust project management strategy as a significant contributor to project setbacks.

Studies by Zhang and Schramm (2020) underscore the important role of project planning in determining project success or failure, with inadequate planning identified as a common precursor to project failures. Their review of literature highlights planning as a critical factor in project outcomes, emphasizing the need for meticulous planning processes to mitigate risks and ensure project success. Indeed, a well-defined project plan is instrumental in guiding project execution and minimizing the likelihood of failure, as demonstrated by research conducted by Volden & Andersen (2018).

Moreover, findings by Sendall et al. (2017) from a study in Chile further emphasize the importance of precise project planning in achieving business objectives. Successful firms were found to submit more detailed project proposals, indicating a correlation between thorough planning and business triumph. This underscores the significance of comprehensive planning processes in optimizing project outcomes and enhancing organizational performance.

In essence, the evolving role of project management in modern business environments underscores its critical importance in navigating complex projects and achieving strategic objectives. By embracing robust planning practices and recognizing the fundamental role of project management in driving success, organizations can effectively mitigate risks, enhance efficiency, and maximize project outcomes.

The correlation between project management processes and the performance of infrastructure projects is intricately intertwined, with project management serving as a framework to optimize project activities and meet stakeholder expectations (Ghobakhloo & Fathi, 2020). What was once a narrowly focused concept has evolved into a comprehensive system encompassing all functional divisions, reflecting its significance in driving project success (Babatunde et al., 2020). The maturity model for project management emphasizes strategic management and successful planning

and execution across essential stages, facilitating benchmarking and continuous improvement practices (Gerbov, Singh, & Herva, 2018).

The aspect of construction project management encompasses a wide array of topics, including stakeholder relationship management, systematic project execution, organizational theories, contract management, success metrics, cost estimation tools, innovative planning approaches, best practices, and the impact of technology on project management. Effective management of stakeholder relationships, particularly among clients, architects, and builders, is important for project success in the transportation infrastructure sector (Dolla & Laishram, 2018; Mahmud et al., 2021).

Identifying and addressing elements that impact infrastructure effectiveness, often referred to as "pitfalls," is essential for enhancing project success. Evaluation frameworks like the "iron triangle" framework, focusing on time, budget, and quality, provide a basis for assessing infrastructure performance, while additional metrics may be considered for a comprehensive evaluation. The Project Management Institute outlines nine areas of knowledge within project management, emphasizing the importance of a robust project governance structure for overall project success (Lehnert et al., 2017).

Technology awareness entails a commitment to Research and Development (R&D), adoption of emerging technologies, and utilization of cutting-edge advancements (Narayanaswami, 2017). Strategic orientations guide organizational practices aimed at securing a competitive edge aligned with long-term objectives, reflecting the organization's comprehensive strategy (Duygu Seckin Halac, 2015).

In essence, the integration of effective project management processes and technology awareness fosters an environment conducive to infrastructure project success, enabling organizations to navigate challenges, optimize resources, and achieve their strategic objectives in the dynamic landscape of infrastructure development.

In today's modern work environment, technology plays an important role in project management, influencing collaboration, networking, and overall project management processes (Oeij et al., 2018). Even in co-located teams, electronic communication tools are heavily relied upon, highlighting the ubiquitous nature of technology in project management practices. Research indicates that neglecting to leverage modern technology can hinder business success, with its absence significantly affecting project performance. Therefore, technology serves as a crucial tool in supporting project managers, with numerous studies emphasizing its importance in shaping project management leadership styles (Sergeeva, 2020).

Technology serves as a critical enabler of project management processes, particularly in the aspect of information technology, facilitating the creation, application, distribution, and sharing of knowledge. Effective management of technological knowledge involves the development, codification, and transmission of knowledge using various tools and platforms, including databases, hardware, software, and intelligent devices (Mhatre, Thakkar, & Maiti, 2017).

