Sudan University of Science and Technology

College of Graduate Studies and Scientific Research

Impact of Logistics Services Planning on Projects' Success: An Applied Study of Residential Complexes in Khartoum State

أثر تخطيط الخدمات اللوجستية علي نجاح المشروعات الإنشائية: دراسة تطبيقية على المجمعات السكنية في ولاية الخرطوم

Thesis Submitted According to the Regulations of the Degree of Doctor of Philosophy in Business Administration

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Author's Declaration

I declare that the work in this thesis was carried out by me in accordance with the regulations of the Sudan University of Science and Technology, and has not been previously submitted to any other University/College/Organization for an academic qualification/certificate/diploma or degree inside or outside The Republic of Sudan; it is original except where indicated by specific reference in the text. The work I have presented does not breach any copyright.

(سُبْحَٰنَكَ لَا عِلْمَ لَنَآ إِلَّا مَا عَلَّمْتَنَآ ۖ إِنَّكَ أَنتَ ٱلْعَلِيمُ ٱلْحَكِيمُ)

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Dedication

I would not have contemplated this road without the unlimited support, belief, encouragement, and direction of my parents, who inspired within me a love of science, the courage to face difficulties, and hope for a better future. My lovely parents, words cannot express the gratitude I owe you. Also, this thesis would not have been possible without the love and support of my brothers and sisters, I would like to thank them from the bottom of my heart. Finally, I would not forget the wonderful support of my wife in all times, especially during those tough times when I lost the hope to complete this doctoral program. I really thank you from the bottom of my heart.

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Abstract

This study discusses the effect of logistics planning on the successful execution of construction projects with regard to their time, cost, and quality. It elucidates the role of logistics strategy management as a mediator variable in the relationship between logistics planning and execution of construction projects. Furthermore, it discusses the effect of lean logistics as a moderator variable in the relationship between logistics strategy management and execution of construction projects in Khartoum State. This study aims to develop a theoretical framework for the assessment and exploration of an important factor for the critical success of construction projects. The study uses a questionnaire as a tool for data collection; 125 questionnaires were collected. The chosen research population includes all personnel providing and dealing with logistics services for construction companies in the residential complexes in Khartoum State. In this study, while partial least squares (PLS) tests the research model, Smart PLS 3.0 M3 assesses the measurement and structural model. The study results indicate logistics strategy management has a positive direct effect on the successful execution of construction projects in terms of cost, quality, and time of execution by the researched companies. Therefore, the study recommends that logistics services planning receive a great consideration from the senior management of construction companies and companies working in other fields.

مستخلص البحث

تناقش هذه الدراسة تأثير التخطيط اللوجستي على التنفيذ الناجح للمشروعات الإنشائية من حيث الوقت والتكلفة والجودة، كما توضح دور إدارة الإستراتيجية اللوجستية كمتغير وسيط في العلاقة بين التخطيط اللوجستي وتنفيذ المشروعات الإنشائية؛ علاوة على ذلك، تناقش الدراسة تأثير إزالة الهدر من الخدمات اللوجستية كمتغير وسيط في العلاقة بين إدارة الإستراتيجية اللوجستية وتنفيذ المشروعات الإنشائية في ولاية الخرطوم. كما تهدف هذه الدراسة إلى تطوير إطار نظري لاستكشاف وتقييم عامل مهم للنجاح الحاسم للمشروعات الإنشائية. استخدمت الدراسة الاستبيان كأداة لجمع البيانات حيث تم جمع 125 استبانة. شمل مجتمع البحث جميع الأفراد الذين يقدمون ويتعاملون مع الخدمات اللوجستية لشركات المقاولات في المجمعات السكنية في ولاية الخرطوم. وقد تم استخدام برنامج التحليل الإحصائي (PLS) Smart PLS 3.0 M3 في هذه الدراسة لتحليل بيانات الاستبانة. وخلصت نتائج الدراسة إلى أن إدارة الإستراتيجية اللوجستية تؤثر تأثيرًا إيجابيًا مباشرًا على التنفيذ الناجح للمشروعات الإنشائية من حيث التكلفة والجودة ووقت التنفيذ في الشركات التي شملها البحث. لذلك توصي الدراسة بأن يحظى تخطيط الخدمات اللوجستية باهتمام كبير من الإدارة العليا لشركات المقاولات والشركات العاملة في المجالات الأخرى.

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List of Abbreviation

ANN	Application of Artificial Neural Network
APM	Association for Project Management
AVE	Average Variance Extracted
B2B	Business to Business
B2C	Business to Consumer
BIM	Building Information Modelling
CB-SEM	Covariance Based Structural Equation Model
CCSAP	Construction Components Storage Areas Planning
CR	Composite Reliability
CSCMP	Council of Supply Chain Management Professionals
EDI	Electronic Data Interchange
EPOS	Electronic Point of Sales
GA	Genetic Algorithms
GDP	General Domestic Product
GIS	Geographical Information System
HTMT	Heterotrait-Monotrait
ICT	Information and Communication Technologies
IS	Information Systems
IT	Information Technology
LMNN	Levenberg–Marquardt Learning Algorithm
MiC	Modular Integrated Construction
NCPDM	National Council of Physical Distribution Management
OED	Oxford English Dictionary
R^2	Coefficient of Determination
PLS	Partial Least Square
PLS-SEM	Partial Least Square Structural Equation Model
PM	Project Manager
PMI	Project Management Institute
SCM	Supply Chain Management
SEM	Structural Equation Model
TPM	Traditional Project Management
UK	United Kingdom
US	United State
USD	United State Dollar
VRA	Volta River

Chapter One

General Introduction

Chapter One

General Introduction

1.1 Background of the Study

The construction projects in Khartoum State have seen considerable growth. This pushes the progressive organizations in the construction sector to embark on a journey where concepts and principles of executing project management are applied.

Additionally, construction projects are considered fundamental for any society. They reflect on the modernity and development of the society and country. Besides, the need for new construction projects is never-ending, as the need for homes, roads, hospitals, and other structures of construction projects is never-ending.

For the successful implementation of construction projects, a perfect flow of materials, services, and information related to it is required. Since providing projects with those essential needs lies within the concept of logistics management, there is a critical need to develop perfect planning for logistics services.

Logistics services play an important role in the execution of construction projects. Logistics management is basically concerned with the provision of required materials, goods, services, and information to the consumers, in this case, the construction projects, as they are considered one of the main consumers of the different materials provided by logistics management.

The supply of construction requirements must be conducted and handled in the best manner with all the related aspects including quality, safety, time, and optimal location to ensure the proper execution of construction projects. Numerous projects fail or get terminated due to problems in the flow of logistics services. These problems occur due to several factors, but improper planning of the logistics services is the most important one.

Thus, there is a great need for the logistics supply service to implement construction projects, as the failure to deliver construction inputs in the required manner to the location of the project will result in the failed execution of the project. To provide the required inputs in the best manner and at the required time, there must be proper planning for the logistics services of the projects: Specifically, there must be a greater concern for the processes of purchasing, transporting, and storing of all materials used in the execution of projects, as well as the handling and flow of information. These shall be investigated and discussed in this research.

1.2 Statement of Problem

This research attempts to discuss and find solutions for the problems faced in the execution of construction projects in the residential complexes of Khartoum State. These projects face numerous difficulties that affect their execution processes in terms of cost, time, and quality. The implementation of most construction projects takes several years, and this raises a need for the accurate planning of everything

related to the execution process. Evidently, logistics services are considered one of most important aspects that affect the execution process of construction projects. Thus, logistics services need to be properly and professionally planned for better execution of construction projects. In a country like Sudan with an unstable economic situation, an instability tends to arise in the prices of supplied materials, cost of transportation, and other related aspects that affect the project cost and follow the change in prices of materials like cement, steel, and aggregate. So, suitable and accurate planning is crucial for all aspects of logistics related to the construction project such as the procurement, transportation, handling, and storage, as well as information flow, to remove or minimize the negative effect of instability in the project execution. Thus, this research attempts to study the impact of logistics services planning on the success of construction projects in Khartoum State, specifically residential complexes, to show how logistics services can improve the quality and decrease the cost and time of executing construction projects.

1.3 Research Aims and Objectives

The following are the general aims of this study:

I. To develop a theoretical framework for the assessment and exploration of an important factor for the critical success of construction projects.

II. To develop the concept of planning for the logistics services of a project to obtain the best method that ensures the effective flow of logistics services for the implementing construction projects in Khartoum State.

III. To create a formulation of logistics services planning that could be implemented to direct the execution process of projects.

IV. The researcher hopes that this research adds to the growing knowledge base of the project management by designing a framework that can better analyze and present solutions to help develop implemented logistics services planning and make the perfect operational decision, which would allow organizations in Khartoum State to implement projects in the best way and as planned.

Further, the following are the objectives of the research:

I. To identify the extent to which logistics planning for materials of construction projects affects the time, cost, and quality of the final project outputs in the surveyed companies.

II. To identify the extent to which logistics planning for materials of construction projects affects the logistics strategy management of the projects in the surveyed companies.

III. To identify the extent to which logistics strategy management for materials of construction projects affects the time, cost, and quality of the final project outputs in the surveyed companies.

IV. To identify the extent to which logistics strategy management contributes to the control of effective and efficient consumption of resources and control of defects.

V. To identify the extent to which the application of lean logistics in construction projects affects the quality of the relationship between logistics strategy management and the success of construction projects in the surveyed companies.

1.4 Research Questions

To achieve all these objectives, this study will attempt to answer the following questions:

I. To what extent does the logistics services planning affect the time, cost, and quality of the execution of constructions projects of the researched companies?

II. To what extent does the logistics planning of transportation, procurement, and storing, as well as handling and flow of information, affect the logistics strategy management of the researched companies?

III. What is the impact of logistics strategy management on the execution of construction projects in Khartoum State?

IV. Does logistics strategy management mediate the relationship between logistics service planning and execution of construction projects?

V. Does the adoption of lean logistics as a moderator variable affect the quality of the relationship between logistics strategy management and execution of construction projects?

1.5 Research Hypotheses

This study is concerned with the concept, value, and importance of logistics services planning for construction projects. Thus, the hypotheses of this study are developed to show the effect of logistics planning on the perfect execution of construction projects related to residential complexes in Khartoum State in terms of their cost, time, and quality. Further, the study will show how logistics strategy management works as a mediator variable in the relationship between logistics planning and the perfect execution of construction projects. Finally, the study will discuss the moderator role of lean logistics in the relationship between logistics strategy management and the perfect execution of construction projects.

For these, the study developed the following hypotheses:

1- There is a positive relationship between logistics planning and the successful execution of construction projects in terms of the time, cost, and quality of these projects.

2- There is a positive relationship between logistics planning and logistics strategy management.

3- There is a positive relationship between logistics strategy management and the successful execution of construction projects in terms of the time, cost, and quality of the project.

4- Logistics strategy management mediates the relationship between logistics planning and the successful execution of construction projects in terms of their time, cost, and quality.

5- Lean logistics moderates the relation between logistics strategy management and the successful execution of construction projects.

1.6 Research Methodology

For the purpose of this research, the researcher has adapted the descriptive-analytical approach by obtaining data from secondary and primary sources and shall basically use a questionnaire as a tool for the collection of research data. The research population comprises all the staff working in the field of logistics services in construction projects in Khartoum State, especially the residential complexes. They will mainly hail from the ten main logistics services companies in the area, which is estimated as 220 individuals. A purposive sample will be chosen for the survey and data collection. Moreover, an in-depth investigation of project and logistics management will be conducted; i.e., the foundations of project management and logistics service planning will be discussed for scientific analysis. This investigation will be based on the field's current and previous issues and problems

to develop logical and actual concepts about the factors that affect the execution of construction projects in the Khartoum State and will suggest applicable solutions to overcome them. Finally, an intellectual analysis will be used to classify the definition, identify processes, and make a value judgment that is concerned with the issues and field studies of project management and logistics services planning.

1.7 Limitation of the Study

The thesis will mainly focus on logistics planning and logistics strategy management during the preparation and execution of the construction projects including planning and performing of purchasing inputs, transporting and handling of materials, and the storage environment. It will focus on the construction projects in Khartoum State, especially the residential complexes, as the costs of materials used in executing projects are not stable, and there is a need for perfect planning to ensure delivery at the required time and quality. Thus, this research will only be concerned with the logistical aspects that affect the execution of construction projects of the residential complexes in Khartoum State.

1.8 Research Division and Context

This research comprises six chapters that are titled as follows: Chapter One: General Introduction; Chapter Two: Literature Review; Chapter Three: Theoretical Framework and Research Hypotheses; Chapter Four: Research Methodology; Chapter Five: Data Analysis; and Chapter Six: Conclusion and Recommendations.

Chapter Two

Literature Review

Chapter Two

Literature Review

2.1 Overview

This chapter discusses the concepts of logistics and logistics management, as well as supply chain management. Following these, the concept of project and project management will be discussed. Finally, the previous studies will be examined at the end of this chapter.

2.2 Logistics and Supply Chain Management Background

Christopher (2011) states that

> Logistics and supply chain management are not new ideas. From the building of the pyramids to the relief of hunger in Africa, the principles underpinning the effective flow of materials and information to meet the requirements of customers have altered little. Throughout the history of mankind, wars have been won and lost through logistics strengths and capabilities – or the lack of them. It has been argued that the defeat of the British in the American War of Independence can largely be attributed to logistics failure. (p. 1)

He (2011) further adds,

> In the Second World War, logistics also played a major role. The Allied Forces' invasion of Europe was a highly skilled exercise in logistics, as

was the defeat of Rommel in the desert. Rommel himself once said that ‘before the fighting proper, the battle is won or lost by quartermasters. However, whilst the Generals and Field Marshals from the earliest times have understood the critical role of logistics, strangely, it is only in the recent past years that business organizations have come to recognize the vital impact that logistics management can have in the achievement of competitive advantage. (p. 1)

Christopher (2011) introduces the definition of logistics as

There are many ways of defining logistics, but the underlying concept might be defined as:

Logistics is the process of strategically managing the procurement, movement, and storage of materials, parts, and finished inventory (and the related information flows) through the organization and its marketing channels in such a way that current and future profitability are maximized through the cost-effective fulfilment of orders. (p. 2)

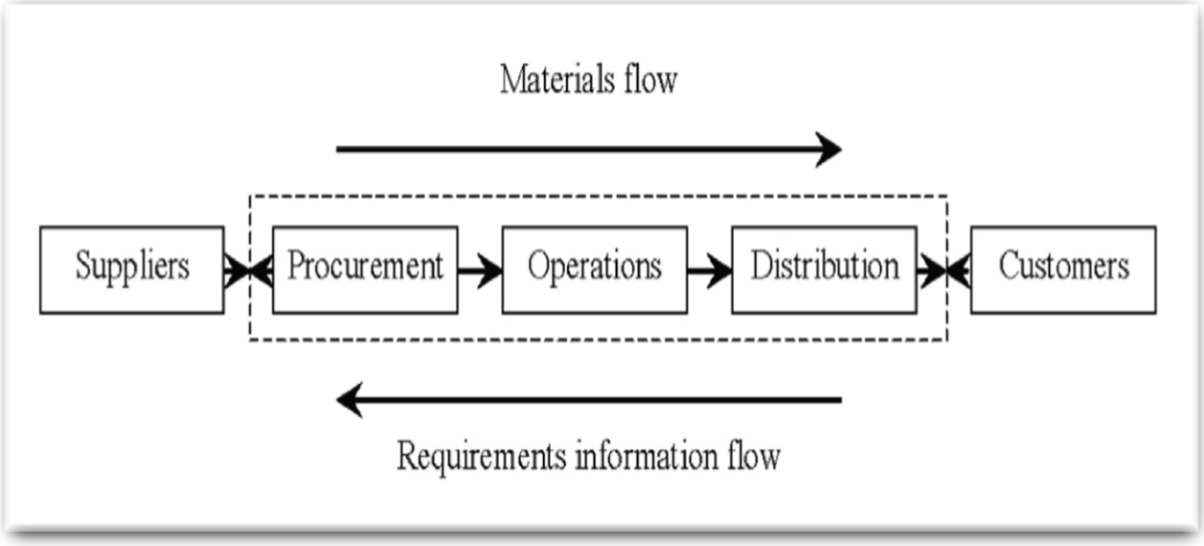

Figure 2.1: *Logistics Management Process. Note.* Adapted from Christopher (1998).

