

**THE USE OF SUPPLY CHAIN MANAGEMENT  
TO REDUCE DELAYS IN PUBLIC ROAD  
PROJECTS IN JORDAN**

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TO REDUCE DELAYS IN PUBLIC ROAD  
PROJECTS IN JORDAN**

by

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## LIST OF ABBREVIATIONS

ATLAS	is a qualitative research tool that can be used for coding and analysing transcripts & field notes, building literature reviews, creating network diagrams, and data visualization
CAQDAS	Computer-assisted qualitative data analysis software
GDP	Gross Domestic Product
JCCA	Jordan Contractors Association
JD	Jordan Dinar
MAXqda	Computer-assisted qualitative and mixed methods data, text and multimedia analysis
MOPWH	Ministry of Public Works and Housing
NVivo	Lumivero's easy-to-use, collaborative qualitative analysis software that allows researchers to import, organize, explore, connect and collaborate on their data to reveal more significant insights from their qualitative data faster
SCM	Supply chain management
USAID	United State Agency for International Development

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**KEGUNAAN PENGURUSAN RANTAIAN BEKALAN UNTUK  
MENGURANGKAN KELEWATAN DALAM PROJEK  
JALAN RAYA AWAM DI JORDAN**

**ABSTRAK**

Tesis ini dijalankan untuk mengkaji aplikasi pengurusan rantai bekalan bagi mengurangkan fenomena kelewatan projek infrastruktur. Projek jalan raya mengalami kelewatan dan telah menjadi subjek penyelidikan selama beberapa dekad. Jordan telah terjejas teruk oleh dilema ini, terutamanya dalam projek sektor awam, khususnya projek infrastruktur. Kadar kelewatan adalah sangat tinggi. Dalam kertas kerja ini, kita mesti membincangkan punca kelewatan dalam projek jalan raya di Jordan. Kajian dijalankan terhadap syarikat yang terlibat dalam pelaksanaan projek jalan raya di tapak pelaksanaan. Pendekatan kuantitatif digunakan di mana data dikumpul melalui temu bual separa berstruktur dengan individu yang berkenaan untuk pelaksanaan projek jalan raya. Semakan dokumen, perbualan tidak formal dan nota juga digunakan untuk menyokong kenyataan daripada temu bual. Data dianalisis dengan memasukkan data ke dalam program analisis (NVivo 12), di mana hasil kajian ini adalah berdasarkan teori tanah. Daripada hasil kajian ternyata, fakta yang menyebabkan kelewatan dalam penyampaian projek ia ternyata undang-undang dan arahan pertukaran daripada kerajaan, wang pinjaman yang tidak mencukupi dan kekurangan pekerja dalam sektor tersebut adalah punca utama kontraktor tidak ada upaya bayar projek yang perlu dilaksanakan. Harga bahan yang tinggi juga menyebabkan fakta kelewatan penyampaian projek . Teknik (SCM) yang sesuai daripada literatur telah ditemui dan digunakan (bersama-sama dengan alat yang disyorkan oleh pengamal industri) untuk mewujudkan rangka kerja lengkap untuk



mengurangkan kelewatan dalam projek infrastruktur Jordan. Hasil pengajian nyata, alat (SCM) ia adalah alat yang penting untuk pengurangan jangkitan khusus dan subkelas patogen tertunda. Penemuan itu mendedahkan bahawa interaksi antara pelbagai pihak adalah yang paling terjejas, membayangkan bahawa kerajaan Jordan harus melancarkan aplikasi (SCM) bertujuan untuk memodenkan amalan sekarang dan menjauhi adat kerja lama yang tidak produktif. Tambahan pula, kerana penggubal dasar mempunyai pengaruh yang besar terhadap industri, penggunaan (SCM) membantu kerajaan mendorong projek tersebut.