However, despite its potential benefits, the construction sector has been slow in adopting innovative technologies compared to other industries. A national study conducted by the Civil

Engineering Research Foundation revealed that the design and construction sector allocates only a minimal percentage (0.5%) of its total earnings towards research and development (R&D) initiatives (Civil Engineering Research Foundation, 2016). An evaluation of 219 completed projects across the United States examined the extent to which technology was integrated into 68 typical project tasks. The analysis considered overall project expenses and adherence to schedules. The findings indicated a stronger correlation between technology usage and project success, particularly in terms of cost and completion time, for medium and small-sized projects compared to larger ones. Essentially, the application of technology had a positive impact on the overall success of medium and small projects (Okudan, Budayan, & Dikmen, 2021).

In summary, technology serves as a powerful ally in modern project management, enabling efficient communication, knowledge sharing, and project coordination. While the construction sector may lag in technology adoption, embracing innovative technologies can enhance project outcomes and contribute to overall project success.

Back and Bell (1994) conducted a study investigating the impact of electronic data interchange (EDI) on the management of bulk materials. They developed a process model to compare integrated and non-integrated systems, aiming to evaluate the benefits of technological integration. Their research revealed that the incorporation of technology into the bulk materials handling process led to significant reductions in cycle times.

While general project management software may lack certain specialized capabilities, such as sizing and cost estimation, which are typically offered by specialized costing software, it still offers valuable advantages. One notable benefit is the streamlining of project management tasks, including scheduling, resource allocation, and communication, which contributes to improved project efficiency. However, the effective use of project management software requires a higher level of managerial skill and expertise.

In a study by Haji Karimian et al. (2019), it was observed that modern project managers have access to a wide range of digital tools to aid their work. The use of computer-aided project management involves assigning specific tasks to different software solutions, with a strong emphasis on integrating all project management systems with digital tools seamlessly. While computerization extends beyond basic project management tasks, it may still require a detailed level of input, akin to manually preparing schedules, cost estimates, or critical analyses using software tools (Mahmud et al., 2021).

Overall, the integration of technology into project management processes offers numerous benefits, including improved efficiency, streamlined communication, and enhanced decision-making capabilities. However, maximizing the potential of digital tools requires project managers to possess a high level of proficiency and skill in utilizing these tools effectively.

FINDINGS AND DISCUSSION

The pace of technological advancement within any industry profoundly influences the adoption of new technologies and the evolution of existing ones. Companies that prioritize technology invest resources in acquiring cutting-edge technologies and innovating their processes, products, and

services (Azam, 2015). Research by Caputo et al. (2019) has highlighted a correlation between a company's awareness of technology and its infrastructure performance. The significance of technology awareness in fostering innovation is widely acknowledged (Chión, Charles, & Morales, 2020), yet there remains a gap in the literature exploring the relationship between technological orientation and corporate performance (Bianchi, Glavas, & Mathews, 2017).

In rapidly evolving technological environments, infrastructures with a strong emphasis on technology tend to perform better because they can introduce innovative solutions to meet customer demands (Giovannetti, Cardinali, & Sharma, 2021). Firms that integrate innovation in customer value with technological advancements are more likely to sustain profitability and achieve higher performance levels (Firdaus, 2021). In competitive markets such as Dubai, where technological progress occurs rapidly, it is imperative for infrastructures to embrace new technologies to maintain competitiveness (Giovannetti et al., 2021; Hirvonen, Laukkanen, & Salo, 2016).

In Libya, infrastructure authorities exhibit a positive attitude towards technology, significantly enhancing their innovation capabilities, consistent with previous research findings (Hruby, Watkins-Mathys, & Hanke, 2016). Libyan infrastructure companies are eager to leverage technology to advance their innovation efforts, recognizing that technology policies and the adoption of new technologies are critical for improving internal operations and methodologies. This recognition motivates them to invest in advanced technologies to foster innovation, making the embrace of technology a key driver of innovative activity within the infrastructure sector (Khin & Ho, 2020).