Furthermore, Christopher (2011) describes supply chain management as follows:

Supply chain management is a wider concept than logistics: Logistics is essentially a planning orientation and framework that seeks to create a single plan for the flow of products and information through a business. Supply chain management builds upon this framework and seeks to achieve linkage and co-ordination between the *processes* of other entities in the pipeline, i.e., suppliers and customers, and the organization itself. Thus, for example, one goal of supply chain management might be to reduce or eliminate the buffers of inventory

that exist between organizations in a chain through the sharing of information on demand and current stock levels.

It will be apparent that supply chain management involves a significant change from the traditional arm's-length, even adversarial, relationships that so often typified buyer/supplier relationships in the past. The focus of supply chain management is on co-operation and trust and the recognition that, properly managed, the 'whole can be greater than the sum of its parts'. (p. 2)

He (2011) defines supply chain management as follows:

The definition of supply chain management adopted in this book is: 'The management of upstream and downstream relationships with suppliers and customers in order to deliver superior customer value at less cost to the supply chain as a whole.

Thus, the focus of supply chain management is upon the management of *relationships* in order to achieve a more profitable outcome for all parties in the chain. This brings with it some significant challenges since there may be occasions when the narrow self-interest of one party has to be subsumed for the benefit of the chain as a whole.

Whilst the phrase 'supply chain management' is now widely used, it could be argued that it should really be termed '*demand chain*

management' to reflect the fact that the chain should be driven by the market, not by suppliers. Equally, the word 'chain' should be replaced by '*network*' since there will normally be multiple suppliers and, indeed, suppliers to suppliers, as well as multiple customers and customers' customers to be included in the total system. (p. 3)

2.3 Definition of Logistics

Prior to defining logistics, it is crucial to confirm that there are several terms used to denote the word "logistics." Waters (2003) clarifies that

Unfortunately, people use many different terms to describe aspects of logistics. Even something as basic as a 'supply chain' may be called a 'process' when emphasizing operations, a 'marketing channel', 'logistics channel,' or 'distribution channel' when emphasizing marketing, a 'value chain' when considering added value, a 'demand chain' to show how customer demand is satisfied, or a 'supply network' or 'supply web' to emphasize its complexity. The variety of terms can be confusing, but each gives a subtle difference in meaning.

Whatever names we give to different logistics activities, the important point is that they combine to form an essential function in every organization. Christopher emphasizes this broad importance by saying that 'Logistics has always been a central and essential feature of all

economic activity.' Shapiro and Heskett agree, saying that 'There are few aspects of human activity that do not ultimately depend on the flow of goods from point of origin to point of consumption. (p. 4)

The several different terms used to describe "logistics" will help us deal with the concepts and definitions of logistics.

Furthermore, the concept of logistics has been explained by Waters (2003) as follows:

> All organizations move materials to support their operations. These materials are both tangible (such as raw materials, components, finished goods, and spare parts) and intangible (predominantly information). Logistics is the function responsible for these movements; it manages the transport and storage of materials on their journey from original suppliers through supply chains and on to final customers. (p. 4)

Besides, Waters (2003, p. 4) confirms that "In practice, the terms 'logistics' and 'supply chain management' are used interchangeably."

Thus, the definition of "logistics" in different terms will be introduced and analyzed to understand the basic concept of logistics services.

The Institute of Logistics (1998) defines logistics as "Logistics is the time related positioning of resources, or the strategic management of the total supply chain."

Matooke and Methanivesana (2012, p. 9) have also adapted numerous definitions for "logistics" as "according to the Oxford English Dictionary (OED), logistics includes the 'assembling of supplies, stores, quarters necessary for the support of troop movements, expeditions …'." Conversely, the Chartered Institute of Logistics and Transport (2006) in the UK defines logistics as the procedure of designing and managing supply chains including purchasing, manufacturing, storage, and transport.

The comprehensive definition of logistics given by Taylor (1997) was developed by the US Council of Logistics Management in 1986 as

> The process of planning, implementing, and controlling the efficient, cost-effective flow and storage of raw materials, in-process inventory, finished goods, and related information from point of origin to point of final consumption for the purpose of conforming to customer requirements.

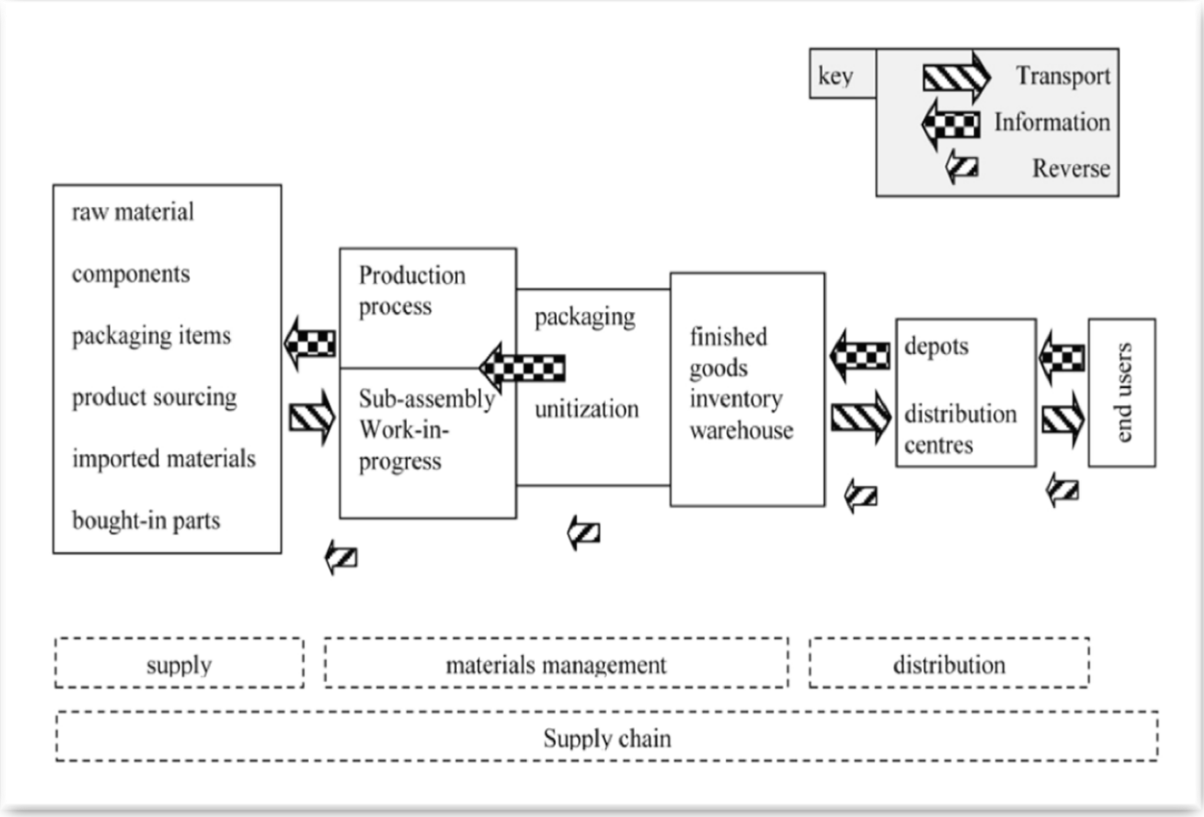

Figure 2.2: *The Configuration of Key Components of Logistics.* Rushton et al. (2006, p. 5)

Further, Matouzko and Methanivesana (2012, p. 9) agree that "logistics management and supply chain management are essentially synonymous terms involving the systematic and holistic approach to managing the flow of materials and information from its raw material state to the end-user's consumption."

Supply chain management has also been defined by the Council of Supply Chain Management Professionals (CSCMP) (The Logistics Handbook A Practical Guide for the Supply Chain Management of Health Commodities, 2011) as:

Supply chain management encompasses the planning and management of all activities involved in sourcing and procurement…and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third party service providers, and customers. In essence, supply chain management integrates supply and demand management within and across companies. (p. 1).

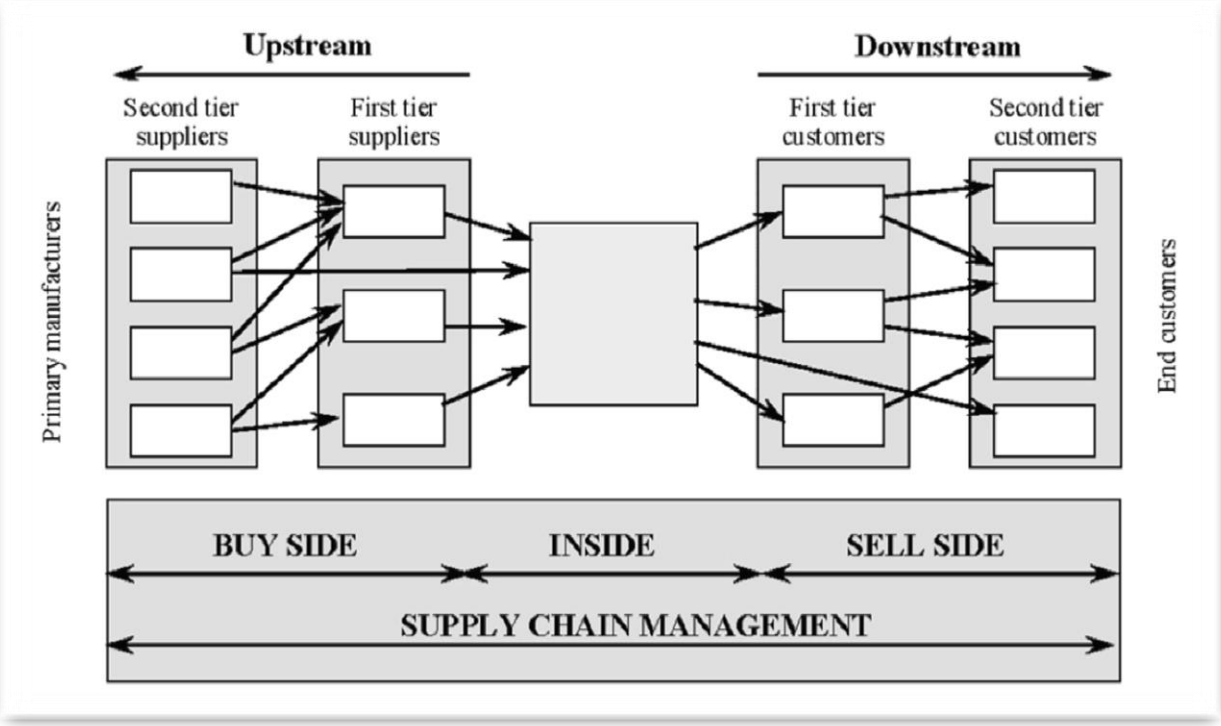

Figure 2.3: *Relationships in the Supply Chain. Note.* Adapted from Harrison & Hoek (2005, p. 9)

Moreover, Yung, (2005) explained the whole logistics system and process as follows:

> Logistics services comprise physical activities (e.g., transport, storage) as well as non-physical activities (e.g., supply chain design, selection of contractors, freightage negotiations). Most activities of logistics services are bi-direction. Information systems include modelling and management of decision making, and more important issues are tracking and tracing. It provides essential data and consultation in each step of the interaction among logistics services and the target stations. Infrastructure comprises human resources, financial resources, packaging materials, warehouses, transport, and communications. Most fixed capital is for building those infrastructures. They are concrete foundations and basements within logistics systems. (p. 1659)

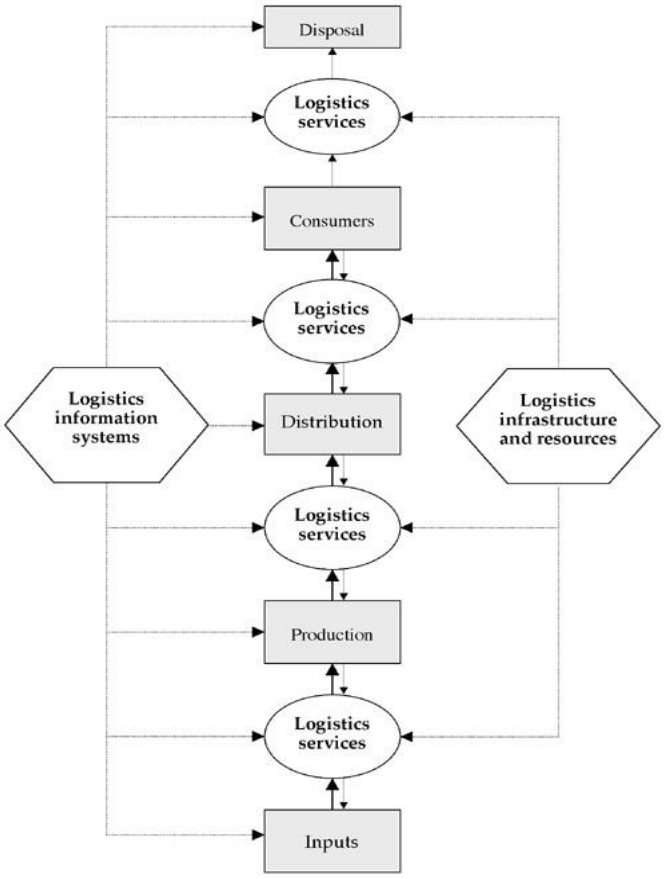

Figure 2.4: *Overview of a Logistics System. Note.* Adapted from BTRE (2001)

So, "logistics" can be described as the part of management that is concerned with the process of acquiring, transferring, storing, and distributing all the elements of production or final goods from the original producers to the final users directly or indirectly (through an intermediate party), whether those elements are primary raw material, work in process, inventory, information, final products, or even supplies and equipment.

2.4 Importance of Logistics and Supply Chain Management

As mentioned, several scholars have suggested that logistics and supply chain carry the same meaning. Thus, the concept and importance of Logistics and Supply Chain Management need more explanation, clarification, and emphasis.

