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Analysis of Supply Chain Management in Delay Factors and Their Impact on Construction Projects in Jordan: A Case Study of Road Projects

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ABSTRACT

This research is aimed at examining the causes of critical delay factors in Jordanian road infrastructure projects, and how Supply Chain Management (SCM) can reduce delays in road infrastructure projects in Jordan. The results emphasize the crucial significance of good management practices in achieving project success, including appropriate planning, adherence to deadlines, and achievement of goals within budget, quality, and time restrictions. The engagement of seasoned road construction firms and oversight by the Ministry of Public Works and Housing further add to the distinctiveness of Jordan's road projects. Project delays are caused by a variety of factors, including inadequate oversight from funders or the Ministry of Public Works and Housing, a lack of contractor expertise or experience, financial difficulties, poor coordination, and delays in payments and material availability. Furthermore, the issue is made worse by the difficulty to recruit international contractors as a result of the economy, financial risks, and regional insecurity. In order to reduce delays in the road sector, supply chain management practices are crucial. Emphasis is placed on efficient communication between consultants, designers, and contractors as well as a thorough knowledge of project specifics and procurement. Implementing supply chain management practices, learning from adjacent nations, and gathering experience are crucial for managing delays. The Ministry of Works includes a division specifically devoted to the supply chain that aims to enhance supplier performance via quick access to information, performance assessment, and ongoing improvement programs. By facilitating cooperation and increasing productivity among project stakeholders, current technology is used.

Keywords: Supply chain management, Construction Projects in Jordan, Road Projects, Appropriate Planning, Adherence to Deadlines, and Time Restrictions.

INTRODUCTION

The success of a project has always been an important goal for the construction industry. While various parties' assessments of a project's success may differ, on average, timely completion is seen as one of the primary measures of success (Jarah et al., 2023). Time is critical in construction; it is specifically stipulated in contracts, and failing to meet it leads to penalties as stipulated is the contract. The construction sector, according to Ismail (2007), functions as a catalyst for economic growth by stimulating development in other industries. Construction endeavours are responsible for providing indispensable infrastructure necessities for housing, communication, water supply, and electricity. To keep pace with the constant expansion and demand of the populace, it is of utmost importance that this infrastructure be consistently expanded and upgraded. However, "Delays & Cost Overruns," a phenomenon that afflicts construction projects universally, continues to plague them. Road projects hold immense significance

in Jordan owing to a plethora of reasons. Firstly, they tend to enhance the country's transportation infrastructure, which in turn facilitates the smooth movement of people and goods alike. Consequently, this may lead to a spurt in the economy, as businesses can conveniently access markets while consumers can easily avail themselves of goods and services. Secondly, road projects create employment opportunities, thereby giving a fillip to the economy. The construction of new roads necessitates a large number of workers, and the operation and maintenance of roads also generate jobs. Thirdly, road projects can work wonders in terms of improving the environment. By curbing traffic congestion, road projects can have a salubrious impact on air quality and reduce noise pollution, thus restoring a sense of balance to the ecosystem.

Background on Road Construction Project in Jordan

The Jordanian government has initiated numerous road projects, some of which are currently underway, including the Desert Highway Rehabilitation Project. This project envisages the refurbishment of the primary highway connecting Amman and Aqaba and is estimated to cost around €298 million, with a completion date of 2024. The other ongoing project is the Amman Ring Road Project, which entails the construction of a new ring road encircling Amman and is expected to cost around €1.8 billion, with a completion date of 2025. Another significant project is the Northern Corridor Project, which aims to upgrade the primary highway between Amman and Irbid and is expected to cost around €1.2 billion, with a completion date of 2026. Still to say that, in Jordan, the Ministry of Public Works and Housing (MOPWH) has invested around $104,330,000 in infrastructure and building projects, which has had an impact on growth across all sectors. A shift in earlier conventional procedures gave SCM encouragement to achieve integration in the construction industry in order to achieve project success. Utilizing SCM technologies has improved performance while lowering cost overruns and project delays. SCM offers chances to extend, track, and decrease project costs, time, and waste, and integrate building chains fosters more communication and collaboration. Collaboration and integration, in particular on recognizing project uncertainty, have a favorable effect on risk management.