In the contemporary world, staying abreast of technological advancements is paramount, especially considering the indispensable role of technologies like voice transmission, messaging, and video conferencing in the development of information and communication technology (ICT) tools. These technologies play an important role in facilitating communication during project execution (Nakata & Antalis, 2015; Stezano & Oliver Espinoza, 2019). The enhancement of infrastructure performance is significantly reliant on advancements in information technology, as ICTs are instrumental in improving the efficiency of infrastructure. Experts in the industry emphasize the critical role of IT in communication, a perspective that resonates across different economies leveraging these technological platforms. In the age of digital transformation, such an approach is crucial for enhancing project performance. Numerous studies conducted worldwide have underscored the correlation between various IT tools and the improvement of infrastructure performance (Mamun, 2018; Stezano & Oliver Espinoza, 2019; Wang, 2020).

For smaller-scale infrastructure projects, premature scaling and excessive expansion can lead to unsustainable scenarios, potentially causing the downfall of firms. Rapid enlargement and growth have the potential to deplete capital resources, imposing financial strain on infrastructure. Adequate funding is essential for maintaining sufficient inventory levels during periods of swift growth and expansion. Consequently, the failure of businesses can often be attributed to such rapid expansion and growth (Norris & Ciesielska, 2019). A study analyzing significant infrastructure projects used cost overruns and the overestimation of benefits as metrics to evaluate project

performance. It revealed that cost overruns have been a consistent issue across many large-scale capital projects since the early 20th century. Despite advancements in cost estimation and control methodologies, the prevalence of cost overruns has remained unchanged over the last seventy years (Buli, 2017).

Alsadi and Aloulou (2021) emphasized the critical importance of integrating project management practices from top leadership to those directly involved in project execution. This holistic approach underscores not only the significance of project management but also other management domains, such as information technology (IT) management, in influencing project outcomes. The IT Management Institute (2018) defines IT management as a vital component of overall business management, highlighting its oversight by the board of directors and senior executives. This domain encompasses leadership, organizational structures, and processes crucial for aligning the organization's IT infrastructure with its strategic objectives. Effective IT management, supported by technology, plays an important role in organizational success by ensuring information security and reliability (Bianchi et al., 2017). It enables IT managers and service providers to develop cohesive plans integrating business and IT strategies, assign roles and responsibilities, prioritize tasks, orchestrate IT efforts, and assess their impact and outcomes (Filieri, 2015). The primary objective of IT management is to align IT initiatives with business goals while facilitating the maintenance of IT operations (Al-Omoush et al., 2020). Research consistently demonstrates that strategic alignment between IT and project initiatives leads to enhanced organizational performance (Kurniawan et al., 2021).

A study revealed that technology utilization significantly enhanced the connection between comprehensive project success and integration management, with a correlation coefficient of 0.343 and a significance level below 0.01. The outcomes from a partial correlation analysis underscored technology's mediating influence on the nexus between seven key project management responsibilities and overall project success. This analysis highlights the importance of digital tools in bridging project management activities with project success. Consequently, the company aimed to improve project outcomes by investing in advanced electronic devices, such as computers, to better integrate the project management framework (Nakata & Antalis, 2015). Wang (2020), in alignment with Nakata and Antalis (2015), found that employing a range of digital tools significantly enhanced construction efficiency and project outcomes. These observations suggest that superior project results are achievable when robust project management techniques are implemented alongside efficient use of technology (Project Management Institute, 2018). The study underscores the critical role of embracing technology within construction firms to achieve better project performance.

CONCLUSION

In conclusion, the multifaceted nature of project delays underscores the importance of a comprehensive understanding of the various factors influencing infrastructure development. The challenges encountered in the construction industry, including those specific to Libya, are diverse and require a nuanced approach to mitigate effectively. From financial constraints to management

inefficiencies and resource shortages, each aspect presents unique hurdles that must be addressed strategically to ensure the successful completion of critical infrastructure projects.

In Libya, like in many other countries, project delays are often exacerbated by a combination of internal and external factors. Internally, issues such as poor project management practices, slow decision-making processes, and inadequate planning contribute significantly to delays. These internal challenges are further compounded by external factors such as economic instability, political unrest, and regulatory complexities, which can hinder progress and exacerbate delays.