Waters (2012, p. 24) describes logistics management as "essentially [being an] integrative process that seeks to optimize the flow of materials and supplies through the organization and its operations to the customer."

Further, he (2012, p. 24) defines logistics management as "essentially a planning process and an information-based activity. Requirements from the marketplace are translated into production requirements and then into material requirements through this planning process."

This explanation provides us with the "operational process of logistics," that is, we understand that the requirements are obtained through the marketing process. The marketing department makes its marketing research and segmentation, and then determines the needs and wants of the target market customers. Following this, the marketing information is sent to the management of an organization, which, in turn, transfers it to the production department, which works to produce the required final products that satisfy the customers' needs.

It is imperative for the production department to have a continuous, progressive flow of raw materials, supplies, and other inputs of the production to

fulfill the requirements of customers. This process, on the one hand, needs planning for acquiring raw materials from the suppliers. Thus, logistics planning is critical in providing the organization with the basic requirements. Consequently, it is clear that the logistics process has two basic directions: The first moves from the source of raw materials, relates to the provision of procurement or purchase, and is achieved by the purchasing department, and the second moves from the organization to its customers, and can be served by the distribution and marketing departments.

This simple explanation has been supported by Lu, (2011, p. 9) who said that the "Supply chain is basically a group of independent organizations connected together through the products and services that they separately and/ or jointly add value on in order to the end customer."

He (2011) further denotes that supply chain management is considered a modern branch of management by saying that

> …over the last three decades, the concept and theory of business management have undergone profound changes and development. Many old ways of doing business have been challenged and many new ideas and approaches have been created, among them are business process re-engineering, strategic management, lean thinking, agile manufacturing, balanced scorecard, blue ocean strategy, just to name a few. Supply chain management is undoubtedly one of those new and

well-grown management approaches emerged and rapidly developed across all industries around the world. (p. 8)

He (2011) then identified the history of the term, supply chain management; in this respect, he argued that

> The earliest appearance of the term ‘supply chain management’ as we know it today published in recognizable media and literatures can be traced back to the early 1980s. More precisely, it first appeared in a Financial Time article written by Oliver and Webber in 1982 describing the range of activities performed by the organization in procuring and managing supplies. However, the early publication of supply chain management in the 1980s were mainly focused on purchasing activities and cost reduction related activities. The major development and the significant increases of publications in the areas of supply chain integration and supplier-buyer relationship came in 1990s when the concept as we know it today was gradually established.
>
> It is therefore clear that supply chain management is not one of the legacy academic subjects existed for hundreds or thousands of years, but rather a young and event nascent subject. It is only recently that business world started making use of this concept. So, the question is “why now?” A convincing answer to this question is that your business

> environment has changed, which includes globalization, more severe competition, heightened customer expectation, technological impact, and geopolitical factors, and so on. Under such a renewed business environment, an organization-focused management approach is no longer adequate to deliver the required competitiveness. Managers must therefore understand that their businesses are only part of the supply chains that they participated and it is the supply chain that wins or loses the competition.
>
> Thus, the arena of competition is moving from 'organization against organization' to 'supply chain against supply chain'. The survival of any business today is no longer solely dependent on its own ability to compete but rather on the ability to cooperate within the supply chain. The seemingly independent relation between the organizations within the supply chain becomes more interdependent. You "sink or swim with the supply chain." It is for this reason that gives rise to need for supply chain management. (p. 8)

Lu's concept implies that supply chain management, although a modern branch of management, is considered one of the most important branches of management.

To prove this, let us analyze the concept of logistics and supply chain management as developed by Lu and other scholars of this branch of management.

Lu says about supply chain management,

> The major development and the significant increases of publications in the areas of supply chain integration and supplier-buyer relationship came in 1990s when the concept as we know it today was gradually established.
>
> It is therefore clear that supply chain management is not one of the legacy academic subjects existed for hundreds or thousands of years, but rather a young and event nascent subject. It is only recently that business world started making use of this concept. So, the question is "why now?

Lu wonders why the supply chain management was developed in the recent years and how it became important.

This question has been answered by Lu himself as

> A convincing answer to this question is that your business environment has changed, which includes globalization, more severe competition, heightened customer expectation, technological impact, and geopolitical factors, and so on. Under such a renewed business

environment, an organization-focused management approach is no longer adequate to deliver the required competitiveness.

Lu attaches numerous reasons to the appearance of supply chain management, which are mentioned above.

However, the important fact is that supply chain management is not entirely a recent or modern branch of management; it is one of the oldest management branches. One can wonder why.

The rational answer is that even in the past, people have been practicing the elements of supply chain management. No one can deny that people have been transporting and transferring their materials and supplies from time immemorial. Besides, they have been purchasing and storing their products and goods for the past several decades. Thus, this easily confirms that the supply chain is not a newly established or discovered branch of management, but rather an organized and developed one. Further, one may wonder, what it means to be organized and developed.

The answer is that it is clear that people knew about supply chain management from early history. However, it was not known as an independent branch of management till the last three decades as approved by Lu.

So, the key word of our answer is “independent”. When we confirm that the people did not know about supply chain management being an independent branch of management, we mean many things:

First: people have applied supply chain management into practice for a long period of time.

Second: the practice of supply chain management had been through and under other branches of management like marketing and manufacturing, and there was no application of supply management as an independent branch of management, but, at the same time, it also means that supply chain management was not applied at that time.

Third: the scholars of supply chain had, just recently, started to deal with supply chain management as an independent branch of management and had organized and developed several theories for this branch of management.

Waters (2003) supports our concept by saying

> …there is a long history of organizations paying little attention to their logistics. They traditionally put all their effort into making products, and then considered the movement and storage of materials as an uninteresting chore that formed part of the overheads of doing business. In 1962, Drucker described physical distribution as ‘the economy’s

> dark continent' and said that this formed 'the most sadly neglected, most promising area of…business' (Drucker, 1962). (p. 4)

Besides, this proves the concept by using the words and terms that were used to describe "logistics" and "supply chain" by the numerous scholars and through the transfer of what was written by Waters (2003) as follows:

> Unfortunately, people use many different terms to describe aspects of logistics. Even something as basic as a 'supply chain' may be called a 'process' when emphasizing operations, a 'marketing channel', 'logistics channel,' or 'distribution channel' when emphasizing marketing, a 'value chain' (Porter, 1985) when considering added value, a 'demand chain' to show how customer demand is satisfied, or a 'supply network' or 'supply web' to emphasize its complexity (Waters, 2003). The variety of terms can be confusing, but each gives a subtle difference in meaning. Whatever names we give to different logistics activities, the important point is that they combine to form an essential function in every organization. Christopher (1986) emphasizes this broad importance by saying that 'Logistics has always been a central and essential feature of all economic activity.' Shapiro and Heskett (1985) agree, saying that 'There are few aspects of human

> activity that do not ultimately depend on the flow of goods from point of origin to point of consumption. (p. 4)

It is clear that Waters confirms that the basic term of "logistics" is also known as "supply chain". And, we should first acknowledge that here, Waters addresses what people accept to describe "logistics" as the modern branch of management.

He then confirms that

> Even something as basic as a 'supply chain' may be called a 'process' when emphasizing operations, a 'marketing channel', 'logistics channel' or 'distribution channel' when emphasizing marketing, a 'value chain' (Porter, 1985) when considering added value, a 'demand chain' to show how customer demand is satisfied.

It can be noted that several terms are used to describe supply chain such as "process" when people are describing operation management, "marketing channels," "logistics channels," or "distribution channels" when they speak about marketing management, and "value chain" when considering added value. This proves our concept that people have known about and practiced supply chain management for a long period of time, but it was under other branches of management and the independent concept of the same has been organized and developed in the last three decades.

However, this leads to another question: if people knew and practiced supply chain management through the application of that concept and under other branches of management, then why did they develop it as an independent branch of management? In other words, why did they need to separate it from the other branches of management?

This question has been answered by Waters (2003) in the following manner:

> Whatever names we give to different logistics activities, the important point is that they combine to form an essential function in every organization. Christopher (1986) emphasizes this broad importance by saying that 'Logistics has always been a central and essential feature of all economic activity.' Shapiro and Heskett (1985) agree, saying that 'There are few aspects of human activity that do not ultimately depend on the flow of goods from point of origin to point of consumption.'
>
> Despite this importance, there is a long history of organizations paying little attention to their logistics. They traditionally put all their effort into making products, and then considered the movement and storage of materials as an uninteresting chore that formed part of the overheads of doing business. In 1962, Drucker described physical distribution as 'the economy's dark continent' and said that this formed 'the most sadly neglected, most promising area of…business' (Drucker, 1962).

After this, organizations began to realize that logistics can be expensive, and they gave it more attention. This was not easy, as Ray noted in 1976 that 'The whole area [of logistics costing] is clouded with ad hoc approaches and untidy accounting procedures, to which there appears little underlying systematic ideology.' At the same time, Little (1977) said that 'Identifying logistics costs through accepted accounting statements in the firm is very misleading.'

Many projects were started to find the 'total cost' of logistics, and by the 1980s, surveys by, for example, McKibbin (1982), Ray, Gattorna, and Allen (1980), Firth *et al.* (1980), and Delaney (1986), suggested that logistics generally account for 15–20 percent of costs. However, as late as 1994, Hill could still say that 'many distributors are unaware of the costs of the distribution service they provide'.

Taking overall figures for, say, the United States, the Gross Domestic Product (GDP) is $10 trillion, so $2 trillion dollars a year might be spent on logistics, with half of this for transport (US Statistical Abstract, 2001). We should, however, interpret such figures carefully as there are alternative views. The UK government, for example, says that 12 percent of the GDP comes from wholesale and retail trades and 6 percent comes from transport and storage (Office of National Statistics,

2001). This suggests that overall logistics costs are considerably higher – perhaps supporting an earlier estimate by Childerley (1980) that logistics accounted for 32.5 percent of the UK GDP. The status of logistics has continued to improve, and by 1996, a survey by Deloitte and Touche in Canada (Factor, 1996) showed that 98 percent of companies considered supply chain management to be either 'critical' or 'very important'. The same survey emphasized the rate of change of logistics, with over 90 percent of organizations either currently improving their supply chain or planning improvements within the next two years. The main pressures for this changing view of logistics can be summarized as follows:

• Recognition that logistics is an essential function in every organization, and that it directly affects overall performance.

• Realization that decisions about the supply chain can have a strategic significance.

• Appreciation of the high cost of logistics and the opportunity for major savings.

• Growing emphasis on customer service, and the way this depends on logistics.

• Increasing competition for both users and providers of logistics, who have to continually improve operations to remain competitive.

• New types of operations, which can force changes to logistics – such as just-in-time, total quality management, flexible operations, mass customization, lean operations, and time compression.

• Improved communications allowing electronic data interchange (EDI), business to business (B2B), business to consumer (B2C), and other aspects of e-commerce.

• Improved technology such as item coding, electronic point of sales (EPOS), and global positioning for identifying, locating, and tracking materials.

• A general trend towards integration of operations, including strategic alliances, partnerships, and collaboration.

• More organizations concentrating on their core operations and outsourcing logistics to third parties.

• More organizations adopting a process focus, with logistics as an integral part of the whole process of satisfying customer demand.

• Changing patterns of power in the supply chain, with large organizations dominating some areas and setting prevailing standards.

• Growing concern for environmental damage, and changing attitudes towards pollution, waste, traffic congestion, road building and so on.

• Changing government policies on the ownership, regulation, use, responsibilities and cost of transport.

• Sustained growth of international trade, particularly through free trade areas such as the European Union and North American Free Trade Agreement. (pp. 4-6)

It will be enough to show that the survey by McKibbin (1982), Ray, Gattorna, and Allen (1980), Firth *et al.* (1980), and Delaney (1986) suggested that logistics generally account for 15–20 percent of costs to answer the question of why logistics is developed to be an independent branch of management.

Furthermore, report shows that in "the United States, the Gross Domestic Product (GDP) is $10 trillion, so $2 trillion dollars a year might be spent on logistics, with half of this for transport" (US Statistical Abstract, 2001).

Also, The UK government, for example, says that "12 percent of the GDP comes from wholesale and retail trades and 6 percent comes from transport and storage (Office of National Statistics, 2001)". (Water, 2003, Global Logistics and Distribution Planning, pp. 4-6)

Thus, these reports and surveys confirm the great economic importance of logistics or supply chain management. If we take a closer look at how much the

logistics process costs the world's leading economy, which is the United States, we will be convinced that logistics management should have the first concern at any company or organization. Further, it also confirms that the decision to deal with "logistics" as an independent branch of management was late for decades, if not centuries.

In addition to the economic importance of logistics, it has other managerial importance. Jaafar (2006) says that

> Since it was given attention in the early 1970s, the concept of logistics customer service remains important until today (Stock and Lambert, 2001; Miyazaki et al., 1999; Kent and Flint, 1997). Much of the influence in developing the concept in the early 1970s to mid-1980s came from the operations management, management science, and to some extent, marketing (Kent and Flint, 1997). The importance of customer service and satisfaction in logistics can be viewed from chronological perspectives. (p. 24)

In this quotation, Jaafar identifies the importance of logistics in the field of operation and marketing management. Further he (2006) details the importance of logistics in marketing as

> In the early years of the "customer-focus" era, companies realized that in order to be successful in business, they must integrate the ideas of

having the right product, at the right price, combined with the right promotion, and available at the right place, which are the four Ps of the marketing mix (Stock and Lambert, 2001; Mentzer et al., 2001; Lambert, 1990). A company may improve their competitive position by allocating resources more effectively and efficiently to these components of the marketing mix to create a market offering, which is attractive to target customers and advances the long-run profit objectives of the company. Thus, customer satisfaction is the output of the marketing efforts of the firm in which it occurs if the firm's overall marketing effort is successful (Lambert and Stock, 1993). Similarly, customer service represents the total output of the logistics system and the key to integrating marketing and logistics. It acts as the binding and unifying force for the total logistics supply chain of warehousing, transportation, inventory management, and order processing and related information flows (Padzie et al., 2005; Stock and Lambert, 2001; Lambert and Stock, 1993; Mentzer et al., 1989). (p. 24)

Thus, we can deduce that logistics and supply chain management are very significant aspects for the success of any company or organization, as they become the main trend of competition, as well as decrease the cost of the whole company or organization's operations if managed in the best way.

2.5 Difference between Logistics and Supply Chain Management

Although several scholars believe that logistics and supply chain carry the same meaning, there are many others whose opinions differ. Since it relates to scientific research, both ideas must be viewed and discussed to derive the best results.

Christopher (2011) described the difference between logistics and supply chain management by saying that

> Logistics is essentially a planning orientation and framework that seeks to create a single plan for the flow of products and information through a business. Supply chain management builds upon this framework and seeks to achieve linkage and co-ordination between the *processes* of other entities in the pipeline, i.e., suppliers and customers, and the organization itself. Thus, for example, one goal of supply chain management might be to reduce or eliminate the buffers of inventory that exist between organizations in a chain through the sharing of information on demand and current stock levels.
>
> It will be apparent that supply chain management involves a significant change from the traditional arm's-length, even adversarial, relationships that so often typified buyer/supplier relationships in the past. The focus of supply chain management is on co-operation and

trust and the recognition that, properly managed, the ‘whole can be greater than the sum of its parts. (p. 3)

Farahani et al. (2011) identified the differences between logistics and supply chain as

We defined logistics and mentioned its importance. It is now generally agreed that for better planning and to realize the real benefits of logistics, its logic should be extended upstream to suppliers and downstream to final customers.