Problem of the Study

These road projects are anticipated to have a substantial impact on Jordan's economy and environment. They are expected to create job opportunities, stimulate economic growth, and contribute towards improving air quality and noise pollution. In addition to these significant projects, the Jordanian government has also undertaken several smaller road projects aimed at enhancing the country's road network and rendering it more secure and efficient. The Jordanian government's investment in road projects is a testament to its unwavering commitment towards economic development and environmental conservation. These projects are envisioned to have a positive impact on the country's economy and environment for years to come.

Objective of the Study

The main objective of the research is to identify the main delay factors in Jordan road infrastructure projects, group the main delay factors into underlying cause and to identify the beneficial of SCM tools and develop a framework utilizing these tools to reduce delay in infrastructure project in Jordan. This research will contribute to both the body of knowledge and the road construction project.

Organisation of the Study

The study is structured as follows, the second section, will provide Literature review, encompassing the Theoretical review. This is followed by the Methodology section, which details the methods used in the study to achieve its objectives. The fourth section, would analysed and provide discussion of the results, that involves the estimation and discussion of the research findings. Lastly, the Conclusion and policy recommendations section concludes the study and provides final remarks

LITERATURE REVIEW

Construction projects commonly encounter delays (Sambasivan and Soon, 2007). In the construction domain, two of the most frequent issues are time delays and cost overruns (Koushki et al., 2005). Arditi et al. (1985) posit that the repercussions of project delays in the construction sector extend beyond its boundaries to impact the overall economy of the nation. The construction process is vulnerable to a host of variables and unforeseeable factors that arise from various sources (Assaf and AlHejji, 2006). Timely project completion serves as a benchmark for efficiency. Despite the employment of advanced technology and management techniques, construction projects continue to be plagued by delays, resulting in postponed project deadlines (Stumpf, 2000). Delayed completion of construction projects has far-reaching negative consequences. These may include disagreements, damage to the construction company's reputation, loss of future project prospects, reduced profit margins or losses, bankruptcy

of the organization, contract cancellation, and others. Delays affect project timelines, expenses, and quality (González et al., 2013). Delay-induced cost overruns impede economic progress. Despite extensive research and documentation of the reasons for delays in construction projects, projects worldwide continue to suffer from delays of varying magnitudes. To ensure timely and budget-friendly project completion, a fresh perspective is required to examine the causes of delay and to address the problems accordingly.

Alinaitwe et al.'s earlier study from 2013 identified a number of client-influenced factors that can affect the outcome of road construction, including design changes, stoppage due to disputes between contractors and owners, stoppage due to insolvency, lack of adherence to regulatory requirements, and inspection delays. Poor planning and management, a lack of experience, inadequate controls during road construction, a shortage of materials for road construction, a delay in starting work, a delay in making decisions, and a failure to address road safety are just a few of the factors that Ogunlana et al. (2015) cited as having an impact on road execution.

Despite the fact that SCM methods are still in their infancy, previous programs have encouraged them to improve construction management, and SCM has long been seen as an excellent public sector endeavour (Nugroho, et al. 2021). SCM methods have included the sustainable connection between suppliers and appearances, procurement, process improvement, technology that improves the environment for best practice procedures, waste disposal via waste-free building, and inventory management (Lee, 2021). The deployment of certain tools has shown Supply Chain Management's (SCM) capacity to decrease delays, which has been well-documented ability to enhance construction performance. SCM refers to enhancing performance by forging stronger ties between various organizational levels in order to save expenses and eliminate duplication.