# **THE USE OF SUPPLY CHAIN MANAGEMENT TO REDUCE DELAYS IN PUBLIC ROAD PROJECTS IN JORDAN**

## **ABSTRACT**

This thesis is investigating the use of supply chain management (SCM) to decrease the phenomena of road project delays. Delays in the completion of highways have been the focus of investigation for decades. Jordan have been significantly impacted by this quandary, especially in public-sector undertakings, particularly road projects. The delay rates were exorbitant. In this study, the study must explore the causes of road project delays in Jordan. Research was done at the implementation site for organisations participating in the execution of road projects. The qualitative data approach is used where data is collected through semi-structured interviews with the individuals concerned for the implementation of road projects. Document reviews, informal conversations, and notes are also used to support statements from interviews. The data was analysed by including data in the analysis program (NVivo 12), where the results of this study are based on the theory of the land. From the results of the study, it appears that laws and government change orders, poor funding and shortages of workers in the sector, reasons related to contractors such as difficulty of financing and inability to provide the project capital. High prices of materials are among the main factors causing delays in project delivery. Appropriate (SCM) approaches from the literature were identified and used (together with tools proposed by industry practitioners) to create a comprehensive framework for reducing delays in Jordanian road projects. Finally, this approach includes important (SCM) tools for the reduction of specific infections and delayed pathogen subclasses. The findings revealed that the interactions between the various

parties were the most affected, implying that the Jordanian government should launch (SCM) applications aimed at modernising present practises and moving away from unproductive old work customs. Furthermore, because policymakers have substantial influence over the industry, the adoption of the (SCM) helps the government push for the project.

# CHAPTER 1

## INTRODUCTION

### 1.1 Introduction

The success of a project has always been an important goal for the road 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. Time is critical in road construction; it is specifically stipulated in contracts, and failing to meet it leads to penalties as stipulated in the contract. However, the industry's dynamic, multi-disciplined, and unpredictable nature has made project completion on time more difficult to achieve (Davis, 2017).

Over the past years, the road construction industry in Jordan (public and private road projects) have been suffering from delays in terms of the completion time that have led to the dissatisfactions of the clients involved, the government and citizens for the whom the projects were meant for. Losses to the government and poor contribution of the sector to the country's gross domestic product (GDP), the Jordanian government has taken several steps to address this issue, such as the privatisation of projects. The outcome, however, were poor. The road projects were not well planned, conflict-ridden, and fraught with distrust.

It was revealed as a result of these concerns that insufficient working environment had the biggest impact to the success of Jordanian building projects, particularly road projects. This scenario necessitates an urgent need for a fundamental change in the way road construction projects are managed in Jordan, with an emphasis

on the urgent need to enhance projects that will be able to thrive in Jordan's road sector.

Many scholars have proposed Supply Chain Management (SCM) as a solution to the ongoing issues in the road projects. (Road construction & Egan, 2002; Bankvall, Bygballe et al., 2010; Riazi & Nawi, 2018). Despite its origins in the manufacturing business, it has shown to be very useful in road construction. Its benefits is in improving combative interactions, resolving divergent problems, increasing harmonious working connections, and establishing an effective risk management system, which are widely established. These may be attained, among other things, by the adoption of best practises and ideals; win-win agreements; the development of trust and shared objectives; and the fostering of innovation and continuous improvements. This provides an advantage over previous approaches in terms of increasing productivity in the business through timely completion. The effectiveness of SCM to reduce delays have also been fully identified in a number of projects in the United Kingdom (UK) and have been proposed as a beneficial public sector initiative. However, despite its benefits, its adoption has been slow. Based on the previously demonstrated achievements and advantages of SCM, there is high hope that it may be a viable way to mimic reduced delays in Jordanian public sector road projects. As a result, the current research studies attempt to implement this approach by presenting useful SCM technologies for decreasing delays in Jordanian public sector. Delays In both the Jordanian public and private sector projects, a framework has been developed, which have been validated by specialized industry practitioners.

## **1.2 Research Problem**

Project delays are a regular occurrence in the road construction industry, and Jordan's road construction sector is no exception, with delays affecting significant public and private road projects (Btoush & Harun, 2017). According to Bekr's (2018) research on large public road construction projects in Jordan, approximately 95% of the projects suffer delays, with more than half exceeding the original completion date by 10% to 30%. Similarly, most road construction projects in Jordan have poor time and cost performance (Al-Hazim, Salem et al., 2017). These delays not only affect project delivery but also lead to further losses in terms of profits, delayed infrastructure, and poor industry image.

Researchers worldwide have attempted to shed light on the issue of project delays in the industry, and the need to understand the causes of delays in Jordan's road construction industry has recently been highlighted by Assbeihat (2016). However, previous studies on this topic have not been thorough enough, with insufficient factors included in their studies. For instance, while some studies have examined more than 200 factors, most studies on Jordan's road construction industry have only looked at a range of 19 to 55 factors. Therefore, a more comprehensive study is needed to ensure that a complete perspective of the delay problem can be obtained and effectively mitigated.