In managing a supply chain, factors such as partnership and the degree of linkage and coordination between chain entities are considered. Rushton et al. mentioned four differences between classic logistics and supply-chain management:

I. From systematic point of view, the supply chain is viewed as a whole rather than as a series of distinguished elements such as procurement, manufacturing, and distribution. Moreover, both suppliers and end users are included in the planning process.

II. Supply-chain management is a highly strategic planning process, based on strategic decisions rather than operational ones.

III. Supply-chain management has another view of inventory. Instead of bulking large inventories in a traditional way as a safety stock for

each entity in a chain, supply-chain management uses inventory as a last resort to balance the integrated flow of product through the chain.

IV. In a supply chain, it is crucial to construct an integrated information system in which all entities have access to information on demand and stock levels. If a supply chain was going to be the sum of entities, not their integration, this flow of information would not have existed, while it is a necessity for the success of the chain. (pp. 45-46)

Based on the above, we can say that logistics management concerns with the process of material management, storage, and material distribution management process from the supplier to the consumer. Whereas, supply chain management includes managing relations with those basic suppliers, even those who do not directly deal with the organization and the final consumers. The differences in the two concepts arise, as logistics management concerns with material management, coordination of the flow of materials from the supplier to the organization stores and from stores to the manufacturing units until the final products reach the stores, and the final consumers who may be regional stores owned by organization, part sale distributor, or personal consumer. On the other hand, supply chain management goes further and concerns with the primary sources of materials, even those that do not directly deal with the organization. And, in terms of distribution, it concerns with

the final users of the products, even those who are not direct customers who buy products from the organization.

Furthermore, it is crucial to confirm that the distinction between the two depends on the nature of the organization itself. Many organizations run their work such that it is very difficult to separate the duties and tasks done by the logistics department from those done by the supply chain department. And this forces even those scholars who adapt the idea of distinction between the two to agree to adapt to the idea that the two can be used interchangeably as well.

Finally, we can say that the two are different branches of management and each has its own tasks and works that serve identified purposes, but the idea of using them interchangeably is not totally rejected, as sometimes, same tasks are done by both branches and also because logistics itself is considered a part of supply chain.

2.6 Concept of Project and Project Management

For the purpose of this study, it is imperative that the general concept and background of the terms, project and project management, be discussed. This background shall help understand the nature of project and project management and make clear overview that helps develop variables for the discussion of the effect of Logistics Planning Variables on the variables of the Construction Project. Furthermore, Kerzner (2001) describes the importance of project management by saying

> Project management came to be recognized as a process that would increase organization value. It allows organizations to lower their cost of operation by accomplishing more work in less time and within fewer resources without any scarify in quality. And, also, it increases profitability. (pp. 1-2)

2.6.1 Definition of Project

The Oxford Dictionary (2006, p. 1162) defines the word "Project" to explain and describe different situations: in terms of planned work as "A planned piece of work that is designed to find information about something, to produce something new, or improve something"; in terms of school or college work as "A piece of work involving careful study of a subject over a period of time, done by school or college students"; and with regard to the set of aims or activities as "Project is a set of aims, ideas, or activities that somebody is interested in or wants to bring to people's attention."

Furthermore, Project Management Institute (PMI) (2008, p. 5) has defined project as "Project is temporary endeavor undertaken to create a unique product, service, or result."

This definition does not differ from the one developed by the Association for Project Management (APM), which defines Projects as "Projects are unique,

transient endeavors undertaken to achieve a desired outcome." (Association for Project Management Body of Knowledge, 2006, p. 2)

Yet another definition of project developed by Meredith and Mantel is that "A project is a specific, finite task to be accomplished." (Project Management A Managerial Approach, 2009, p. 9)

Further, Wysoki and McGray defined project as "A project is a sequence of unique, complex, and connected activities having one goal or purpose and that must be completed by a specific time, within budget, and according to specification." (Effective Project Management Traditional, Adaptive, Extreme, 2003, p. 3)

These definitions have affirmed that project is a work or task that needs to be planned and executed to give us a result. This may be information, product, people's attention as explained by the Oxford Dictionary; a unique product, service, or result as PMI described the goal of project to be; or even task as identified by Meredith.

Additionally, all definitions agreed that a project should have a specific time to be executed, and the result of project to be unique or new, which means it was not previously accomplished.

So, these definitions provide us with several characteristics of project which are as follows:

I. Project is a specific work, task, or activity.

II. Project should be well planned to be executed.

III. Project has a specific period of time to be executed.

IV. Project has a specific budget.

V. Project should create new or unique result.

Finally, from all these aspects and characteristics, *project may be defined as any planned work or activity that could be achieved and aimed to create a new unique product, service, or result at a specific time and within an identified budget*.

2.6.2 Definition of Project Management

APM defines project management as "Project management is the process by which projects are defined, planned, monitored, controlled, and delivered such that the agreed benefits are realized." (APM Body of Knowledge, 2006, p. 2)

PMI defines project management as "Project management is the application of knowledge, skills, tools, and techniques to project activities to meet the project requirement." (PMI Body of Knowledge, 2008, p. 5)

Both these definitions are considered as references for the term Project Management in The United States and Europe. And most project scholars build their concept of understanding project management from these definitions.

Besides, Anderson, Grude, and Haug (2009, p. 14) describes project management as "Project management establishes the foundation for project. It plans, organizes, and controls it."

It is also defined by Cleland and Ireland as “Project management is a series of activities embodied in a process of getting things done on a project, working with project team members and other stakeholders to attain project schedule, cost, and technical performance objectives.” (Project Management Strategic Design and Implementation, 2002, p. 39)

Additionally, Dennis Lock defines project management as “Project management has evolved to plan, coordinate, and control the complex and diverse activities of modern industrial, commercial and management change, and Information Technology Projects.”

Lock takes it further and explains the purpose of project management as

> The purpose of project management is to foresee or predict as many of the dangers and problems as possible and to plan, organize, and control activities so that project is completed successfully in spite of all risks. This process should start well before any resource is committed, and must continue until work is finished.

Following which, Lock states the aim of Project Manager (Project Management Dennis Lock, 2007) as

> The primary aim of project manager is for the result of satisfy project’s sponsor or purchaser and all other principal stakeholders, within the

promised time scale and without using more money and other resources than those were originally set aside or budget. (p. 1)

Further, Meredith and Mantel have supported this concept and briefly described the purpose of project management as “The basic purpose of initiating project is to accomplish specific goals. The reason for organizing the task as a project is to focus the responsibility and authority for the attainment of the goals on an individual or small group.” (Project Management A Managerial Approach, 2009, p. 12)

Thus, from all that is mentioned above, we can deduce that project management basically concerns with all the levels of the project life cycle, from the initiation until the close out of the project. And this appears when we analyze both the main definitions of project management, which are developed by APM and PMI.

APM describes project management as the process of determining the project and practicing the other functions up till the delivery of the final result of the project.

Furthermore, the definition for the same by PMI refers to the application method of knowledge, skills, tools, and techniques through the activities of projects to execute the project as required. The referred activities of the project are basically built on the function of management, i.e., Planning, Organizing, Executing, and Controlling. However, the project is distinguished by other functions, which are

initiation and close out of the project. All these functions together shape the Project Life Cycle, which will be discussed in detail in this chapter.

2.7 Project Life Cycle

Project life cycle has been defined by PMI as

> A project life cycle is a collection of generally sequential and sometimes overlapping project phases whose name and number are determined by the management and control needs of the organization or organizations involved in the project, the nature of project itself, and its area of application.

Further, PMI (PMI Body of Knowledge, 2008) identifies the process of determining the project life cycle and the output of that process as

> The project life cycle can be documented with a methodology. The life cycle can be determined or shaped by the unique aspects of the organization, industry, or technology employed. While every project has a definite start and a definite end, the specific deliverables and activities that take place in between will vary widely with the project. The life cycle provides the basic frame work for managing project, regardless of the specific work involved. (p. 15)

This idea has been strongly supported by APM, which explains project life cycle as

> Project life cycle consists of number of distinct phases. All projects follow a life cycle and life cycle differs across industries and business sectors. A life cycle allows the project to be considered as a sequence of phases, which provides the structure and approach for progressively delivered and require work.

Additionally, APM divides project life cycle into different phases as "The project life cycle phases will follow a similar high-level generic sequence: concept, definition, implementation and handover, and close out."

Furthermore, APM affirms that two other phases may be added to project life cycle in specific circumstances, and explains that "In specific circumstances, the project life cycle is replaced by an extended form. This extended life cycle includes two further phases: operations and termination." (APM Body of Knowledge, 2006, p. 80)

PMI does not differ much from this concept of dividing the project life cycle. It expresses its particular phases of project life cycle as "Starting the project, organizing and preparing, carrying out the project work, and closing the project." (PMI Body of Knowledge, 2008, p. 16)

Furthermore, Dennis Lock (2007, p. 7) briefly describes project life cycle as "The period between the beginning and end of a project is usually referred to as project life cycle."

Additionally, Meredith and Mantel (Project Management Managerial Approach, 2009) explain this view as

> Most projects go through similar stages on the bath from origin to completion. We define these stages as project life cycles. The project is born (its start-up phase) and a manager is selected. The project team and initial resources are assembled, and the work program is organized. Then, work goes under way and momentum quickly build progress is made. This continues until the end is in sight." (p. 14)

Moreover, Cleland and Ireland (Project Management Strategic Design and Implementation, 2002) have expressed their detailed explanation for project life cycle as

> Project management is a continuing process. New demands always are put on the project team and have to be coordinated by project manager through a process of planning, organizing, motivating, directing, and controlling. As new needs come up before the project, someone has to satisfy these needs, solve the problem, and exploit the opportunities. The project originates as an idea in someone's mind, take a conceptual form, and eventually have enough substance so that key decision makers in the organization select the project as a means of executing elements of strategy in the organization. In practice, the project

> manager must learn to deal with a wide range of problems and opportunities, each in different stage of evolution and each having different relationship with evolving project. This continuing flow of problems and opportunities, in continuous life-cycle mode, underscores the need to comprehend a project management process, which if effectively and efficiently planned for and executed, result in the creation of project results that complement the organization strategy. (p. 44)

Williams (2008) has given the simplest and clearest description for the project life cycle as

> The generic project life cycle is fairly simple- first you start the project (called the initiating), then you go on to actually do the project (through the planning, executing, and controlling phases, which form a loop), and finally you finish with everyone happy, a strategy for future, idea in place, and check in your hand (closing). (p.3)

So, we can deduce that each project passes through an identified life cycle. It comprises different phases that start from a specific idea in someone's mind, develops to be a plan for a needed project, and then progresses until the idea becomes a successfully executed project.

2.7.1 Project Initiation

Initiation is the first phase of the project life cycle. Oxford Dictionary defines initiation as **"**The act of starting something." (Oxford Advanced Learner's Dictionary, 2006, p. 767). This means that when we talk about initiation of a project, we mean the starting point of the project life cycle. This idea is strongly supported by PMI (2008, p. 15) as "Projects vary in size and complexity. No matter how large, simple, or complex, all projects can be mapped to the following life cycle structure: starting the project, organizing and preparing, caring out the project work, and closing the project."

Even APM (2006) addresses the initiation phase or starting of the project by using the word "concept" to describe the first phase of the project (initiation) as

> Concept is the first phase of project life cycle. During this phase, the need, opportunity, or problem is confirmed, the overall feasibility of the project is considered, and a preferred solution is identified. The business case for project will be produced in this phase. (p. 82)

This definition harmonizes with the definition of purpose of initiating phase that was developed by Williams (The Principle of Project Management, 2008), which is as follows:

> The purpose of initiating phase is to set the project for success. I often argue that it is the most important phase of the project life cycle, since

> if it is neglected, the result can be catastrophic. After all, the beginning of the project is the point at which you form with customer the contract (both formal and informal) that explains what will be delivered, roughly how it will be done, and it will be ready. (p. 43)

Although Wysocki and McGary (Effective Project Management Tradition, Adaptive, Extreme, 2003) support this concept, they used another terminology to describe project initiation, Defining, but they agree with the other scholars in the concept of this phase of the project and describe this phase as

> One of the first tasks for project managers is to define the work that needs to be done in their area of responsibility. Exactly the same task applies to people management. In project management, however, the defining phase is very formal, while in people management, it can often be informal.
>
> There is a parallel in traditional project management (TPM). For the project manager, defining the tasks to do is a preliminary phase of the project life cycle and an important one. In this phase, the requestor (also known as the customer) and the project manager come to an agreement about several important aspects of the project. Regardless of the format used, every good defining phase answer five basic questions:
>
> - What is the problem or opportunity to be addressed?

- What is the goal of the project?

- What objectives must be met to accomplish the goal?

- How will we determine if the project has been successful?

- Are there any assumptions, risks, or obstacles that may affect project success?

The defining phase sets the scope of the project. It forms the basis for deciding if a particular function or feature is within the scope of the project. (p. 18)

Moreover, both terminologies, concept and initiating, are mentioned by Dennis Lock to describe the first phase of project as "All projects begin as a concept, a gleam in the eye of their progenitor. An entrepreneur or organization recognizes the need for a project and forms an initial idea that justifies further investigation." (Project Management Dennis Lock, 2007, p. 10) By this supposition, he refers to the first phase of project as concept by saying that "All projects begin as a concept." He describes it as an initial idea by saying that "An entrepreneur or organization recognizes the need for project and forms an initial idea that justifies further investigation." Thus, concept and initiation are referred to mean the first phase of the project. Besides, Lock adapted a clearer concept of this phase; he divided it into four small phases, namely Original Concept, Feasibility Study, Business Plan, and Risk Assessment. Furthermore, he (2007) thinks that those small phases work

together to form the initiation or project concept and describes the work of those phases as

> Phases 1 to 4 comprise this formative period, which should end in proposal and a business plan that describes the project, sets out financial requirements, the intended benefits and the principal milestones. Taken together, these early phases form the initial project definition. (p. 10)

By the expression ‘phases 1 to 4,’ Lock refers to the four small phases that make up the first phase of the project (Project Concept or Project Initiation).

Another terminology for project initiation has been developed by Anderson, Grude, and Haug (2009, p. 33) who refer it as Foundation and express the operations in this phase as “The project owner in the base organization must decide what he wants from the project. He must express what the purpose of the project is: Why does the organization wish to undertake this project?”

And, after this introduction, they give some details as

> In general, the project should lay the foundation for a future desired situation for the organization. What this situation actually should look like depends fully on the organization and its preference. It may, for example, wish to be more competitive in a certain marketplace, have a better functioning organization, or have more satisfied customers. The

project owner (preferably in a dialogue with the project manager) states the purpose of the project.

Additionally, they also describe another operation that should be done during the project initiation as

> Furthermore, goals have to be set for the project. The goals should express that certain 'products' (deliverables) will be delivered within time and cost limits and with a certain quality. They should be stated in such way that when they are achieved, they contribute to the purpose of the project. Project deliverables bring the organization closer to the desired situation. There is a tight connection between the purpose and the goal of the project.