Addressing these challenges requires a multifaceted approach that involves collaboration among stakeholders, including government agencies, private sector entities, and international partners. One key aspect of this approach is the adoption of robust project management practices tailored to the Libyan context. This may involve investing in training and capacity building for project managers, improving decision-making processes, and enhancing coordination among project stakeholders.

Furthermore, leveraging technological advancements can play a crucial role in streamlining project management processes and improving efficiency. Embracing digital tools and innovative technologies can facilitate better communication, streamline workflows, and provide real-time visibility into project progress. This, in turn, can help identify potential issues early on and mitigate risks before they escalate into delays.

Additionally, addressing resource shortages, particularly in terms of skilled labor and materials, is paramount. Investing in workforce development initiatives, promoting vocational training programs, and incentivizing local businesses to participate in infrastructure projects can help alleviate these shortages and ensure the timely completion of projects.

Moreover, fostering a conducive regulatory environment and promoting transparency and accountability in project governance are essential for building trust among stakeholders and attracting investment. Clear and predictable regulatory frameworks can help mitigate project risks and provide investors with the confidence needed to commit resources to infrastructure development initiatives.

Also, effective project management, coupled with strategic planning, stakeholder engagement, and the adoption of innovative technologies, is crucial for overcoming the challenges associated with infrastructure development in Libya. By addressing these challenges head-on and implementing targeted interventions, stakeholders can pave the way for the successful completion of critical infrastructure projects, ultimately contributing to the socio-economic development and prosperity of the nation.

Research on infrastructure development in Libya faces several limitations that hinder the depth and breadth of analysis. Firstly, the availability of comprehensive and up-to-date data is a significant constraint, as reliable information on project timelines, budget allocations, and performance metrics is often scarce. Additionally, many studies suffer from small sample sizes or limited geographic representation, which may not accurately capture the diverse challenges faced across different regions of the country. The volatile political and economic landscape in Libya introduces external factors such as changes in government policies, security concerns, and

fluctuations in global oil prices, which may not always be adequately accounted for in research studies. Language barriers further limit access to relevant literature, as much of the existing research may be available only in Arabic. Finally, research findings may be subject to bias or lack of reliability due to the political and social context in Libya, particularly if influenced by political agendas or vested interests.

To overcome these limitations and advance our understanding of infrastructure development in Libya, several avenues for further research can be pursued. Longitudinal studies tracking the progress and performance of infrastructure projects over time can provide valuable insights into trends, challenges, and success factors. Comparative analysis with other countries facing similar challenges can help identify transferable lessons and best practices. Exploring the perspectives and experiences of different stakeholders involved in infrastructure projects can offer insights into their roles, challenges, and priorities. Additionally, investigating the potential impact of emerging technologies and evaluating the effectiveness of capacity building initiatives and policy frameworks can inform strategies for promoting sustainable and inclusive infrastructure development in Libya. Finally, advocating for improved data collection and sharing mechanisms and promoting multidisciplinary research approaches can enhance the depth and reliability of research on infrastructure development in Libya.

REFERENCES

Abdulla Al Marzooqi, F., & Zamberi Ahmad, S. (2018). Unasco: Exploring The Market For Sustainable Business. Emerald Emerging Markets Case Studies, 8(3), 1-19. Doi:10.1108/Eemcs-08-2017-0201

Al Nahyan, M. T., Sohal, A. S., Fildes, B. N., & Hawas, Y. E. (2012). Transportation Infrastructure Development In The Uae. Construction Innovation, 12(4), 492-514. Doi:10.1108/14714171211272234

Alhammadi, A., & Memon, A. (2020). Inhibiting Factors of Cost Performance in UAE Construction Projects. International Journal of Sustainable Construction Engineering and Technology, 11. doi:10.30880/ijscet.2020.11.02.014

Al-Omoush, K. S., Al Attar, M. K., Saleh, I. H., & Alsmadi, A. A. (2020). The drivers of E-banking entrepreneurship: an empirical study. International Journal of Bank Marketing, 38(2), 485-500. doi:10.1108/IJBM-03-2019-0113

Alsadi, A. K., & Aloulou, W. J. (2021). Impacts of strategic orientations on Saudi firm performance: is supply chain integration a missing link? The International Journal of Logistics Management, 32(4), 1264-1289. doi:10.1108/IJLM-02-2020-0080

Azam, M. S. (2015). Diffusion of ICT and SME Performance. In E-Services Adoption: Processes by Firms in Developing Nations (Vol. 23A, pp. 7-290): Emerald Group Publishing Limited.