Previous studies have also been criticized for employing inadequate tactics that ignored the fundamental causes. This antagonistic view not only fails to address the problem but may also lead to further disagreements since road construction processes are inextricably linked. It is critical to understand them as a system and hold everyone accountable for project performance. Using the "pathogen" approach can enable the

identification of the very root of delay contributors to be identified for effective recovery actions.

Supply Chain Management (SCM) has been repeatedly recommended as a way forward to address road construction delays. SCM recommends organizational reorganization and extending success across organizations. It is a theory that recommends improving the functioning of an organization by using components of integration, coordination, communication, information, and control systems to extract greater value from every activity. Collaboration has been described as a key driver of SCM, and its benefits for road construction performance have been proven.

Many SCM tools have been proposed as solutions for delays in road construction projects, and this research aims to develop a framework that proposes useful and diverse SCM tools specifically linked to addressing the specific problematic areas in project management that have been causing delays in Jordan's road construction sector. This framework is crucial since previous government plans appeared ineffective in executing the notion, resulting in a scarcity of modern tactics. SCM has also been recognized as a good public sector initiative, and there is a likelihood that the framework will be effective in helping strategize delay reduction in future projects, as supported by previous research benefits and recorded successes.

### **1.3 Research question**

The questions in this research will be based on a review of the literature of previous studies regarding delay factors in road projects in Jordan. At the end of this research, the study attempts to answer the following main questions:

- 1) What are the critical delay factors Jordanian road construction projects?
- 2) What are the main delays group in roads to underlying causes?
- 3) How can SCM reduce delays in Jordanian road construction projects?

#### **1.4 Aim and Objectives of Research**

The aim of this research is to study and evaluate the issues related to the major causes of road project delays in Jordan. Therefore, the objectives of this study are as follows:

- 1) To identify the main delay factors in Jordan road projects.
- 2) To group the main delay factors into underlying causes.
- 3) To identify the beneficial SCM tools and develop a framework utilizing these tools to reduce delay in road project in Jordan.

#### **1.5 Scope of Research**

The scope of road construction research may cover various aspects related to the planning, design, construction, operation, and maintenance of roads and highways. Some of the topics that may be included in road construction research are:

- a. Design and planning of roads and highways
- b. Construction techniques and materials
- c. Environmental impact and sustainability
- d. Traffic management and control
- e. Pavement performance and maintenance
- f. Safety measures and accident investigation



- g. Cost and economic analysis of road construction projects
- h. Innovation and technology in road construction.

The specific scope of a road construction research study depends on the objectives and research questions of the researcher. This research aims to develop a SCM framework to overcome delays in Jordan highway road construction projects. Yet, despite the fact that the road construction industry is one of Jordan's key economic contributors, study into what caused the delays has been incomplete (Hiyassat, Hiyari et al., 2016). Although various research on these delay difficulties have been undertaken, they have been insufficiently comprehensive, particularly in terms of the number of delay factors included in their investigations. The following are some of the studies that have been conducted: (Odeh & Battaineh, 2002) - twenty eight elements; (Sweis, Sweis et al., 2008) - twenty eight factors; (Sweis, 2013) - thirty seven factors; (Al-Hazim & Salem, 2015) - nineteen factors; (Samarah & Bekr, 2016) - fifty five factors; (Assbeihat, 2016) - forty five factors; (Al-Hazim, Salem et al.,). These figures are deemed insignificant, especially when compared to Riazi's (2014) study, which included 210 criteria in his research on the delays of Malaysian public sector projects. In undertaking this research, the following are the scopes that will be covered in this research:

Firstly, this research will be focusing only on *public road infrastructure projects*. There has been evidence from past studies that public road projects (i.e., roads) in the country have been very poor in terms of time performance. In fact, most road construction projects in Jordan are characterized by the overrun in cost and time (Al-Hazim & Salem, 2015; Al Rekhawi, Ayyad et al., 2017) while project delays in the country generally involves major public and private road projects (Btoush &