Thus, we can deduce that there are numerous terminologies used to describe the initiation phase of the project, and despite these different terminologies, they carry the same concept, which proves that initiation is the phase of the project in which the comprehensive imagination for the project's purpose, goal, time, quality, cost, and final result or product are established and determined.

2.7.2 Project Planning

Planning greatly affects the determination of the ability to achieve success in all projects, regardless of its kind. It affects the project's execution, results, and outputs. Any mistake in the planning process shall seriously cause disastrous results

for the project. Thus, due to this great importance, project planning needs to be widely discussed and emphasized.

Project planning has been defined by Cleland and Ireland as

> Project planning is the process of thinking through and making explicit the objectives, goals, and strategies necessary to bring the project through its life cycle to a successful termination when the project's product, service, or process takes its rightful place in the execution of project owner strategies.

This definition serves as a detailed expression to the definition quoted by McNeil and Hertly, which is that "Project planning is a rational determination of how to initiate, sustain, and terminate a project." (Project Management Strategic Planning and Implementation, 2002, p. 310)

Through simple expression of the planning function, which involves selecting the mission and objectives and acting to achieve them, we find that both the definitions support the functional concept of planning, i.e., both describe the process that should take place to make general planning for the enterprise or planning for a project. To make plans for the general enterprise, we should determine the mission, goals, and objectives of that enterprise, and finally, the tools of executing and achieving those goals and objectives. These processes are also followed in project planning by forming the initiation idea of the project, which includes mission, goals,

and objectives of the project, and the determination of how these should be carried out (execution of the project).

2.7.2.1 Importance of Project Planning

Planning is the most important phase for the success of any project. It interrelates with all other phases of the project, i.e., initiation, execution, and other phases of the project should be well-planned to get a successful project.

This idea has been supported by numerous scholars of project management. APM confirms this idea by explaining that "A project that properly planned will have a far greater chance of success than a poorly planned project." (APM Body of Knowledge, 2006, p. 17)

Moreover, Williams supports this idea by describing the importance of project planning as "Planning is arguably the most important phase of your project. Skimp here and you'll suffer later. But if you invest in planning, the entire project will run much more smoothly." (The Principle of Project Management, 2008, p. 53)

Additionally, Cleland and Ireland believe that planning is the responsibility of the project team, and they explain this as "The most important responsibility of project team is to develop the project plan in consort with other supportive stakeholder." Cleland and Ireland explained the importance of project planning in-depth as

> Project planning is an important part of the "deciding" aspect of the project team's job to think about the project's future in relationship to its present in such a way that organizational resources can be allocated in a manner which best suits the project's purposes. More explicitly, project planning is the process of thinking through and making explicit the objectives, goals, and strategies necessary to bring the project through its life cycle to a successful termination when the project's product, service, or process takes its rightful place in the execution of project owner strategies.

Finally, Cleland and Ireland (Project Management Strategic Planning and Implementation, 2002) go even further and describe the aim of project planning and how it should be as

> Project planning is reflective thinking about the project's future in relationship to its present role in the design and execution of enterprise strategies. The project plan must be harmonious with the strategic plan of the enterprise, the functional plans, and, where appropriate, with the plans of the relevant stakeholders. (pp. 309-310)

Furthermore, Andersen, Grude, and Haug (2009) have their own concept about the importance of project planning, which is explained as

> Planning should provide everyone involved in the project with a common understanding of the project. Planning should motivate project members for the task and provide them with a platform for cooperation. The process should stimulate the involvement of interested parties in the planning stages, as well as in the subsequent implementation of the plans. We shall go so far as to say that planning should be fun. Planning should be an opportunity to think anew and form different perspectives and to test ideas in a stimulating environment. Planning must be a group activity. If all the central project members are involved, they acquire a common insight into the project and a common understanding of future requirements. It is agreed that 80–90 percent of the time consumed in planning meetings of this kind is devoted to discussions around project content and problem solving. Only 10–20 percent is formal planning. (p.62)

Thus, one can deduce that planning is the main aspect that determines the fate of the project, i.e., perfect planning will lead to a successful project and good closing, while improper planning leads to the disastrous end of the project and great loses for the enterprise and stakeholders of the project.

2.7.3 Project Execution Monitor and Control

After completing the planning of the project, the next step is to actualize what is planned and transfer the ideas and desires to real tangible product or result. This happens in the execution phase of the project. For this to be done correctly, the monitoring and controlling processes should be interrelated with execution. Thus, all these phases shall be discussed in this section.

2.7.3.1 Definition of Project Execution

There are several definitions of project execution. PMI (2008, p. 57) defines project execution as "Direct and Manage Project Execution is the process of performing the work defined in the project management plan to achieve the project's objectives."

This concept is supported by Williams (2008, p. 77) who defines project execution as "The Executing phase of the project life cycle is all about doing the work—creating the product."

Here, we notice that Williams expresses the same idea as PMI, but differently. Rather than using "planned work" as done by PMI, he uses "project life cycle". It is common knowledge that the execution phase in project life cycle succeeds the planning phase and ensures that what is planned in the planning phase would be executed. Thus, we can confirm that the output of project planning is considered as the input of project execution.

Moreover, we notice that PMI uses the phrase, “to achieve project objectives,” rather than the phrase, “creating the product”, which is used by Williams, and in the project concept, they carry the same meaning, as the objective of the project is to obtain the specific product, service, or result.

Further, Wysocki and McGary (2003) share the same concept about the execution of the project, which is expressed as

> Executing the project plan is equivalent to authorizing your staff to perform the tasks that define their respective jobs. Each staff member knows what is expected of him or her, how to accomplish the work, and when to have it completed.

Moreover, they ensure that the execution of the project involves the process of transferring the plan of the project into action, which is expressed as

> Executing the project plan involves four steps. In addition to organizing the people who will work on the project, a project manager also needs to do the following:
>
> 1. Identify the specific resources (person power, materials, and money) that will be required to accomplish the work defined in the plan.
> 2. Assign workers to activities.
> 3. Schedule activities with specific start and end dates.
> 4. Launch the plan. (p. 20)

Thus, we can confirm that Project Execution is the process of transferring the Project Plan into action to obtain and achieve the final required product or result of the project.

2.7.3.2 Project Monitor and Control

Monitor and Control is crucial for the success of any project. This process ensures that the planned and executed work is carried out as required. Moreover, it includes the correction of any variances and incongruent works.

2.7.3.3 Definition of Project Monitor and Control

Monitoring has been defined by Meredith and Mantel (Project Management Managerial Approach, 2009) as "Collecting, recording, and reporting information concerning any and all aspects of project performance that the project manager or others in the organization wish to know."

They further ensured that there should be a differentiation between monitoring, controlling, and evaluation as

> In our discussion, it is important to remember that monitoring, as an activity, should be kept distinct from controlling (which uses the data supplied by monitoring to bring actual performance into approximate congruence with planned performance), as well as from evaluation (through which judgments are made about the quality and effectiveness of project performance). (p. 435)

On the other hand, Cleland and Ireland (2002, pp. 377-378) think that the process of control includes monitoring and evaluating as well, and describes it as "Control is the process of monitoring, evaluating, and comparing planned results with actual results to determine the progress toward the project cost, schedule, and technical performance objectives, as well as the project's "strategic fit" with enterprise purposes."

Moreover, PMI (2006) expresses monitor and control as "Process Group" describes this process as

> The Monitoring and Controlling Process Group consists of those processes required to track, review, and regulate the progress and performance of the project; identify any areas in which changes to the plan are required; and initiate the corresponding changes. The key benefit of this Process Group is that project performance is observed and measured regularly and consistently to identify variances from the project management plan. (p. 59)

By analyzing the definition of these aspects (monitoring, controlling, and evaluating), we find that they are concerned with determining whether the planning and execution of the project is done well or not and correcting the variances.

Simply put, monitoring is concerned with collecting and reporting of the information related to both planning and execution.

Evaluation is concerned with determining whether or not the work is done as required.

And, controlling is concerned with making corrections to the work that is incongruent to what is planned.

Thus, to deduce all these aspects: Monitoring, Controlling, and Evaluating are complemented in order to make project progress done as required.

2.7.4 Project Termination and Closeout

The last phase of project life cycle is the termination or closeout of the project, and it depends on the progress of work in the project.

As mentioned, all projects have a beginning and an end. The end differs from project to project. Some projects achieve their goals and objectives, which are developed and created to achieve them, while others fail to do so. In both situations, there must be a process to end the project. Thus, sometimes, this process may be to close out the project, while at other times, it may be to terminate the project.

2.7.4.1 Distinction between Termination and Closeout

The terms termination and closeout do not carry the same meaning. Oxford dictionary defines termination as “Termination is the act of ending something; the end of something: failure to comply with these conditions will result in termination of the contract.” (Oxford Advanced Learner Dictionary, 2006, p. 1526). This definition describes the meaning of termination as an ending of something and

supports it with the example, “failure to comply with these conditions will result in termination of the contract.” Thus, termination could mean the ending of something before it is complete. Yet another example by Oxford dictionary is, “A medical operation to end a PREGNANCY at an early stage.” Despite being a medical definition, it shows that the word termination is used to describe things that end before they are completed. This is what is implied when we say termination of the project.

This concept is supported by Meredith and Mantel (2009) who say

> For our purposes, a project can be said to be terminated when work on the substance of the project has ceased or slowed to the point that further progress on the project is no longer possible, when the project has been indefinitely delayed, when its resources have been deployed to other projects, or when project personnel (especially the PM) become personae non grate with senior management and in the company lunchroom. (p. 552)

So, this means that the project is terminated when there is no encouragement to keep the work progress in the project. This mainly happens when the project seems to be unable to meet its stated goals and objectives.

Thus, we can define project termination as *the process of stopping work in the project when the project no longer achieves its agreed goals and objectives, or the*

deliverables of the project shall not meet the required product, service, or result that was aimed to be created by the project.

On the other hand, closeout has been defined by APM as "Closeout is the process of finalizing all project matters, carrying out final project reviews, archiving project information, and redeploying the project team."

Some may say that the process described in this definition may be done in the case of *termination* as well*; but APM explains the case in which this process happens as* "The most important aspect of this phase is allowing project to enter into an operational environment. This decision will be based on the successful testing of the project to ensure deliverables meet the agreed acceptance criteria." (APM, Body of Knowledge, 2006, p. 88)

The concept of calling the closing process as a successful project is also referred to by Williams (2008) who says that

> Closing your project involves a four-step process: review, agree, complete, and celebrate. As in other project activities, it's important, first of all, to determine who needs to be involved in each step. For instance, you might want to celebrate the project being completed with everyone involved, but actually completing the final tasks would primarily involve your project team. (p. 139)

We notice that Williams uses the words “completed project,” “final task,” and “celebrate” to describe the process of closing project. This supports the idea about the term closeout, as unfinished projects are ended before the final works and tasks are completed, and no one celebrates unfinished or failed projects. Thus, we can deduce that the word termination is used when the project has failed to meet its objectives and thus ended, while closeout is used to describe a successfully ended project.

2.7.4.2 Reasons for Terminating Projects

As mentioned, a project will be closed when it has successfully achieved its aimed goals and objectives or its final deliverables have been delivered to the customers, i.e., the product, service, or result that is achieved from executing the project is accepted and affirmed by the project’s team, customers, and all other stakeholders.

However, why is a project terminated? Or what reasons cause the project to stop before the completion of its execution process?

Cleland and Ireland (2002) had developed numerous reasons that cause the termination of the project as

Project termination comes about for several reasons:

* The project results have been delivered to the customer. If appropriate, service and maintenance contracts can be negotiated and consummated.

* The project has overrun its cost and schedule objectives and/or is failing to make satisfactory progress toward attaining its technical performance objectives.

* The project owner's strategy has changed such that the project no longer has a strategic fit in the owner organization's future.

* The project's champion has been lost, thereby putting the continued application of resources on the project in doubt.

* Environmental changes have emerged, which adversely influence the project's future.

* Advances in the state of the art hoped for in the project (such as in research and development) have not been realized, and therefore further funding is not forthcoming.

* The project's priority is not high enough to survive in competition with higher priority projects. (p. 436)

Additionally, Meredith (2009) has divided the reasons for the termination of the project in terms of several factors, and ensured that there are numerous factors that cause the termination of the project before the completion of its implementation. These factors according to Meredith has been developed as

1-Technical:

Low probability of achieving technical objectives or commercializing results.

Technical or manufacturing problems cannot be solved with available R&D skills.

Higher priority of other projects requiring R&D labor or funds.

2-Economic:

Low profitability or return on investment.

Too costly to develop as individual product.

3-Market:

Low market potential.

Change in competitive factors or market needs.

4-Others:

Too long a time required to achieve commercial results.

Negative effects on other projects or products.

Patent problems. (p. 557)

In brief, we can deduce that a project is terminated when the project owners or management is convinced that the progress of executing the project will not generate benefits for the organization; or that investing the certified resources of the project in another project will create better benefits for the organization and stakeholders.

2.8 Previous Studies

The researcher has consulted several previous studies concerned with construction projects and the logistic services related to them. These studies greatly helped to develop the research hypotheses, as well as build the research framework and plan.

Duiyoung et al. (2014)[1]

The study was titled "Engineering Construction Project Site Logistics Management." This study revealed the significance of physical distribution activities in the process of executing the construction project. It discussed the problem of not attaching a proper value to the delivery service. The study found that the key goal for the logistics of a construction project is to ensure that the products can arrive at the site within the required time and quantity. This goal not only relies on the efficiency of the supply network, but also on the advanced planning of the required materials and products in the construction site. Additionally, the full partnership between manufacturers and suppliers can have a significant effect on the improvement of the project logistics. If they are involved in the project earlier, especially if they can provide information for the list of materials in the design stage

[1] Duiyoung, Shidong, and Mingshan (2014). *Engineering construction project site logistics management*. Journal of Chemical and Pharmaceutical Research, 2014, 6(7):353-360.

and input information for the logistics plan ultimately, they will make a significant contribution to the efficiency of the project logistics.

Johansson and Tornqvist (2014)[1]

The study was titled "The Role of Logistics in Urban Tunnel Construction Projects." This study purposed to investigate the importance of logistics management in an urban tunnel construction project, and to identify the key factors that can enhance the supply-chain management, as well as to evaluate whether the construction industry is aware of these, and if not, to decide which areas demand a bigger focus. The study had discussed the problem of narrow space at the tunnel's site, which prevents the project management purchase and the storing of sufficient work materials, and it causes several restrictions during the execution of the project. The method consists of mainly two parts, namely a literature review and a number of interviews. To emphasize the issues at the on-going construction sites and demonstrate this in a more distinct fashion, there was also site observations in part. Finally, the study had obtained several findings: It is important to consider the size of the access tunnels, not only because of passing vehicles, but also for the available selection of prefabricated elements. Waiting periods due to limited access has proven to result in a major decrease in productivity. Planning of access tunnels is important to establish well-working logistics, however there are factors such as lack of space

[1] Johansson and Mellgren (2021). *The Role of Municipalities in Construction Logistics for Sustainable Cities: A study to research the prerequisites of effective construction logistics with a municipality perspective.* Chalmers University of Technology, Gothenburg, Sweden

or economic reasons that prevent additional service tunnels from being constructed. When the possibility of constructing additional tunnels do not exist, a widening of the existing access tunnel could be considered instead. The head of the logistics must be well-aware of the building process and the fact that the bottleneck problem increases, along with the increased number of installations that is finished in the tunnel. The logistics cost increases due to unloading at specified times, however this is the only way possible for most of these projects, especially when there is only a single entrance available.