Babatunde, S. O., & Perera, S. (2017). Cross-Sectional Comparison Of Public-Private Partnerships In Transport Infrastructure Development In Nigeria. Engineering, Construction And Architectural Management, 24(6), 875-900. Doi:10.1108/Ecam-11-2015-0186

Bianchi, C., Glavas, C., & Mathews, S. (2017). SME international performance in Latin America. Journal of Small Business and Enterprise Development, 24(1), 176-195. doi:10.1108/JSBED-09-2016-0142

Bianchi, C., Glavas, C., & Mathews, S. (2017). SME international performance in Latin America. Journal of Small Business and Enterprise Development, 24(1), 176-195. doi:10.1108/JSBED-09-2016-0142

Buli, B. M. (2017). Entrepreneurial orientation, market orientation and performance of SMEs in the manufacturing industry. Management Research Review, 40(3), 292-309. doi:10.1108/MRR-07-2016-0173

Caputo, F., Garcia-Perez, A., Cillo, V., & Giacosa, E. (2019). A knowledge-based view of people and technology: directions for a value co-creation-based learning organisation. Journal of Knowledge Management, 23(7), 1314-1334. doi:10.1108/JKM-10-2018-0645

Chión, S. J., Charles, V., & Morales, J. (2020). The impact of organisational culture, organisational structure and technological infrastructure on process improvement through knowledge sharing. Business Process Management Journal, 26(6), 1443-1472. doi:10.1108/BPMJ-10-2018-0279

Dewan Md Zahurul Islam (2018), "Prospects For European Sustainable Rail Freight Transport During Economic Austerity", Benchmarking: An International Journal, Https://Doi.Org/10.1108/Bij-12-2016-0187.

Dolla, T., & Laishram, B. S. (2018). Procurement of low carbon municipal solid waste infrastructure in India through public-private partnerships. Built Environment Project and Asset Management, 8(5), 449-460. doi:10.1108/BEPAM-10-2017-0087

Ewedairo, K., Chhetri, P., & Jie, F. (2018). Estimating transportation network impedance to last-mile delivery. The International Journal of Logistics Management, 29(1), 110-130. doi:10.1108/IJLM-10-2016-0247

Faridi, A. S., & El-Sayegh, S. M. (2006). Significant factors causing delay in the UAE construction industry. Construction Management and Economics, 24(11), 1167-1176. doi:10.1080/01446190600827033

Filieri, R. (2015). From market-driving to market-driven. Marketing Intelligence & Planning, 33(3), 238-257. doi:10.1108/MIP-02-2014-0037

Firdaus, A. (2021). Determination Of Organisational Essential Needs As The Basis For Developing A -Based Performance Measurement. Isra International Journal Of Islamic Finance, 13(2), 229-250. Doi:10.1108/Ijif-11-2017-0041

Gerbov, A., Singh, V., & Herva, M. (2018). Challenges in applying design research studies to assess benefits of BIM in infrastructure projects. Engineering, Construction and Architectural Management, 25(1), 2-20. doi:10.1108/ECAM-12-2016-0260

Gharehgozli, A., De Vries, H., & Decrauw, S. (2019). The Role Of Standardisation In European Intermodal Transportation. Maritime Business Review, 4(2), 151-168. Doi:10.1108/Mabr-09-2018-0038

Ghobakhloo, M., & Fathi, M. (2020). Corporate survival in Industry 4.0 era: the enabling role of lean-digitized manufacturing. Journal of Manufacturing Technology Management, 31(1), 1-30. doi:10.1108/JMTM-11-2018-0417