Harun, 2017). Highway projects are generally characterized as big projects since the contract value is seldom low thus is more prone to unexpected risk which leads to poor time predictability. Big projects are particular problem in Jordan based on finding by Btoush and Harun (2017), Bekr (2018) who did a study on the significant delay causes that affect the performance of large public road construction projects in Jordan and found that about 95% of the projects suffer from delays and more than 50% of them have had delays between 10-30%. Beyond that, there were also studies that studied road projects specifically and found delays as a common phenomenon for instance (Al-Hazim & Salem, 2015) did a study on delays on 9 road construction projects in Amman, Jordan which took place between 2000 and 2008. In their study, they found that time extensions ranging between 125 % to 445 %, with an average of 226 %. On the other hand, (Msallam, Abojaradeh et al., 2015) who did a research on variation order in 9 highway projects in Jordan, also had data on delays in those project. Based on their study, maximum percentage of time overrun in the 9 highway projects in the Ministry of Public Works and Housing in Jordan (MOPWH) that were studied have been identified to be at 180.50% and averaging at 83.57%. Additionally, (Al-Hazim, Salem et al., 2017) studied the final reports of 40 public road projects in Jordan from year 2000 to 2008 and found that delays rates averaged at 226%. The final reports of 40 public infrastructure projects completed between 2000 and 2008 were gathered and analysed. The final results were obtained from Jordan's Ministry of Public Works and Housing (MPOWH), which manages public infrastructure projects in the capital Amman.

Therefore understanding the causes of delays is a major concern in order to minimize and avoid the delays and their corresponding expenses in Jordan road construction industry (Assbeihat, 2016). Thus, it is based on these basis that this

research aims to establish the factors of delays in Jordanian public highway road projects.

- a) Secondly, this research aims to focus on **highway projects valued up to JD 210,000.00 only**. Sure, here's a proofread version of the text: "This was determined based on research by Msallam, Abojaradeh et al. (2015), who studied the time overrun in nine highway projects in the Ministry of Public Works and Housing in Jordan (MOPWH) using a variation order techniques had found delays that averaging at 83.57%. In their study, three projects had a significantly higher delay percentage than others and were valued at JD 132,900.00, JD 202,400.00, and JD 149,500.00. The first one had a delay of 180.50%, while the other two were at 163.80% respectively. Only four projects had a delay rate of more than 100%, and they were valued between JD 132,900.00 and JD 202,400.00. Six out of eight projects that were delayed (the other two did not experience delays) were valued between JD 80,892.50 and JD 202,400.00. Thus, based on their findings, it was evident that most projects that were delayed were valued at JD 202,400.00 or less. This is used as justification by this research to focus only on projects valued up to JD 210,000.00.
- b) Thirdly, this study will be looking on **Road projects undertaken from year 2009 to 2018** only since (Al-Hazim & Salem, 2015; Msallam, Abojaradeh et al., 2015) has already studied projects up to 2008 and that no studies have been conducted for the years after 2008 despite the road construction industry being among the major economic contributor for Jordan, research regarding to what caused the delays have not been thorough . Although numerous studies have been conducted on these delay challenges, they were insufficiently

incomprehensive, particularly in terms of the number of delay factors included in their studies

- c) Fourthly, this study will be focusing on **highway projects undertaken by the Ministry of Public Works and Housing (MOPWH) in Jordan** only since it has been evident that projects by MOPWH have been very poor in terms of time performances.
- d) Fifthly, the **respondents that will be targeted by this research will be the main supply chains that are involved in highway projects under MOPWH in Jordan** since it is important that the viewpoint of all main players are obtained for a conclusive and accurate result. Past research related to delays in Jordan has been short in this aspect with many researcher being very selective in their respondent group; for example a study by Sweis (2013) on time overrun in Jordan Public Road construction projects and they only targeted 30 engineers who serve the MOPWH and the Association of Road construction Contractors who were willing to participate. Others researchers such as (Al-Hazim & Salem 2015; Al-Hazim, Salem et al., 2017) who studied road and road projects studied only the project documents and final report; thus there exist a lack of viewpoint from the main project stakeholders and implementer groups that are more exposed and knowledgeable on the true facts of delay occurrence in their projects. Hence, this research aims to be more thorough by covering the perspective of all main supply chains of the public highway projects towards obtaining an accurate outcome as possible.