Successful Application of SCM in Jordan

The success of construction projects is greatly influenced by the information flow, which is why there is no conflict clause for coalition building and trust promotion, long-term agreements are known as Framework Agreements, and "Common Goal" and "Team Building" are effective ways to improve cooperation. With the integration of SCM, which includes continuous improvement in the integration of three different areas: quality management (QM), perspective to improve efficiency and quality (Backlund and Sundqvist 2018), a need to comprehend the continuous improvement process has arisen. The implementation of "training and development policies" (Huang, Yan et al. 2018) will enable process-based improvement initiatives like "Ongoing Training" (Wall and Clarke 1998) and employee development (du Preez 2019) to be sustainable in response to intermittently changing needs. In the construction industry, the use of performance measurement systems is essential. Restricting supplier performance and encouraging feedback are vital ways to enhance SCM.

RESEARCH METHODOLOGY

Research is acquiring the new knowledge of the underlying phenomena and observable facts through the experimental or theoretical work without any particular application or use in view (Creswell and Creswell, 2018). Qualitative approach is an analytical method where a thorough and in-depth investigation and the conclusion of the review and interpretation of the participants are needed. Often qualitative research is used when it is of interest in context and meaning (Merriam and Grenier 2019). The growth of organizational structures and culture, as well as how to face new problems for design and implementation, are all taken into account while building and executing complex multi-stakeholder organizations like road industry.

Research Design

This entails deciding on the methodologies to be used to address a set of research issues or research questions (Martens and Carvalho 2017) taking into account potential limits (Gronum, Verreynne et al. 2012). A detailed examination of the research questions and objectives was carried out in order to determine the best appropriate strategy to address each objective, and in this research, the use of qualitative inquiry and objective analysis in order to identify delay factors in infrastructure projects, and then, to develop a framework for supply chain tools to reduce delays scenarios in Jordanian road projects. The qualitative approach is used when researching a problem or issue; Qualitative research focuses on words, not numbers. (Unno, Takabayashi et al. 2007). Alhojailan (2012), emphasized qualitative data as structured data that has a tangible, attractive and meaningful flavour that is more convincing to the reader. The use of the qualitative approach in this research would encourage the respondents to express their opinions, listen to their voices and expressions, and be sensitive to the research question.

Sampling Method

Sampling is crucial to research since there is often a larger population, and because of several constraints, sampling is the only practical way to get accurate replies/information that reflect the opinions of the larger population (Saunders et al., 2019). A predetermined number of observations are chosen at random from a larger

population in the sampling process. In order to ensure representativeness in this study, a purposive sampling technique was adopted (Teddlie and Tashakkori, 2010). Drawing samples that are both readily available and willing to participate in a study is part of the purposive sampling technique. Expert and practitioners were included in the study sample. The interviews took 20 to 30 minutes.

Data Collection

The researcher had 27 questionnaire sources in total for the project; They were in the form of text in Microsoft Office word format. After all the necessary files had been moved, the next step was coding, which is the process of putting together the extracts (via documents) linked together into groups called nodes. In particular, the scripts were thoroughly read and nodes were created in the process to house relevant excerpts or texts from the scripts using NVivo software's Word-Cloud metaphorical analysis. From these nodes, three tree nodes were created and these nodes continued to be coded with the rest of the documents. The content of the contract was constantly revised by double-clicking on it. Coding lines were also run to help manage the coding process by providing some insights, for example, where to find the densest parts or coding etc.

Instrumentation, Validity and Reliability

A questionnaire approach using semi-structured interviews on road infrastructure view sector provided the primary data for this research. The research topic, "Analysis of Delay Factors and Their Impact on Construction Projects in Jordan: A Case Study of Road Projects" was accompolished by these semi-structured interviews. Semi-structured interviews provide some flexibility and are one method for getting a true representation of a person's viewpoint (Gruber et al., 2008).

Thematic analysis was used to examine the interviews. Open coding of meaning units, such as words and phrases, was used in the study to code the transcripts of the interviews. Basically, phrases, sentences, and paragraphs entailed labeling concepts. Themes were created using the developing concepts. The themes were cross-checked during author group talks. Threats to validity were reduced through the triangulation of data collection techniques (interviews, observations, internal, and external documents), as well as participant verification of the initial thematic codes, where they assessed the accuracy of the data collected but not its conclusions (Tajeddini and Mueller, 2009).