Giovannetti, M., Cardinali, S., & Sharma, P. (2021). Sales technology and salespeople's ambidexterity: an ecosystem approach. Journal of Business & Industrial Marketing, 36(4), 615-629. doi:10.1108/JBIM-01-2020-0034

Haji Karimian, S., Mbachu, J., Egbelakin, T., & Shahzad, W. (2019). Improving Efficiency In Roading Projects: A New Zealand Study. Engineering, Construction And Architectural Management, 26(5), 827-849. Doi:10.1108/Ecam-02-2018-0060

Haque, M. N., Saroar, M., Fattah, M. A., & Morshed, S. R. (2020). Public-Private Partnership for achieving sustainable development goals: a case study of Khulna, Bangladesh. Public Administration and Policy, 23(3), 283-298. doi:10.1108/PAP-04-2020-0023

Herman Fithra , Sirojuzilam , Sofyan M. Saleh , Erlina (2018), Effect Of Freight Transportation For Regional Development In The North Zone Of Aceh, In (Ed.) Proceedings Of Micoms 2017 (Emerald Reach Proceedings Series, Volume 1) Emerald Publishing Limited, Pp.35 – 42

Hirvonen, S., Laukkanen, T., & Salo, J. (2016). Does brand orientation help B2B SMEs in gaining business growth? Journal of Business & Industrial Marketing, 31(4), 472-487. doi:10.1108/JBIM-11-2014-0217

Hruby, J., Watkins-Mathys, L., & Hanke, T. (2016). Antecedents and Outcomes of a Global Mindset: A Thematic Analysis of Research from 1994 to 2013 and Future Research Agenda. In Advances in Global Leadership (Vol. 9, pp. 213-280): Emerald Group Publishing Limited.

Hua Song, Kangkang Yu, Anirban Gangly, Rabia Turson. (2016) "Supply Chain Network, Information Sharing And Sme Credit Quality", Industrial Management & Data Systems, 116(4), Pp.740 – 758

Hussain, R. S., Ruikar, K., Enoch, M. P., Brien, N., & Gartside, D. (2017). Process mapping for road works planning and coordination. Built Environment Project and Asset Management, 7(2), 157-172. doi:10.1108/BEPAM-08-2016-0041

Ismail, Z.-A. (2019). Optimising the safety of road transport workers on IBS building construction projects: a review. Social Responsibility Journal, 15(6), 837-851. doi:10.1108/SRJ-09-2018-0240

Johnson, R., & Babu, R. (2018). Time and cost overruns in the UAE construction industry: a critical analysis. International Journal of Construction Management, 20, 1-10. doi:10.1080/15623599.2018.1484864

Koul, P., Verma, P., & Arora, L. (2021). Road infrastructure development under PPP model in India: a credit rating perspective. Built Environment Project and Asset Management, 11(2), 266-283. doi:10.1108/BEPAM-08-2020-0137

Kurniawan, R., Budiastuti, D., Hamsal, M., & Kosasih, W. (2021). Networking capability and firm performance: the mediating role of market orientation and business process agility. Journal of Business & Industrial Marketing, 36(9), 1646-1664. doi:10.1108/JBIM-01-2020-0023

Lehnert, M., Linhart, A., & Roeglinger, M. (2017). Exploring the intersection of business process improvement and BPM capability development. Business Process Management Journal, 23(2), 275-292. doi:10.1108/BPMJ-05-2016-0095

Lenahan O'connell, Juita-Elena (Wie) Yusuf, Khairul Azfi Anuar, (2018) "Beyond New Roads And Bridges: Understanding Public Preferences For Investing In Urban Non-Automobile Transportation Infrastructure", Journal Of Public Budgeting, Accounting & Financial Management, 30(2), Pp.175-190.