## **1.6 Significance of Research**

The road construction industry is one of the most important sectors in the world. The road construction sector creates job opportunities and development. Moreover, the road projects have a great impact on the development of the industry as well as creating multiplier effects on other sectors such as manufacturing and services. The road construction industry's poor performance has an impact on its GDP contributions, the industry's image as well as affecting investors' confidence.

The Jordanian government has indicated its desire to increase industry performance through a variety of programmes such as privatisation, collaboration, the Industrialized Building System, and others. Periodic plans (such as the Jordanian Plans) and long-term plans have both been on the government's agenda, although neither have solved the delay problems. The research methodology produced in this study would serve as a roadmap for better incorporating best practises and SCM technologies into industrial work practises. With established benefits and success instances in SCM deployment, it is expected that the framework would be of great aid in improving time performances. The framework may also be developed, adjusted, and upgraded to accommodate projects of varying complexity levels. Better performance of the industry would translate to better contributions to GDP, consequently making positive multiplier effects on other industries which are dependent on this sector. Better public sector performance will also benefit the general public.

The purpose of this research is to fulfil several conditions which is considered important to refer to the parties that were involved in road construction. These significant involve: First, to study the factors that cause delays in road projects and

produce the statistical results. The result of the study is the guideline to the parties that is involved, so to avoid any source that will be participating in their projects.

## **1.7 Thesis outline**

The thesis structure is made up of six interconnected chapters, as seen in the outline below. The first chapter served as a "broad introduction" since it addressed the research's background and the research challenges that necessitated the research efforts. The studies objectives, research questions, and scope were all mentioned in this chapter. The literature review covers a wide range of past work. Chapter Two. Progress in the literature review is included, as well as thorough coverage of prior work. The second portion examined the literature study in general, as well as Jordan, which included a discussion of the Jordanian road construction sector and Jordanian road projects. On the other side, the arguments for altering the constructive approach and shortening the wait. Implementing SCM in the road construction field through the participation in the Jordanian road construction sector. Chapter Three - Research Methodology - Focus on the systematic approach that will be participating in this research and will provide discussions on the analytical tools for data collections. The results and discussion of the data obtained are presented in the fourth chapter. The fifth chapter summarises and examines the study's findings, and the sixth chapter, which reviews the conclusions and suggestions.

## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.1 Introduction**

This section reviews the exploration delay of the road projects from each hand, reviews the user's approach, and then justifies the approach. This section begins with the aspects related to the study of a successful project through different point of view, which may vary depending on the many developmental and structural issues. Through this chapter, the aspects of delays will be explored and thorough delays in projects and how it affects the industry in various forms through the review of previous studies. Through this chapter, the study will talk about ways to provide an approach for the adoption and justifications.

Overall project implementation involves various stages, each of which must be effectively coordinated to achieve successful completion of the project within the planned timelines and budget. The following are the common project implementation stages involved in road construction projects:

1. **Planning Phase:** This phase seeks to establish project objectives, identify the scope of the project, evaluate the feasibility, and arrive at a comprehensive design. It also includes scheduling, resourcing, and risk identification, amongst other things.
  
2. **Procurement and Contracting:** This phase involves identifying and selecting suppliers that can provide the necessary materials, machinery, and equipment for the construction process. Contracts are also negotiated with contractors who can handle the work efficiently.

3. Pre-Construction Phase: During this phase, the construction team gets the planning and procurement processes underway. This includes site preparation, mobilizing equipment to the site, and preparing the work area.
4. Construction Phase: The construction phase involves executing the construction plan laid out during the planning phase. Heavy equipment is deployed to the site and excavation work begins. The sub-base, base, and surface layers are installed sequentially. This stage is the most engaging period where the process requires attention to detail so as not to affect the project timeline while meeting required specifications.
5. Quality Control and Assurance: Quality control and assurance assessments are carried out throughout the construction process to ensure that the road construction project meets project specifications and contractual requirements.

Delays in projects can occur at various stages of project implementation, including:

1. Regulatory delays: Projects may have to comply with various regulatory restrictions that can result in delays.
2. Environmental issues: Projects may face significant delays due to environmental compliance requirements such as environmental assessments and permits.



3. Limited resources: Limited human and financial resources could constrain project success, particularly if they cause equipment downtime and delays.
4. Access constraints: Restricted access for heavy equipment to the construction site can significantly impact project timelines and increase costs.
5. Inadequate planning: Poor planning of road construction projects can lead to cost overruns, delays, and the need for expensive corrective action.