ANALYSIS OF THE RESULT

The current study reveals that the road infrastructure sector comprises many distinct component, with a distinct characteristic that has impacted each party. The researcher put a lot of effort and much time to transcribe all the interviews, in addition to use an analysis program that could also allow transcribe transcripts. NVivo software's Word-Cloud metaphorical analysis was chosen because it meets these requirements. The analysis began with the creation of a new project at NVivo, which called "Using SCM.".

Jordanian government and road construction companies have put strategies in place in order to comply with laydown procedures. Currently, most road construction projects in Jordan have established guidelines and protocols that allow for efficient laydown procedures. These procedures involve careful planning and coordination to optimize the allocation of resources and ensure smooth operations on the construction site. The current study reveals that the infrastructure sector requires the adaptation of supply change management to cushion the delay effect of road construction project on economy which involves the assessment of different factors as responded by interviewers on various issues ask about and here are the questionnaire breakdown containing four sections of how the role of SCM could help to promote delay in road construction project in Jordan. Section 1 of the questionnaire entails, biography of the respondent, followed by project success in section two. Project delay becomes the third section, while section four examines supply chain management factors on delay

Table 4. Summary of the result base on Project success, Project delay, and supply chain management

Sections	Summary of Interviewee Respond	Related Work
Project Success	The success of a project relies on effective management, including setting and adhering to a suitable schedule, aligning design with implementation, and meeting objectives within budget, quality, and time constraints. Key factors contributing to project success include proper planning, well-designed processes, competent team members, an effective strategy, and fulfilling agreed-upon requirements, while customer satisfaction serves as an important indicator of overall achievement.	Tabassi, & Fayek, (2017); Al-Senidi, & Smith, (2016); Almatarneh et al., (2023).

	Road projects in Jordan differ from other construction projects due to factors such as the involvement of experienced road construction companies, supervision by the Ministry of Public Works and Housing, varying activities and expectations, time management, unique project management decisions, contracts, budget and personnel differences, and the complexity of approvals, studies, financing, and resource allocation.	Al-Tabtabai,, & Al-Hammad, (2018); Alazzam et al., (2023).
Project Delay	The timely completion of a project is crucial to avoid additional costs and penalties, and delays can occur due to unforeseen circumstances such as weather conditions or accidents, which may result in failure to meet contractual obligations and project specifications.	Rahman, & Ha, (2014).
	Delays in construction projects can be attributed to various factors involving multiple parties, including contractors, project owners, and external factors such as weather conditions, inadequate control from donors or the Ministry of Public Works and Housing, lack of contractor experience or competence, inadequate project classification, simultaneous involvement in multiple projects, inappropriate design and planning, financial issues, lack of technology and qualified personnel, disputes between contractors, consultants, and monitoring authorities, corruption, poor designs and contract value, insufficient manpower, delayed payments, material unavailability, lengthy approval processes, poor coordination, lack of honesty, transparency, credibility, and inadequate monitoring and follow-up.	Rezaee, Yousefi, & Chakrabortty, (2019)
	The government's inability to attract investments due to deteriorating economic conditions, financial problems in the region, imposed taxes on non-local companies, lengthy transaction periods, and the presence of financial risks and regional instability are hindrances to bringing in foreign contractors for project implementation in Jordan.	Bikitsha, & Amoah, (2020)
	The risks in projects include financial risks, changes in the project, economic factors, lack of funding, material-related risks, budget and cost risks, machinery risks, salary expense risks, liquidity risks faced by the contractor, taxes, fluctuations in material prices, as well as financial and administrative problems, which can contribute to delays, along with challenges arising from land acquisition by the Ministry of Public Works and Housing.	Rostami., & Oduoza, (2017)
	Traffic congestion, conflicts between contractors and project owners, public mistrust and dissatisfaction with the government, crises and accidents, and a negative reputation can lead to contractor exclusion and market distrust, while traffic disruptions and project delays result in financial losses, wasted time, unemployment, and hindered project progress, affecting all stakeholders involved, including contractors, implementers, consultants, and the Ministry of Public Works and Housing.	Brent,, & Beland, (2020)
Supply Chain Management	Effective coordination among the consultant, designers, and contractor, along with a comprehensive understanding of project details, procurement, and treating the project as an integrated work chain with each party focusing on their goals and interdependence, coupled with learning from neighboring countries, gaining experience, utilizing proper expertise, tools, resources, materials, and adequate project liquidity, and implementing supply chain management practices, can help reduce delays in the road sector; however, the challenge lies in addressing the lack of knowledge among workers in supply chain management.	Gao, et al.. (2018)
	The Ministry of Works has a dedicated supply chain section that aims to enhance supplier performance by providing them with easy access to information, measuring performance, implementing continuous improvement initiatives, and integrating programs and tools to measure project performance and enhance operations. The use of modern technology facilitates collaboration and boosts productivity among project stakeholders, while the department responsible for direct project provisioning requires knowledgeable human resources capable of coordinating with other parties. The contractor operates based on available materials, resources, and human resources,	Noshad,, & Awasthi, (2018)