Andersson and Nilsson (2018)[1]

The study was titled "Planning for construction logistics: An evaluation and development of a construction logistics plan at Serneke." It stated the problem of the lower amount of added value per worker in the construction field, compared to the world economy and the manufacturing industries.

They believed that material transportation, employees waiting for materials or other processes to be completed, and rework were the key factors that contributed to the low productivity in the industry. Also, they felt that productivity was closely related to the ability to manage and eliminate time and waste materials throughout the entire supply chain. Moreover, they stated the reason behind the inefficiency of

[1] Andersson & Nilssson, (2018). *Planning for construction logistics: An evaluation and development of a construction logistics plan at Serneke*. Chalmers University of Technology. Gothenburg.

construction industry and how lean logistics could play a role in developing the efficiency of the industry.

Additionally, the purpose of the study was to identify logistical challenges in urban city construction projects for Serneke, and how the logistical processes could be developed to cope with these challenges. The study found that the main identified barriers that prevent a sufficient working climate with enhanced focus on logistical challenges and processes can be summarized into four categories. First, there is no sufficient way to measure the benefits of assigning a logistics manager and the true outcomes of proactive working with the logistical challenges. This often results in logistics processes being treated reactively rather than proactively due to insufficient time and attention. Second, the competences at site and within the organization must correspond with the performances that the person is expected to carry out. No team will be stronger than the weakest link, and if the competences are not matched with the work tasks, the utilization will not be maximized. Third, there is no clear guidelines or detailed specifications embedded in the procurement of sub-contractors and materials. This gap creates possibilities for the suppliers and sub-contractors to create their own way of addressing issues if the main contractor is often left without possibilities to really affect how these processes are conducted. Finally, there is a necessity of enhanced communication between all the involved parties of the construction project. Communication, predetermined ways of

execution, and knowledge management are important to not only deliver the highest added value to the customer but also to evolve as an organization and to learn from the previous projects, not only on the individual level but on an organizational level.

Matouzko and Methanivesana (2012)[1]

The study was titled "Improving Construction Logistics A Case Study of Residential Building Project." It discussed the relation between logistics services and construction projects.

This study proposed to investigate the construction logistics processes and give suggestions for improvement by optimizing the material delivery process. The main idea was to investigate the current logistics situation on the construction site with focus on the material delivery process and the time that craftsmen spend on handling materials. The suggestions for improvements have been given based on the results from the case study. The possible economic and production benefits from the proposed solution have been calculated.

Moreover, the study discussed the problem of reduced productivity of the construction project, and how it affects the quality, time, and costs of the project. The researchers believed that the reason for this reduced productivity was often the poor management of materials, equipment, and tools. They think that proper

[1] Matouzko (2015). Efficient Construction Logistics A case study of an Office Block Project. Department of Real Estate and Construction Management. Stockholm: Sweden.

management of these three important components could increase the productivity significantly; and these components should be accurately managed on site for the projects to be successful.

The study revealed that the importance of construction logistics was underestimated by construction companies. In the Swedish construction industry, companies are unaware of how important logistics is and what could be the consequences of poor logistics planning. In the example of the apartment building project, the study analyzed the costs associated with material handling.

Inside wall materials*:* During the case study, it was discovered that the inside wall materials were delivered during the structural stage and stored on-site for several months. This way of handling has always been considered as the only way. Thus, the study showed that other ways of doing this could be more effective. The suggested logistics solution helps cut down the costs for transporting inside wall materials to the working place and avoid unnecessary work.

Interior materials*:* Skilled workers spend part of their time carrying materials to the working place. A third of all the materials that arrive to the site are handled by ordinary workers and two-thirds are handled by the carrying men. The study found that it was a good idea to hire sub-contractors for the carrying works. The researchers believed that the Construction Company could increase their

productivity even more if they employed carrying men for 100% of all the incoming materials.

Saving potential*:* Except the direct saving potential, there is a possibility to shorten the time for the entire project. Implementation of the suggested logistics solution could reduce the production time by 3.3%.

***Fadiya (2012)*[1]**

The study was titled "Development of An Integrated Decision Analysis Framework for Selecting ICT-Based Logistics Systems in the Construction Industry". It discussed the problem of non-evaluation of the information systems (IS) and associated technologies that the companies use, as well as the lack of awareness about information and communication technologies (ICT) and the over-reliance on cash flows that make the processes associated with the IT investment justification a burdensome process for many construction project managers. The study aimed to develop a computerized framework for the evaluation of alternative ICT-based logistics systems in the construction industry. The proposed toolkit will assist construction logistics decision-makers in making knowledge-based decisions on the implementation of ICT systems for improving the logistics. The study reiterated the importance of the operational benefits of implementing ICT to improve

[1] Fadiya, (2012). *Development of An Integrated Decision Analysis Framework for Selecting ICTBASED Logistics Systems in the Construction Industry*. University of Wolverhampton, UK.

the construction logistics. The operational benefits represent the reduction of the problems of construction logistics, which include waste, theft, collision accident, delivery lateness, data inaccuracy, time consuming process, and misplacement.

Muya (1999)[1]

The study was titled "A Systematic Approach for Improving Construction Materials Logistics." The overall aim of this thesis was to develop a systematic supplier management decision-support process model that contractors can use for the short- and long-term management of suppliers in the implementation of construction materials supply logistics. Such a process model would benefit construction companies by identifying the essential elements that lead to improved supply of construction materials.

The objectives of the research were as follows:

- Assess the extent to which information and communication technologies were being used in materials management in the UK construction industry.
- Examine the nature of relationships and attitudes between contractors and suppliers in construction materials supply logistics.
- Assess the importance that UK contractors and suppliers attached to logistics performance indicators, and the extent to which they assessed the indicators to contribute to improved customer service in the supply of construction materials.

[1] Muya, (1999). *A Systematic Approach for Improving Construction Materials Logistics*. Loughborough University, UK.

- Assess the importance that UK contractors attached to logistics enablers, and the extent to which they took the enablers into consideration when evaluating and selecting construction materials suppliers.

The following were the outcomes of the study findings:

- A systematic supplier management decision-support process maps that contractor can use for short and long-term management of suppliers in the implementation of construction materials supply logistics.
- An understanding of the supply of construction materials into construction processes from the wider perspective of logistics and supply chain management, as opposed to traditional materials management.
- The identification of the performance indicators against which the performance of suppliers can be evaluated and the quantification of the relative contribution of the performance indicators to the improvements in customer service.
- The identification of factors that enable suppliers to improve the level of customer service and the quantification of the relative extent to which these factors enable suppliers to contribute to the improvements in their levels of customer service in the delivery of construction materials.
- Identification of the extent to which both performance indicators and enablers were used in supplier evaluation and selection.

- Evaluation and comparison of the extent to which contractors and suppliers used information and communication technologies in internal and external materials supply logistics processes.
- Evaluation of the nature of relationships between contractors and suppliers.

Dahlström (2011)[1]

The study was titled "Organizing Robust Logistics Systems in Major Construction Projects", 2011, Chalmers University of Technology. It discussed the problem of construction industry being continuously accused of inefficiency and an unwillingness to innovate; the lack of feedback learning and neglecting the evaluation of the project's success or failure in the construction industry, which further complicates the possibility for increased efficiency; and the process of innovation in terms of new materials and solutions in combining materials is moving forward, but the actual construction process has more or less been the same since the start of the construction.

The hypotheses developed by the study suggest that by increasing the efficiency in the construction process, costs in the construction industry can be cut down, which would result in projects being on time and on budget, and hence lowering the cost for the end user. Since the construction industry is process-driven,

[1] Dahlström (2011). *Organizing Robust Logistics Systems in Major Construction Projects*. https://odr.chalmers.se/handle/20.500.12380/144277

there are difficulties to implement traditional quality improvement models of total quality.

The study, which was conducted at a complex arena project with a high number of parties, implemented an on-site logistics organization to increase the efficiency and coordinate the different processes. Due to the complexity of the project, the coordination of activities was crucial for the project's success. Thus, the study investigated a limited number of critical incidents that had an impact on the logistics system at the project Stockholm arena. The study aimed to analyze these critical incidents and their contribution to the complexity to use this analysis as feedback material to be able to build robust logistics systems in the future.

The study found that to build robust logistics systems, construction projects should implement a thorough stakeholder/impact analysis to map the different stakeholders and their possible contribution to the complexity of the project. Moreover, the study concluded that every project in the construction industry should have an on-site logistics organization of some sort that is implemented at an early stage to take into account the complexity of the project from a logistics point of view.

Gil Saura et al. (2008)[1]

The study was titled "Logistics service quality: a new way to loyalty". It described a framework to explore the relationships between service quality, customer satisfaction, and loyalty in the supply chain from the perspective of ICT. The study aimed to analyze the quality, satisfaction, and loyalty sequence in the context of logistic service delivery, with the purpose of considering the role of ICT in this chain of effects. The study used the questionnaire tool to collect primary data from 194 companies. Structural equation modelling was applied to this data to test the relationships among the variables in the study. The findings showed the reliability and validity tests and results. The conclusions confirmed this chain of consequences, and emphasized the incidence of ICT in the description and intensity of these relations.

Ogunsanmi (2013)[2]

The study was titled "Effect of Procurement Related factors on Construction Project Performance in Nigeria". The study aimed to investigate the effects of procurement-related factors including procurement selection criteria, tendering

[1] Gil Saura, I., Servera Francés, D., Berenguer Contrí, G. and Fuentes Blasco, M. (2008), *Logistics service quality: a new way to loyalty*, Industrial Management & Data Systems, Vol. 108 No. 5, pp. 650-668.

[2] Ristovskai, Kozuharov and Petkovski (2017). *The Impact of Logistics Management Practices on Company's Performance*. International Journal of Academic Research in Accounting, Finance and Management Sciences Vol. 7, No.1, January 2017, pp. 245–252.

methods, and variation orders on project performance. The study proposed to evaluate the effects of procurement-related factors on the project performance. Snowballing sampling technique was used in selecting forty (40) construction organizations in Lagos Metropolitan City. Results of the study indicated that procurement selection criteria of cost, time, quality, project characteristic,s and external environmental factors have effects on the project's performance. Competitive, open, and selective tendering methods have high impacts on the project performance. No significant difference was found between the impacts of the tendering methods on project performance. Variation orders impact project performance with time, cost overruns, and disputes, and it affects project performance. The study concluded that procurement selection criteria, tendering methods, and variation orders impacts the project performance. Cost-, time-, and quality-related factors, tendering methods, and variation orders strongly affect the project performance. The study recommended that clients, stakeholders, practitioners, and consultants should consider tendering methods, use selective, open and competitive tendering approaches, and discourage excessive variation orders during construction. Policy makers in the government, clients, and private developers in housing projects should give adequate attention when selecting appropriate procurement and tendering methods for better management of future projects in Nigeria and other developing countries.

Ristovskai et al. (2017)[1]

The study was titled "The Impact of Logistics Management Practices on Company's Performance".

The study discussed the problem of survival of the companies with regard to the increased offer on the market, which led to intensive competition. The research aimed to analyze the impact of the company's logistics management including transportation, warehousing, packaging, inventory, and information management for efficiency and effectiveness. The study revealed that reducing the cost of each logistics activity influences the total amount of costs and enhances the company's performance. The empirical research was conducted on a sample of 80 examinees from 80 different companies in the Republic of Macedonia. The results showed that the companies control the level of stocks, or maintain electronic records of the minimum amount of inventory, and thus decrease the amount of so-called "dead" capital that stands in storage. The easier the inventory control, the more flexible the procurement is and the lower the costs are. Besides, companies maintain records of the time required for procurement and storage. Moreover, the results revealed that proper storage management and control reduces storage costs. When the companies choose the location of the main and auxiliary storages, it reduces the "idle" capital,

[1] Ristovskai, Kozuharov and Petkovski (2017). *The Impact of Logistics Management Practices on Company's Performance*. International Journal of Academic Research in Accounting, Finance and Management Sciences Vol. 7, No.1, January 2017, pp. 245–252.

and with proper storage of stocks, one may avoid the possibilities of reducing the product's lifespan and incurring additional costs due to improper storage. Thus, the results indicated that accurate, relevant, and timely information from inside and outside the company enables appropriate and timely decision-making.

Anane et al. (2019)[1]

The study was titled "Effect of Procurement Practices on Service Delivery: A Case Study of VRA, Ghana". It attempted to fill the gap of the limited empirical literature on the effect of procurement practices on service provision, especially with the electricity sector in the developing countries. The general objective of the study was to determine the effect of procurement practices on service delivery in the electricity sector. Moreover, the study was conducted to determine the effect of procurement policy, procurement planning, and sustainable procurement on service delivery. The study employed a quantitative research approach and an explanatory design. The target population for the study was staff and management of the Volta River. Structured questionnaire was used to gather primary data from 241 respondents. The study found that 73.6% variations in service delivery were explained by Procurement Policy, Procurement Planning, and Sustainable Procurement. Further that Procurement Policy is a significant determinant of service

[1] Anane, Adoma and Awuah (2019). The Effect of Procurement Practices on Service Delivery: A Case Study of VRA, Ghana (Asian Journal of Economics, Business and Accounting, 13(1): 1-23, 2019; Article no. AJEBA.53090 ISSN: 2456-639X.

delivery, such that a unit change in procurement policy will result in 62.3% change in service delivery. Moreover, the study found that Procurement Planning is a significant determinant of service delivery, such that a unit change in procurement planning will result in 2.7% change in service delivery. Also, it found that Sustainable Procurement is a significant determinant of service delivery, such that a unit change in Sustainable Procurement will result in 39% change in service delivery. From the model estimation, procurement policy was the strongest predictor of service delivery, followed by sustainable procurement, and lastly procurement planning. The study revealed a strong, significant, positive correlation between procurement policy and service delivery, between procurement planning and service delivery, and between sustainable procurement and service delivery. The study concluded that Procurement Policy, Procurement Planning, and Sustainable Procurement significantly predict service delivery of VRA. The study recommends that the management of VRA must continuously invest in sustainable procurement, procurement planning, and procurement policy to enhance service delivery to the public.

Norton (2015)[1]

The study was titled "Strategies for Greener Logistics in the Charity Sector". It discussed the problem of donation collection that is commonly run on a set

[1] Norton (2015). *Strategies for Greener Logistics in the Charity Sector*. University of Southampton.

schedule, where the same shops and donation banks are visited at the same time each week, which can result in some sites being visited too often or not often enough on occasions, given the dynamic nature of donations. Therefore, if a site is visited too often, this results in the driver not having a worthwhile amount of stock to collect or deliver, which can prove to be an inefficient use of the resources. This results in wasted journeys, and cost and time could be saved by optimizing the collection schedules to visit the sites when needed. Moreover, if a shop site was not visited often enough for the collection of excess stock, this could result in limited stock space within the shop's storage areas. If a donation bank site was not visited often enough, then it could cause the donation bank to overflow and spill onto the surrounding area. This could result in increased levels of donation bank theft. The study found that drivers should visit as many locations as possible during each day to maximize the efficiency. Moreover, they must reduce the schedules to 4-day weeks to realize cost savings. It was recommended that the collection routes minimize the distance travelled. Donation banks that showed high theft levels should be provided with better security or visited more often to reduce the amount that is possibly stolen.