Liyanage, C., Dias, N., Amaratunga, D., & Haigh, R. (2017). Current context of transport sector in South Asia. Built Environment Project and Asset Management, 7(5), 490-505. doi:10.1108/BEPAM-10-2016-0051

Mahmud, A. T., Ogunlana, S. O., & Hong, W. T. (2021). Key Driving Factors Of Cost Overrun In Highway Infrastructure Projects In Nigeria: A Context-Based Perspective. Journal Of Engineering, Design And Technology, 19(6), 1530-1555. Doi:10.1108/Jedt-05-2020-0171

Mainga, W. (2017). Examining project learning, project management competencies, and project efficiency in project-based firms (PBFs). International Journal of Managing Projects in Business, 10(3), 454-504. doi:10.1108/IJMPB-04-2016-0035

Mamun, A. A. (2018). Diffusion of innovation among Malaysian manufacturing SMEs. European Journal of Innovation Management, 21(1), 113-141. doi:10.1108/EJIM-02-2017-0017

Manamgoda, M. G. N., Perera, B. A. K. S., & Perera, C. S. R. (2018). Impact of interest rates of bank loans on road construction: the case of Sri Lanka. Journal of Engineering, Design and Technology, 16(4), 518-532. doi:10.1108/JEDT-12-2017-0133

Mangioni, V. (2018). Evaluating the impact of the land acquisition phase on property owners in megaprojects. International Journal of Managing Projects in Business, 11(1), 158-173. doi:10.1108/IJMPB-08-2017-0090

Marcel Van Assen, (2018) "Process Orientation And The Impact On Operational Performance And Customer-Focused Performance", Business Process Management Journal, 24(2).

Martinsuo, M. M., Vuorinen, L., & Killen, C. (2019). Lifecycle-oriented framing of value at the front end of infrastructure projects. International Journal of Managing Projects in Business, 12(3), 617-643. doi:10.1108/IJMPB-09-2018-0172

Maude Brunet, Monique Aubry, (2018) "The Governance Of Major Public Infrastructure Projects: The Process Of Translation", International Journal Of Managing Projects In Business, 11(1), Pp.80-103.

Mhatre, T. N., Thakkar, J. J., & Maiti, J. (2017). Modelling critical risk factors for Indian construction project using interpretive ranking process (IRP) and system dynamics (SD). International Journal of Quality & Reliability Management, 34(9), 1451-1473. doi:10.1108/IJQRM-09-2015-0140

Mwelu, N., Davis, P. R., Ke, Y., & Watundu, S. (2020). Compliance mediating role within road construction regulatory framework. Journal of Public Procurement, 20(3), 209-233. doi:10.1108/JOPP-12-2018-0052

Nakata, C., & Antalis, E. (2015). Enhancing market exchanges at the base of the pyramid. International Marketing Review, 32(6), 762-782. doi:10.1108/IMR-07-2015-0172

Nakata, C., & Antalis, E. (2015). Enhancing market exchanges at the base of the pyramid. International Marketing Review, 32(6), 762-782. doi:10.1108/IMR-07-2015-0172

Narayanaswami, S. (2017). Urban transportation: innovations in infrastructure planning and development. The International Journal of Logistics Management, 28(1), 150-171. doi:10.1108/IJLM-08-2015-0135

Norris, D., & Ciesielska, M. (2019). Towards a framework for innovation orientation within business and management studies. Journal of Organizational Change Management, 32(1), 123-144. doi:10.1108/JOCM-02-2018-0051

Oeij, P. R. A., Van Vuuren, T., Dhondt, S., Gaspersz, J., & De Vroome, E. M. M. (2018). Mindful infrastructure as antecedent of innovation resilience behaviour of project teams. Team Performance Management: An International Journal, 24(7/8), 435-456. doi:10.1108/TPM-09-2017-0045

Ogbu, C. P., & Adindu, C. C. (2020). Direct risk factors and cost performance of road projects in developing countries. Journal of Engineering, Design and Technology, 18(2), 326-342. doi:10.1108/JEDT-05-2019-0121

Okudan, O., Budayan, C., & Dikmen, I. (2021). Development of a conceptual life cycle performance measurement system for build–operate–transfer (BOT) projects. Engineering, Construction and Architectural Management, 28(6), 1635-1656.