	employing a system that considers both price and quality when comparing contractors and suppliers.	
	The company ensures resource management by providing the project with skilled workers who understand its requirements, and decisions regarding their involvement are made in coordination with the Ministry of Public Works and Housing to ensure supervision and communication among project stakeholders and minimize potential incidents. Implementation and supervision play a crucial role in the project, involving modern methods, effective communication, and information sharing between the suppliers and the project parties to fulfill its needs.	Callistus, & Clinton, (2018); Tubishat et al., 2024).
	Effective communication and the use of technology facilitate the transfer of data and information between managers and engineers, minimizing potential risks in the project, while employees are appointed based on required specialization through the service bureau, and large projects are supervised by field experts who provide regular reports to the ministry, which is monitored through periodic visits. However, the selection of employees in the supply department is based on experience and compliance with the requirements of the Jordanian construction sector, aiming to reduce material waste and ensure smooth progress through supervision and control by project supervisors and engineers, while keeping the Ministry of Public Works and Housing updated on the project's progress.	Kania, Radziszewska-Zielina, & Śladowski, (2020)

Table 4. provides insights into project success and delays in the context of road projects in Jordan. Effective management, including correct planning, adherence to deadlines Tabassi, & Fayek, (2017); Al-Senidi, & Smith, (2016), alignment of design and execution, and accomplishing goals within budget, quality, and time restrictions, is crucial to project success. Competent team members, well-designed procedures, and meeting predetermined criteria are significant success factors. Customer happiness is a crucial metric for measuring overall success. However, Jordanian road projects encounter particular difficulties, including a variety of activities and expectations, difficult project management choices, and the presence of skilled road construction firms. The complexity of these projects is increased by elements like varying budgets and staffing levels, approvals, research, finance, and resource distribution.

Other several factors involving several parties might cause delays in construction projects as explained in the study by (Rezaee, Yousefi, & Chakrabortty, 2019). These include insufficient oversight from funders or the Ministry of Public Works and Housing, a lack of expertise or competence on the part of contractors, problems with finances, poor design and planning, a lack of personnel, a lack of material availability, and ineffective coordination. Delays may also be caused by outside factors, such as bad weather and clogged roads. All parties involved, including contractors, implementers, consultants, and the Ministry of Public Works and Housing, may suffer financial losses, lost time, and job loss as a consequence of project completion delays as consistent with the work of (Rostami., & Oduoza, 2017). Therefore, resolving these issues and putting into practice efficient supply chain management strategies Noshad,, & Awasthi, (2018), together with appropriate coordination, knowledge-sharing, and the use of technology, are crucial for minimizing delays in Jordan's crucial road sector and guaranteeing good project results.

DISCUSSION

The Supply chain management is aim at providing a prior solution to the continuous process of delay that predominate road construction in Jordan. Currently, the majority of road construction projects in Jordan follow set rules and procedures that make laydown procedures efficient (Hailat et al., 2023). To maximize resource allocation and guarantee smooth operations on the construction site, these procedures need rigorous planning and coordination. The Jordanian government and road construction firms have used strategies to increase project effectiveness and decrease delays. They may improve project management, reduce material handling hazards, and maintain a safer and more orderly workplace by following correct laydown procedures.