Moreover, effective project management is essential in ensuring the success of road construction projects. The proper planning phase, procurement, and quality control are crucial aspects of the construction process. Addressing common constraints and delays is essential through strong coordination and communication among various stakeholders in the project.

## **2.2 Definition / Terminology**

### **2.2.1 Supply Chain management:**

Supply chain management is the coordination and management of all activities involved in the production and delivery of goods and services from raw materials to end customers (Chopra & Meindl, 2021). It involves the management of the flow of materials, information, and finances from suppliers to manufacturers, wholesalers, retailers, and customers. According to Chopra and Meindl (2021), effective supply chain management can help organizations to improve operational efficiency, reduce costs, enhance customer satisfaction, and gain competitive advantage. It involves the

integration of different functions such as procurement, production, logistics, and marketing to optimize the performance of the entire supply chain.

### **2.2.2 Supply chain performance**

Supply chain performance refers to the ability of a supply chain to meet customer demands while achieving operational efficiency and cost effectiveness (Cao et al., 2018). The performance of a supply chain can be measured in terms of various metrics such as on-time delivery, lead time, inventory levels, order accuracy, and customer satisfaction (Cao et al., 2018).

### **2.2.3 Construction supply chain**

The construction supply chain involves the coordination and management of all activities involved in the procurement, production, and delivery of materials and equipment required for construction projects (Cheng et al., 2020). It includes the management of the flow of materials, information, and finances from suppliers to contractors, subcontractors, and customers.

### **2.2.4 Construction project**

A construction project is a temporary endeavor aimed at creating a unique product or service through the construction of a building, infrastructure, or other physical asset (PMI, 2017). Construction projects typically involve a wide range of stakeholders, including owners, contractors, architects, engineers, suppliers, and regulators.

### **2.2.5 Project Delay**

Project delay refers to the situation where a construction project does not meet its planned completion date or schedule (Yahaya et al., 2017). Delays can occur due to various factors such as design changes, weather conditions, material and equipment availability, labor shortages, and unforeseen circumstances.

### **2.2.6 Project Supervision**

Project supervision involves overseeing and monitoring the activities and progress of a construction project to ensure that it is completed on time, within budget, and to the required quality standards (Datta & Roy, 2019). The role of a project supervisor includes coordinating the work of contractors and subcontractors, managing the project schedule, ensuring compliance with safety and environmental regulations, and resolving any issues or conflicts that arise during the project.

### **2.2.7 Road construction industry**

The road construction industry involves the design, construction, and maintenance of roads, highways, bridges, and other transportation infrastructure (Li et al., 2019). The industry plays a crucial role in supporting economic growth and development by providing essential transportation infrastructure for the movement of goods and people.

## **2.3 Project Parties**

In a construction project, there are various parties involved who have different roles and responsibilities. These parties include owners, contractors, subcontractors, architects, engineers, suppliers, and regulators (PMI, 2017).

According to Cheng et al. (2020), the owner of a construction project is responsible for defining the project requirements, providing funding, and overseeing the project to ensure that it is completed on time and within budget. The contractor is responsible for managing the construction process and coordinating the work of subcontractors and suppliers. The architect and engineer are responsible for the design of the project and ensuring that it meets the required standards and regulations. Subcontractors are responsible for carrying out specific tasks or activities within the project, and suppliers are responsible for providing the materials and equipment required for the project. Regulators are responsible for ensuring that the project complies with all relevant laws and regulations.

### **2.3.1 Materials**

It defines all the materials required for road construction such as asphalt, concrete, gravel, sand, and aggregates.

### **2.3.2 Equipment**

It defines all the heavy equipment required for road construction such as excavators, bulldozers, graders, and rollers.

### **2.3.3 Transportation**

It defines the transportation of materials and equipment to and from the construction site.

### **2.3.4 Suppliers**

This explains the suppliers of materials and equipment.

### **2.3.5 Logistics**

This includes the planning, coordination, and management of the transportation and supply of materials and equipment.

### **2.3.6 Inventory management**

It tells the tracking and management of materials and equipment inventory.

### **2.3.7 Procurement**

Is the process of acquiring materials and equipment required for road construction.