Pålsson, H., Winslott Hiselius, L., Wandel, S., Khan, J., & Adell, E. (2017). Longer and heavier road freight vehicles in Sweden. International Journal of Physical Distribution & Logistics Management, 47(7), 603-622. doi:10.1108/IJPDLM-02-2017-0118

Saiful Islam, M., & Trigunarsyah, B. (2017). Construction Delays in Developing Countries: A Review. Journal of construction engineering and project management, 7. doi:10.6106/JCEPM.2017.3.30.001

Sendall, M. C., Crane, P., McCosker, L., Fleming, M., Biggs, H. C., & Rowland, B. (2017). Truckies and health promotion: using the ANGELO framework to understand the workplace's role. International Journal of Workplace Health Management, 10(6), 406-417. doi:10.1108/IJWHM-09-2017-0070

Sergeeva, N. (2020). Towards more flexible approach to governance to allow innovation: the case of UK infrastructure. International Journal of Managing Projects in Business, 13(1), 1-19. doi:10.1108/IJMPB-10-2018-0216

Shebob, A., Dawood, N., Shah, R. K., & Xu, Q. (2012). Comparative study of delay factors in Libyan and the UK construction industry. Engineering, Construction and Architectural Management, 19(6), 688-712. doi:10.1108/09699981211277577

Stezano, F., & Oliver Espinoza, R. (2019). Innovation capabilities and performance of biotechnology firms. Management Research: Journal of the Iberoamerican Academy of Management, 17(4), 445-473. doi:10.1108/MRJIAM-11-2018-0880

Sundaraj, G., & Eaton, D. (2013). Quantifying robustness in PFIs. Journal of Financial Management of Property and Construction, 18(1), 26-52. doi:10.1108/13664381311305069

Suryani, E., Hendrawan, R. A., Adipraja, P. F. E., Wibisono, A., & Dewi, L. P. (2021). Urban mobility modeling to reduce traffic congestion in Surabaya: a system dynamics framework. Journal of Modelling in Management, 16(1), 37-69. doi:10.1108/JM2-03-2019-0055

Sutrisna, M., & Goulding, J. (2019). Managing information flow and design processes to reduce design risks in offsite construction projects. Engineering, Construction and Architectural Management, 26(2), 267-284. doi:10.1108/ECAM-11-2017-0250

Taleb, H. M. (2020). The Potential Of Implementing A Toxicity Tax For Heavily Polluting Vehicles In The United Arab Emirates. Transforming Government: People, Process And Policy, 14(1), 101-123. Doi:10.1108/Tg-08-2019-0073

Todorov, K., & Akbar, Y. H. (2018). Basics of Strategic ManagementEtihad Rail: A New Way to Change a Business Landmark in the United Arab EmiratesCase Study: Inchcape plc. Part 3. In Strategic Management in Emerging Markets (pp. 109-161): Emerald Publishing Limited.

Volden, G. H., & Andersen, B. (2018). The hierarchy of public project governance frameworks. International Journal of Managing Projects in Business, 11(1), 174-197. doi:10.1108/IJMPB-04-2017-0040

Walimuni, P. C., Samaraweera, A., & De Silva, L. (2017). Payment mechanisms for contractors for better environmental hazard controlling in road construction projects. Built Environment Project and Asset Management, 7(4), 426-440. doi:10.1108/BEPAM-11-2016-0069

Wang, F. (2020). Digital Marketing Capabilities In International Firms: A Relational Perspective. International Marketing Review, 37(3), 559-577. Doi:10.1108/Imr-04-2018-0128

Zamberi Ahmad, S., & Ahmad, N. (2016). Etihad Rail: a new way to change a business landmark in the United Arab Emirates. Emerald Emerging Markets Case Studies, 6(3), 1-16. doi:10.1108/EEMCS-01-2015-0008

Zhang, X., & Schramm, H.-J. (2020). Assessing the market niche of Eurasian rail freight in the belt and road era. The International Journal of Logistics Management, 31(4), 729-751. doi:10.1108/IJLM-12-2019-0351

Zou, P. X. W., Wang, S., & Fang, D. (2008). A life-cycle risk management framework for PPP infrastructure projects. Journal of Financial Management of Property and Construction, 13(2), 123-142. doi:10.1108/13664380810898131.