Firstly, in terms of project success, effective management practices play a critical role. This entails careful planning, adhering to timelines, aligning design and execution, and achieving goals within time, quality, and budget limits. The engagement of seasoned road construction firms and oversight by the Ministry of Public Works and Housing further add to the distinctiveness of Jordan's road projects. Customer satisfaction, which reflects total project objective accomplishment, is another indicator of project success.

Secondly, project delays are a significant challenge in construction projects, and they can arise from various factors involving multiple parties. These factors include insufficient donor or Ministry of Public Works and Housing oversight, a lack of contractor expertise or experience, financial problems, ineffective coordination, delays in payments and the availability of materials, and a lack of workforce. Delays may also be caused by outside factors like the weather and modifications to the project's scope. Furthermore, difficulties in luring international contractors because of the economy, financial risks, and regional insecurity worsen the issue.

Thirdly, supply chain management is crucial for reducing delays in the road sector. Emphasis is placed on efficient communication between consultants, designers, and contractors as well as a thorough knowledge of project specifics and procurement. Delays may be reduced by acquiring experience, learning from adjacent nations, and using supply chain management techniques. In order to enhance supplier performance, undertake continuous improvement projects, and increase efficiency, the Ministry of Works maintains a specialized supply chain unit. In order to guarantee project success, proper resource management and the selection of qualified staff are also crucial.

CONCLUSION, RECOMMENDATIONS AND FUTURE RESEARCH WORK

Today, the success of road construction projects depends on their sincere dedication to being "value-led" and implementing an all-encompassing strategy to deal with unprecedented difficulties. Road project delays, which have become one of Jordan's most difficult difficulties, have significantly impacted the country's road construction business. These delays are impacting practically every sub-sector to varied degrees and are spreading quickly throughout the industry. There are worries that road projects might fail in these uncertain times, inflicting a heavy financial load on the economy as a result of cost overruns and project delays. To be ready for potential crises, the sector must put safeguards in place, including long- and short-term planning. Governments all across the globe view road construction as a crucial investment in reviving economic growth. In addition to highlighting the improvements made to the construction sector to line with the value-led strategy while maintaining productivity, this study offers a better knowledge of the impact of road construction projects in Jordan. With an emphasis on delays, the study attempts to educate policymakers about the lessons discovered while managing road construction projects. The article addresses current road construction projects impacted by delays and their impact on many stakeholders, including the management team, operations team (site engineers, surveyors), design team, and supply chain management. Managing delays is difficult, resulting in delays in project activities and potential financial burden on the government. Effective team management is a challenge for directors and managers. However, it has been shown that delivering successful projects within the allotted time range is the most effective strategy.

Given the many scheduled projects with predetermined budgets and timelines, it is imperative that the road construction sector draft a growth plan. Any extensions to project time lines may cause delays and extra expenditures for the government. The sector is committed to upholding contractual responsibilities and project viability while adjusting to new approaches to contract fulfillment and working to complete projects on schedule. Delays may be harmful, perhaps causing contracting businesses to be liquidated owing to exorbitant expenditures and a lack of time to finish projects as scheduled. Table 3 presents insights that encourage decision-makers in the infrastructure sector to reevaluate their approaches and take the necessary changes. This study has certain limitations while providing unique insights. The findings are provisional and have only a limited potential to be generalized because of Jordan's distinctive topography and other environmental conditions. This study was exploratory and preliminary. The results are also limited to Jordan's road infrastructure construction sector, which limits their usefulness outside of this setting. Nevertheless, it is said that the findings are important for emerging Asian and Arab nations.

Delays in acquiring client or architect specifications, as well as gaining planning approvals or authorization from local governments, which would have varying effects on the overall project, might be studied further. Nevertheless, if these non-supply chain delays are excluded from the project, total delays may well be compared to corroborate the research's findings. It's worth noting that information flow delays are the employer's responsibility, therefore they're unlikely to be included in the main contractor's expenses.

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