### **2.3.8 Cost control**

It defines the management of costs associated with road construction, including the costs of materials, equipment, and labor.

### **2.3.9 Quality control**

Is the processes and procedures for ensuring that the road construction meets the required quality standards.

### **2.3.10 Risk management**

Is the identification and management of risks associated with road construction, such as weather conditions, labor shortages, and equipment breakdowns.

## **2.4 Project Success**

Project success depends on many factors including project management experience, employee stability, level of supervision, planning, cash flow, project control, etc. The success of a project is linked to good management, as good management is where many researchers agree that good management includes (planning, monitoring, a specific and clear target and provide motivation for project employees) (Howes, 2019). A project should be distinguished from project and project management, where the project can be considered to seek a specific goal through a series of activities and successive tasks that consume resources. It must be completed within the prescribed specifications, specifying the start and finish dates of the project.

According to Koskla (2000) and Richardson (2010), the basis of project management is made up of two major theories: the project theory and the management theory. Complexity Theory, as defined by Curlee and Gordon (2011). The complexity theory for each part of the system contains different kind of parts. According to the theory of complexity, because most people are dissatisfied with changes because they should be starting work from scratch. In the life cycle of the project, where the attention of members of the project team on how the project will end, and how to complete the project required within the budget.

They assess aspects of project performance along with time and costs (Ashley & Bonner, 1987). It is believed that a successful project not only lies in the cost and time expected but must be able to achieve more. Project success metrics may vary from project to project (Parfitt & Sanvido, 1993). The level of success is measured by the completion of the project according to the agreed time, cost, and quality known as the "Iron Triangle" (Larsen, Shen et al., 2016). These factors are evident in many

studies as the reasons for the success of the project and thus were promoted as "Iron Triangle" and "Eternal Triangle" (Atkinson 1999; Narayan & Tan, 2019). Respectively, as there is a correlation between time, cost, and quality, as any change may affect the project as a whole, achieving success factors by completing the project with the highest quality, lowest costs, and the shortest possible period (Robbins & Stuart-Kotze, 1988; Munyao, 2016).

#### **2.4.1 Project performance**

Due to its emphasis on the integration of various operations within the company and the supply chain, supply chain management (SCM) has emerged as a key study field in project management. It has been shown that the function of SCM is crucial for enhancing project performance (Jing, Wang & Qi, 2018). SCM is crucial to a company's performance, particularly when taking into account complicated projects that call for a certain amount of efficiency, coordination, and collaboration within the supply chain. The connection between SCM and project performance has been studied in the past. For instance, studies have shown that SCM improves project performance by facilitating stakeholder coordination, communication, and cooperation (Santos, Correia, & Ferreira, 2014).

In a research they did in 2004, Chen and Paulraj looked at project management best practices for SCM. The research discovered that putting good SCM processes in place may enhance project performance. The survey also found that an integrated SCM strategy promotes internal and external stakeholder engagement and communication, gives businesses a competitive edge, and results in sustainable performance.

The effect of SCM techniques on the results of building projects was researched by Wang et al. in 2015. According to their study, using SCM techniques in building projects improved project results. The research demonstrated that enhancing performance via cost reduction, boosting communication and cooperation, and reducing the amount of time and resource waste was the most important advantage of SCM in construction project management. Earlier research have shown that SCM plays a vital role in enhancing project performance. Better coordination, communication, and cooperation among stakeholders may result from effective SCM procedures, and this helps to enhance project results. Companies may develop a competitive edge, achieve sustainable performance, and improve their project management methodology by using SCM. Supply chain management must thus be a key factor in the success of any project.

#### **2.4.2 Better Project Team Selection**

Practicing coordination among employees is critical for achieving organizational goals and objectives (Magova & Kessy, 2020). Teamwork helps employees get the job done efficiently through collaboration, improved relationships and experience. Besides ensuring improved project efficiency and supply chains. In addition, democracy among the project's employees promotes creativity and decision-making innovation, as there is a link between worker performance and teamwork practices as a whole (Kelemba, Chepkilot et al., 2017). On the other hand, SCM in a performance environment of a teamwork can be strengthened (Eslami, Hosseini et al. 2013). Identifying employees is critical (Liu & Liu, 2010), selecting teams to achieve sustainability in terms of long-term mentality (Kumaraswamy, Ling et al.). Improving project teams creates the highest levels of productivity among employees, in addition,



achieving common goals and successfully completing the project (Clarke, Tuuli et al., 2012; Ibrahim, Costello et al., 2015; Svalestuen, Frøystad et al., 2015).