Chistnikova et al. (2020)[1]

The study was titled "Features of the Use of Lean Logistics Tools in Agricultural Regions". It discussed the problem of inefficient storage of the crop farm and the lack of a logistics management process in agricultural organizations. It found that the use of a logistic approach in agriculture could contribute to a significant reduction in the cost of agricultural products, and the development of individual farms and the country's agro-industrial complex as a whole. Lean logistics in crop companies requires clear coordination of the activities of all categories of personnel involved in the value stream: main and auxiliary production workers, service, and management personnel. The proposed directions for organizing lean logistics will help reduce the unnecessary actions and standardize the crop production processes. Finally, the study claimed that since the logistics process was auxiliary, the effect of lean logistics would largely depend on the company's comprehensive work on quality management and planning.

Wronka (2016)[2]

The study was titled "Lean logistics". It aimed to present the key assumptions of Lean Management, with particular focus on the components of Lean Management

[1] Chistnikova, Ermachenko and Gunter (2020). *Features of the Use of Lean Logistics Tools in Agricultural Regions.* Advances in Economics, Business and Management Research, volume 181, 3rd International Conference Spatial Development of Territories (SDT 2020).

[2] Wronka (2016). Lean logistics. Journal of Positive Management, Vol. 7, No. 2, 2016, pp. 55–63.

System and the assessment matrix of implementing the Lean concept. Additionally, it demonstrated the applicability of Lean paradigms to improve the logistics area, as well as to improve the functioning of supply chains, especially by using methodology that links Six Sigma, Lean ideas and Agile approach. The used research approach was the detailed analysis of logistics international literature and case study based on internal documents and interviews with lean managers from an international company. As the findings suggested, the study emphasized the multidimensionality of the concept, and indicated the potential areas of integration Lean with other tools and strategies used in modern businesses management, like Six Sigma or Agile approach. The study presented a practical application of Lean in logistics.

Niu et al. (2019)[1]

The study was titled "Logistics Planning and Visualization of Modular Integrated Construction Projects Based on BIM-GIS Integration and Vehicle Routing Algorithm". It discussed the problem of a significant lack of studies in logistics planning, optimization, and visualization for modular integrated construction (MiC) projects. This study aimed to establish an integrated MiC logistics planning and visualization platform, which was grounded on the integration

[1] Niu, Yang, and Pan (2019). Logistics Planning and Visualization of Modular Integrated Construction Projects Based on BIM-GIS Integration and Vehicle Routing Algorithm. Modular and Offsite Construction, May 21-24 2019, Fairmont Banff Spring Hotel, Banff, AB, Canada.

of building information modeling (BIM), geographical information system (GIS), and vehicle routing problem (VRP) algorithm. A case study was used in the methodology to identify the optimal logistics scenario of trailer routes to meet the installation time window of MiC projects in Hong Kong. The study found that the proposed platform had the ability to make optimized logistics scenario for MiC projects, and to visualize the logistics scenario in a 3-dimensional interactive environment.

Johansson and Mellgren (2021)[1]

The study was titled "The Role of Municipalities in Construction Logistics for Sustainable Cities: A study to research the prerequisites of effective construction logistics with a municipality perspective". It discussed the problem of space limitations, accessibility, and noise, as well as environmental aspects such as pollution caused during the production of new or renovation of existing buildings in the urban areas. It aimed to investigate the municipality's role, incentives, and responsibilities in achieving sustainable construction logistics. The study found that the implementation of construction logistics varied in the studied municipalities. Meanwhile, all municipalities showed an interest in construction logistics and saw the benefits in its implementation. Construction logistics is considered important, as

[1] Johansson and Mellgren (2021). *The Role of Municipalities in Construction Logistics for Sustainable Cities: A study to research the prerequisites of effective construction logistics with a municipality perspective.* Chalmers University of Technology, Gothenburg, Sweden.

it can reduce the climate impact and contribute to an attractive city. Construction logistics thus contributes to the municipalities' goals of reducing emission. Moreover, the study concludes that to be able to implement a well-functioning construction logistics solution, the solution has to be developed by actors who possess the right knowledge and experience. Furthermore, the potentials with construction logistics have to be discussed at an early stage with affected stakeholders to create awareness and engagement among them. The result pointed that an implementation of a construction logistic solution should be stated in the municipalities land allocation agreement in case of municipality-owned land or the land development agreement if the land is owned by a private actor.

Matouzko (2015)[1]

The study was titled "Efficient Construction Logistics A case study of an Office Block Project". It discussed the lack of general knowledge with regard to material logistics in construction projects, which leads to many unnecessary movements on site that interrupt the production and displaces the direct value-added activities. The study proposed to investigate the existing logistic approach on the construction site, as well as provide proper logistic strategy for improving the construction process. It was mainly focused on material deliveries within the

[1] Matouzko (2015). Efficient Construction Logistics A case study of an Office Block Project. Department of Real Estate and Construction Management. Stockholm: Sweden.

construction site. The study found that despite hiring subcontractors for material handling, skilled workers were still spending non-direct value-added time while moving material. Due to inefficient logistics solutions, production process is extended. The study demonstrated that by implementing other logistics solution, time and cost can be saved, thus giving the time saving for 6 working days and direct saving potential for almost 20 SEK/m^2 of living area. Besides, the study highlights the significance of construction logistics, and shows the consequences to be faced due to the lack of proper logistic planning. Whereas, achieving benefits throughout the entire project is possible if a proper logistic approach is used.

Arabzadeh and Niaki (2018)[1]

The study was titled "Construction cost estimation of spherical storage tanks: artificial neural networks and hybrid regression—GA algorithms". It discussed the process of estimating the cost of construction projects, and how this process involves a wide range of uncertainties, which make it a challenging task. Owing to unknown issues, using the experience of experts or looking for similar cases are the conventional methods to deal with cost estimation. The study presented data-driven methods for cost estimation based on the application of artificial neural network (ANN) and regression models. The learning algorithms of the ANN are the

[1] Arabzadeh and Niaki, (2018). *Construction cost estimation of spherical storage tanks: artificial neural networks and hybrid regression—GA algorithms*. Journal of Industrial Engineering International. Volume 14, Issue 4, Autumn 2018.

Levenberg– Marquardt and the Bayesian regulated. Moreover, regression models are hybridized with a genetic algorithm to obtain better estimates of coefficients. The methods are applied in a real case, where the input parameters of the models are assigned based on the key issues involved in a spherical tank construction. The study found that while a high correlation between the estimated cost and real cost exists, both ANNs could perform better than the hybridized regression models. Additionally, the ANN with the Levenberg–Marquardt learning algorithm (LMNN) obtained a better estimation than the ANN with the Bayesian-regulated learning algorithm (BRNN). The correlation between the real data and estimated values was over 90%, while the mean square error achieved was around 0.4. The proposed LMNN model can be effective to reduce the uncertainty and complexity in the early stages of the construction project.

Kaiman et al. (2019)[1]

The study was titled "A non-centralized adaptive method for dynamic planning of construction components storage areas." It discussed the problem of re-handling of the construction components, such as pipes, structural steel elements, and curtain walls, which increase the handling cost, reduce the construction efficiency, and cause a critical issue for the storage area plans of a project. Moreover,

[1] Kaiman Li, Hanbin Luo, Mirosław J.Skibniewskicde (2019). *A non-centralized adaptive method for dynamic planning of construction components storage areas*. Advanced Engineering Informatics: Volume 39: 80-94.

on some construction sites where space is limited, there are not adequate storage areas for centralized stacking of components and frequent changes in spatial state. The study proposed a novel and flexible arrangement method for incoming components in a limited site space. That method was non-centralized and adaptive to the dynamic change of the actual component requirements based on construction activities and the real-time storage area availability. Therefore, a construction components storage areas planning (CCSAP) model was developed for the dynamic allocation of construction component's storage areas. Further, BIM was used to generate the material requirements planning prior to the construction according to the actual construction activities. The study presented an imaging technology with a low-rank matrix to identify on-site unoccupied locations automatically in real time. Additionally, genetic algorithms (GA) consider two types of decision variables, namely actual components supply and real-time space availability. Finally, a dynamic visualization platform was built for planning construction components storage areas. Based on the implementation example that demonstrated the validation of principles, the study showed a 21.9% reduction in the handling cost and a 19.4% increase in the construction efficiency, compared to conventional methods.

Brat and Raghu (2012)[1]

The study was titled "The Influence of Logistics Outsourcing on Supply Chain Management." It discussed the problem of the increasing trend of outsourcing logistics function or activities, for example, transposition and warehousing, and how these outsourced logistics functions or activities influence the company strategies and the direction in Supply Chain Management (SCM). The overall purpose of this thesis was to investigate how logistics outsourcing may influence supply chain management from a strategic perspective. The study collected data from 39 companies in Sweden and 26 companies in France. The study found that there was a similar trend of outsourcing logistics functions by companies in Sweden and France. The trends signify that transportation and custom brokerage are the two main activities that are outsourced, and the outsourcing trend for transportation is 80% and for custom brokerage is about 60%. The study concluded that outsourcing of these two functions influenced the SCM and its strategy.

[1] Brat and Raghu, (2012). *The Influence of Logistics Outsourcing on Supply Chain Management*. **https://www.semanticscholar.org/**

Chapter Three

Theoretical Framework and Research Hypothesis

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Theoretical Framework and Research Hypothesis

3.1 Overview

This chapter intends to discuss the theoretical framework of the study and develop the research hypotheses. Sekaran (2016) described a theoretical framework as

> A theoretical framework represents your beliefs on how certain phenomena (or variables or concepts) are related to each other (a model) and an explanation of why you believe that these variables are associated with each other (a theory). Both the model and the theory flow logically from the documentation of previous research in the problem area. Integrating your logical beliefs with published research, taking into consideration the boundaries and constraints governing the situation, is pivotal in developing a scientific basis for investigating the research problem. (p. 72)

Moreover, Sekaran (2016) identified the process of building a theoretical framework:

The process of building a theoretical framework includes:

1. Introducing definitions of the concepts or variables in your model.

2. Developing a conceptual model that provides a descriptive representation of your theory.

3. Coming up with a theory that provides an explanation for relationships between the variables in your model. (p. 72)

Based on that, the theories on which a research is based will be introduced; the concepts and definitions of logistics planning and construction project, as well as lean logistics and logistics strategy, which all serve as the variables of the study, will be discussed. Additionally, the conceptual model that describes the relationships between the variables as a model will be developed. Further, the relations between the variables will be developed in this chapter. There will be an explanation of the relationships between the independent variable, which is logistics service planning, and the dependent variable, which is construction projects, and how the mediating variable, logistics strategy management, mediates the relationship between the two and, lastly, how the moderating variable, lean logistics, moderates the relation between the mediator variable and the dependent variable. At the end of the chapter, the descriptive framework will be developed.

3.2 Research Theory

This research is based on the management science theory. Imhanzenobe (2021) describes management science theory as follows:

The Management Science theory is one of the theories of management that attributes management effectiveness to the application of scientific methods. It goes a step beyond the famous scientific management theory by applying operations research tools and techniques to solving practical problems. Its origin can be traced to the Second World War in Britain. Its method of expressing business factors in form of variables allows for the accurate prediction of business phenomena and overall optimization of profits. The management science approach uses computer applications and operations research tools to solve business problems around quantitative management, operations research, total quality management and management information systems. Overall, the management science theory provides a new and proactive way of solving business problems by identifying relationships among different business variables that were previously considered unrelated and so, have provided modern businesses with a better way of doing things. (p. 133)

3.2.1 Branches of the Management Theory

Imhanzenobe (2021, pp. 134–135) states the following:

Over the years, four main branches of Management Science approach have gained ground. Each branch of the Management Science approach

addresses a specific set of problems. The branches include the following:

I- Quantitative Management:

This branch of the Management Science school makes use of mathematical tools (such as linear programming, financial modeling, simulation, queuing theory, etc.) to help managers make the strategic or tactical decisions (MeroSpark, 2014). For instance, financial modelling can help a manager decide how to invest his capital in the most rewarding way.

II- Operations Research:

This branch of the Management Science approach provides managers with a set of techniques (e.g., stepping stone, economic order quantity) that can be used to analyze different aspects of an organization's production system with the aim of increasing efficiency (Jones and George, 2016). With the advent of information technology, regular communication and benchmarking has been made easier and this has impacted the effectiveness of input sourcing and output marketing.

III- Total quality management (TQM):

This branch of Management Science focuses on analyzing an organization's value chain (input, conversion, and output process) to increase the overall quality of the product or service (Lawrence and Steck, 1991). Once again, sophisticated computer-controlled processes like machine vision and three-dimensional printing help to enhance precision in production process and overall quality (Deming, 1986).

IV- Management Information System:

Management information systems generally refer to the collection of information systems that provide managers with information on both internal and external events. Information reduces uncertainty; thus, managers make more quality decisions when there is more information available. This branch of Management Science theory helps design information systems (e.g., Transaction Processing Systems, Decision Support Systems, Office Automation Systems, etc.) that provide managers with both internal and external information to make quality decision. IT offers managers new and improved ways of handling information to help them make more accurate assessments of the situation and informed decisions (Dewett & Jones, 2001).

3.2.2 Contribution of Management Science Theory to this Research

Imhanzenobe (2021) states that

One of the major contributions of the Management Science approach to management theories is the increase in precise prediction of certain aspects of the business process. Business processes and systems are expressed in measurable terms and fitted into a model that can predict possible outcomes when there are changes in its constituent variables. The Management Science approach brings a new and practical perspective on how the different aspects of the business, which were previously regarded as unrelated, depend on one another for the overall effectiveness of the organization (Jeanty, 2019). This school of thought provides a new and proactive method of dealing with complex managerial problems. The possibility of identifying existing relationship among the organizational variables gives managers a better understanding of the overall organization's process. Also, given that organizational variable are expressed in measurable terms, it becomes easier to monitor processes and evaluate performance with a lot of precision, order, and objectivity. (p. 136)

The Management Science approach applies mathematical models and techniques in a scientific manner to enhance business processes. Mathematical models uncover relationships among several variables within industries (Jeanty, 2019). (p. 135).

> The Management Science approach involves some underlying assumptions (Rahman, 2013). First, it regards an organization's management structure as a problem-solving mechanism. Secondly, it assumes that all management problems can be expressed in a quantitative form. It assumes that most decision outcomes and human behavior are predictable. (p. 136).

Therefore, this theory will help us adapt relevant quantitative and mathematical techniques to expect and discover the relationships between the selected variables.