Cooperation and trust are both important factors that help in project success (Strahorn, Brewer et al., 2017). Some of the tools through which the team is selected include: - “Team Criteria” Pre-Qualification, “Prequalification” Rating and Transparency Classification, “Value for Money” (Dulaimi, Kumaraswamy et al. 2007), “Relational Index” to measure “Relational Score” (Cheung, Yiu et al., 2006).

### **2.4.3 Time**

The project varies from one project to another in terms of duration depending on the nature, type, and scope of the project. Specific time required to complete the project according to the project schedule. Time equals money. Time is the most important factor in the success of a project. Since time is associated with quality as well (Frefer, Mahmoud et al., 2018)

### **2.4.4 Cost**

The cost of implementing the project is an important factor in the projects. The lower the cost of the project, the greater the profits. Project managers must take into consideration when assessing contractor bids to choose the best prices. The price (the estimated cost) of the project (Jackson & Moulin 1992; Connell & Rasmusen, 2019).

### **2.4.5 Quality**

Quality management is "a group of activities seeking quality control". Define project quality management as "the set of tasks that are applied in order to ensure that the project outputs and the set of processes through which is to ensure that the project

outcomes meet the needs of stakeholders. The quality of the project depends on quality resources (equipment, materials, skilled worker, the parties operating in the project contractor, consultant, and owner )(Wright & Lawlor-Wright, 2018).

## **2.5 Road construction Project Delay**

In today's environment, timely completion of building projects poses a major problem. As the phrase goes, "time is money," and any delays will result in a loss of funds from the facility, particularly for private clients. The delays has an impact on the government's budget planning and allocations. Road construction is a distinctive sector in comparison to other industries owing to the engagement of several parties and the exposure to a variety of unforeseen events. As a result, a team of highly trained and devoted team members is necessary to carry out pre-defined activities in order to achieve mutually agreed-upon goals. These goals may be jeopardised if the contractor fails to complete the project before the deadline (Adaku, Ankrah et al., 2021).

Due to the fact that timely completion is very essential in a project, it is very important to first know what delay really means, what it is all about and how a project is determined as delayed. Therefore, many definitions have been presented by researchers and industry practitioners with regard to this term. A common tenet is that delay refers to the extended completion time beyond what has been pre-planned by the contractor (Kaming, Olomolaiye et al., 1996). Another point of view is that an road project is deemed delayed if it fails to fulfil its completion date, regardless of what occurred to the plans throughout the road construction time (Burns & Turner, 1989). In summary, road construction delay may be described as a failure of a project to reach its pre-determined/original schedule. However, given the multi-entity structure

of the road construction business and the interdependence of each discipline, the blame for the delay should be held by all the relevant project parties and not the contractor alone.

### **2.5.1 Definition of road construction delay**

Delay is considered to be one of the most common problem and is usually advertised as a complex and costly instability in the road construction industry. It is of paramount importance to consider both the owner (in terms of overall performance) and the movers (in terms of money), a common source of disputes between the parties that lead to complaints (Doloi, Iyer et al., 2011). Besides, projects may be delayed by a few days, including delays of more than one year. Deferred factors must be identified in an attempt to reduce delays in the road construction project and to avoid it all together (Hamzah, Khoiry et al., 2011). Views differed on the causes of delays in projects, which refers to systematic errors and administrative deficiencies, and others can be attributed to several quarters. There have been many studies that were meant to provide factors that cause delays in road construction projects. (Mansfield-Devine, 2017) noted in a study conducted in Nigeria on the delay in road construction projects. He pointed out that the most important factors are as follows: financing and price for completed works, terrible agreement control, adjustments in web page situations, scarcity of substances, and poor planning. Assaf and Al-Hejji (2006) described through his study on road construction projects in Saudi Arabia. In their studies, they renewed 56 factors were affecting the road construction projects in Saudi Arabia. The most important factors according to the contractors, the design and the preparation of drawings and approval by the relevant authority in the project (delays in contractor's progress, payment by owners and design change). The engineers' opinions were that,