3.3 Logistics Planning

Logistics planning has been defined by the Association of Southeast Asian Nations (ASEAN, 2014, p. 2) as follows: "Logistics planning is the process that creates value by timing and positioning inventory; it is the combination of a firm's order management, inventory, transportation, warehousing, materials handling, and packaging as integrated throughout a facility network."

3.3.1 Logistics Planning Process

Heckenberger (2016) describes the logistics planning process as follows:

> Logistics process planning starts with the supplier and takes into consideration the entire logistical chain, all the way up to handover of the final product to the customer. Both the complete material flow and

the flow of information are planned logistically. This includes upstream logistics functions such as distribution center management, WOW (warehouse on wheels), container yards, trailer yards, consignment stores, transshipment points, hubs, and consolidation centers, as well as all stages of the material flow – from warehouse planning, picking, and sequencing to intra-company transportation, production supply, packaging, and shipping.

Additionally, Jaecques (2002) argue as follows regarding the logistics planning process:

> Companies have two philosophical approaches in developing a plan for their distribution centers – biased and unbiased. The biased approach refers to using a supplier that represents specific equipment or systems. With this approach, the solution is based on the resources available to that supplier, and can result in a solution that may not maximize available universal resources.
>
> Developing an efficient and effective unbiased logistics plan involves developing what Saenz calls 'best-practice solutions' and defining detailed future planning requirements. 'The result of this approach is a future distribution center logistics plan that considers the full facility expansion capability on your available site, which maximizes your

> space, equipment, and labor resources.' The unbiased approach is available through consulting firms that do not have exclusive alliances with suppliers. Regardless of the approach used by a company, developing a logistics plan is a critical first step to design and build an efficient distribution center.

It is clear that both these opinions reiterate the importance of creating plans for the whole journey of products from the point of origin (supplier) till the point of delivery (customer) passing by the point of the operator (store). Moreover, each point needs to be identified clearly. Any work during these operations should be previously identified and planned. For example, the tool and time of acquiring products from the supplier should be known in detail, and there must even be an emergency plan to face unexpected situations. The storing point must also be developed in this phase to guarantee the best flow and distribution of the products. Finally, the time and tools for distributing the products should also be identified to provide the best customer services; during all these processes, the information flow mechanism should be well considered.

3.3.2 Logistics Planning Levels

There are three levels of logistics planning according to Ballou (2009, p. 56):

> Logistics planning occurs at three levels: strategic, tactics, and operation. The main difference between these three types of planning

> is time framework of planning operation. Strategic planning is considered as the long-time planning, which plans for a period of time always take more than one year, while the tactics planning is concerning with a period of less than year, and finally the operation planning that concern basically with daily decision making.

Additionally, Farahani et al. (2011, p. 47) identify logistics planning level as follows: “Logistics planning for any business is based on the three levels of decisions. Logistics planning starts from strategic decision-making and hierarchically covers tactical and operational decisions.”

Farahani et al. (2011, p. 47) point out that logistics planning scope changes with regard to the nature of the business:

> Remember that the scope and structure of logistics planning can change from one business to another based on its nature and size, and the strategies it uses. Factors such as the time frame, resources required, and level of managerial responsibilities affect this difference. For example, distribution planning may be a part of the strategic decision-making of one firm but be a tactical plan in another firm. What is clear is that these decisions overlap and are interrelated.

Moreover, Farahani et al. (2011) state the key inputs for developing an effective logistics plan are as follows:

1. Marketing inputs: knowledge of products, pricing programs, sales programs and forecasts, and customer-service policies

2. Manufacturing inputs: manufacturing capabilities and locations

3. Purchasing inputs: new sources, materials, services, and technologies

4. Financial inputs: the source of the cost data and the availability of capital

5. Logistics inputs: location of current logistics facilities (p. 48)

Farahani et al. (2011) also explain the work done to implement a logistics plan:

> Finally, strategic decisions determine what our distribution system should be, tactical decisions are how the distribution system can be utilized, and operational decisions implement action — "Let's get the goods out." In the managerial hierarchy of a logistics system, strategic decisions are made by top managers, tactical decisions are made by middle managers, and operational ones are made by supervisory personnel. A logistics plan is about implementing the logistics strategy, so this strategy should be translatable to both tactical aims and operational actions. An organization will not achieve its goals with a badly designed strategy or an inappropriate execution plan. (p. 48)

Thus, we can confirm that logistics planning passes through three main levels; each has its own characteristics, missions and objectives, and time period. Additionally, the output of the logistics planning process, which is the logistics plan, needs to be continuously controlled to avoid any unexpected violations or mistakes.

3.3.3 Scope of Logistics Planning

According to Ballou (2009),

> Logistics planning focuses on four main problems: customer service, location decisions, storing decisions, and transport decisions. And, customer service is the result of planning of other three scopes. The level of customer service logistics affects more than other elements on the system designing. Because the poor level of service means less stores at less locations and uses of cheap tools of transport. While, high service requires the opposite. So, the first interesting of logistics planning should be customer service. Then, the geographic location of Stocking points and sourcing points create the framework of logistics planning. Furthermore, the storing decisions refer to tool of managing stores. And, finally, the transportation decision includes: choosing transportation tool, size of shipment, path of shipment and scheduling. (pp. 57–58)

Moreover, Farahani et al. (2011) concur with this concept:

> Logistics is the entire process of planning, implementing, and controlling the efficient flow and storage of materials and products, services, information, energy, people, and other resources that move into, through, and out of a firm (in both the public and private sectors) from the point of origin to the point of consumption and with the purpose of meeting customer requirements. (p. 45)

Furthermore, Farahani et al. (2011) identifies the scope of logistics as follows:

> A logistics system based on its definition and nature includes the following:
>
> 1. Storage, warehousing, and material handling
> 2. Packaging and unitization
> 3. Inventory
> 4. Transport
> 5. Information and control (p. 45)

Thus, it is evident that logistics planning focuses and is concerned with three main aspects, namely, location, storing, and transportation decisions. These aspects work together to achieve the main goal of logistics, which is to provide the customer with the best service. To do this perfectly, there should be planning and implementation to acquire the products and services, as well as information flow and control, to ensure that customers are well served and the handling process is perfect.

In our case, for determining the impact of logistics service planning on the success of the construction projects, we will discuss how these aspects of logistics planning affect the time, cost, and quality of a construction project.

3.3.4 Procurement

Van Weele (2014) defines procurement as follows:

> All undertakings that are required in order to get the product/service from the supplier to its final destination. The practice entails the whole lifespan of activities beginning with need identification, tender evaluation, purchasing, and ongoing managing of contract until the culmination of the contract.

Moreover, as we deal with a project study in this research, PMI (2008, p. 313) identifies project procurement management as follows: “Project Procurement Management includes the processes necessary to purchase or acquire products, services, or results needed from outside the project team.” PMI (2008, p. 313) details these processes in the following manner: “Project Procurement Management includes the contract management and change control processes required to develop and administer contracts or purchase orders issued by authorized project team members. Project Procurement Management also includes administering any contract issued by an outside organization (the buyer) that is acquiring the project

from the performing organization (the seller) and administering contractual obligations placed on the project team by the contract.

3.3.5 Transportation

Gassin (2005, p. 10) defines transportation: “Transportation can be defined as the act of moving goods or people from an origin to a required destination. It also includes the creation of time and place utilities.”

On the other hand, Kondratjev (2015, p. 13) defines transportation as follows: “Transport is part of the economic activity, which is associated with an increase in the degree of satisfaction of people and businesses by changing the geographical location of goods and people.”

Moreover, he explained the transportation process as follows:

> Transport – means of satisfying needs through transportation of goods and passengers. Transportation - one of the key logistics functions associated with moving goods vehicle on a particular technology in the supply chain, consisting of logistics operations and functions, including forwarding, cargo handling, packaging, and transfer of ownership of the goods, risk insurance, customs procedures, and so on. From an economic point of view, transport is one of the defining elements of the production process. The production and use of goods, there are two limiting factors - the time factor and the spatial factor.

Yung et al. (2005, p. 1660) identifies the importance of transportation:

> Transport system is the most important economic activity among the components of business logistics systems. Around one-third to two-thirds of the expenses of enterprises' logistics costs are spent on transportation. According to the investigation of National Council of Physical Distribution Management (NCPDM) in 1982 (Chang, 1988), the cost of transportation, on average, accounted for 6.5% of market revenue and 44% of logistics costs.

3.3.6 Storage

Keyence (2021) defines storage:

> Storage is the activity of storing products at warehouses and logistics centers. Its role is to provide a steady supply of goods to the market to fill the temporal gap between producers and consumers. It also plays an important role in maintaining quality at warehouses and logistics centers and value of products."

Lumsden (2003, p. 167) says, "An inventory is created to give internal security to the company headed for disturbance in the material flow."

Lumsden (2003, p. 167) further states that "Building an inventory in the need for high functional guarantee and that the customers should have access to articles whenever they need them."

Moreover, Lumsden (Fundamentals of Logistics, 2003) suggests,

A good way to define the different types of inventories is to start from its function within the company. Below, we present several functions of inventory.

Cycle stock:

Is used to weigh the set-up costs of manufacturing against the costs on interest related to keeping an inventory for manufacturing in batches.

Safety stock:

Is used to make sure that disruptions and variations in demand and deliveries do not cause shortages, delivery readiness is required in uncertain surroundings.

Market stock:

As a company performs any activity in connection to marketing or introduction of new products, the demand increases temporarily. The inventory created will supply this demand.

Speculation stock:

In cases when it is difficult to predict the market in terms of supply and demand elements, pricing, and supply variation, companies create storage to face this.

Cross-Docking terminals:

Cross-docking means that a large incoming goods consignment is split up into a number of outgoing consignments. This process involves scheduling of the corresponding incoming and outgoing transport in a maximum time of 24 hours. This means that the goods are never put into storage, but pass directly through the terminal. A requirement for a cross-docking system to function is that the information system must be well developed.

Split point and co-loading point terminals

A co-loading point is a point where goods arrive from a number of different points, and the goods are coordinated in a transport relation with one direction. A split point is the opposite of a gathering point, but follows the same logical sequence. In this case, goods arrive from one transport relation, which is then split up to a number of relations. (p. 168).

3.3.7 Handling

Handling has been defined by Lumsden (2003, p. 190) as "Handling is the movement, protection, storage, and control of materials and products throughout manufacturing, warehousing, distribution, consumption, and disposal."

Additionally, Lumsden describes the handling process as “As a process, material handling incorporates a wide range of manual, semi-automated, and automated equipment and systems that support logistics and make the supply chain work.”

Finally, Lumsden describes the benefits of successful handling as “A company’s material handling system and processes are put in place to improve customer service, reduce inventory, shorten delivery time, and lower overall handling costs in manufacturing, distribution, and transportation” (2003, p. 193).

3.3.8 Information Flow

Chaffe (2001) describes information logistics as “The process of acquiring, maintaining, transporting, and compiling information within and among entities.”

Moreover, Klein (1993) states that the concept of information logistics links the functions of business logistics and information management. It focuses on vertical coordination within firms and horizontal coordination within and beyond the boundaries of the firm. From a conceptual perspective, information logistics is a crucial element of a revised model of the firm. In an inter-organizational perspective, information logistics refers to the emerging telecommunication infrastructure.”

3.4 Construction Project

To define the term *construction project*, we first need to identify, define, and perfectly explain the meaning of the word *construction* to have a clear vision of the term *construction project*.

3.4.1 Definition of Construction

The word *construction* has been defined by Oxford Dictionary (2006, p. 312) as "The process or method of building or making something, especially roads, buildings, bridges, etc."

3.4.2 Construction Project Definition

The word *project* is defined by Oxford Dictionary (2006, p. 1162) to explain and describe different situations: in terms of planned work as "A planned piece of work that is designed to find information about something, produce something new, or improve something"; in terms of school or college work as "A piece of work involving careful study of a subject over a period of time, done by school or college students"; and when concerned with a set of aims or activities as "Project is a set of aims, ideas, or activities that somebody is interested in or wants to bring to people's attention."

Furthermore, PMI (2008, p. 5) has defined *project* as follows: "[A p]roject is [a] temporary endeavor undertaken to create a unique product, service, or result."

This definition does not differ much from the one developed by APM, which is “Projects are unique, transient endeavors undertaken to achieve a desired outcome” (2006, p. 2).

Yet another definition for project developed by Meredith and Mantel is “A project is a specific, finite task to be accomplished” (2009, p. 9).

Moreover, Wysoki and McGray defined a project as “A project is a sequence of unique, complex, and connected activities having one goal or purpose, and that must be completed by a specific time, within budget, and according to specification” (2003, p. 3).

These definitions have affirmed that a project is a work or task that needs to be planned and executed to provide a result. This result may be information, product, and people’s attention, as explained by Oxford Dictionary; a unique product, service, or result, as PMI described the goal of project; or a task, as identified by Meredith.

Additionally, all definitions agree that a project should have a specific time to be executed; and the result of the project should be unique or new, something that has not been accomplished previously.

Therefore, with regard to both definitions of the word *construction* and the word *project*, we may be able to describe a construction project as “any planned work or activity that could be achieved and aimed, to build or make roads, buildings,

and bridges, for residential and/or commercial purpose that are new and unique at a specific time and with an identified budget."

3.4.3 Project Time

The time of execution of a project should be known and determined during the planning process of the project. This is considered one of the main missions of project planning.

The importance of this step has been highlighted by Wysocki and McGray (2003):

> Time is an interesting resource. It can't be inventoried. It is consumed whether we use it or not. The objective for the project manager is to use the future time allotted to the project in the most effective and productive ways possible. Future time (time that has not yet occurred) can be a resource to be traded within a project or across projects. Once a project has begun, the prime resource available to the project manager to keep the project on schedule or get it back on schedule is time. A good project manager realizes this and protects the future time resource jealously. (pp. 8-9)

Furthermore, PMI (2008, p. 129) identifies the project time process as "the processes required to manage timely completion of the project."

PMI (2008) details these processes in the following manner:

"1- Define Activities is the process of identifying the specific actions to be performed to produce the project deliverables.

2- Sequence Activities is the process of identifying and documenting relationships among the project activities.

3- Estimate Activity Resources is the process of estimating the type and quantities of material, people, equipment, or supplies required to perform each activity.

4- Estimate Activity Durations is the process of approximating the number of work periods needed to complete individual activities with estimated resources.

5- Develop Schedule is the process of analyzing activity sequences, durations, resource requirements, and schedule constraints to create the project schedule.

6- Control Schedule is the process of monitoring the status of the project to update project progress and managing changes to the schedule baseline. (p. 129)

3.4.4 Project Cost

The importance of project cost had been developed by Wysocki and McGray (2003) who suggested that

> Cost is a major consideration throughout the project management life cycle. In fact, it is the first consideration occurs at an early and informal stage in the life of a project. The customer can simply offer a figure about equal to what he or she had in mind for the project. Depending on how much thought the customer put into it, the number could be fairly close to or wide of the actual cost for the project. Consultants often encounter situations in which the customer is willing to spend only a certain amount for the work. In these situations, you do what you can with what you have. In more formal situations, the project manager prepares a proposal for the projected work. That proposal includes an estimate (perhaps even a quote) of the total cost of the project. Even if a preliminary figure had been supplied by the project manager, the proposal allows the customer to base his or her go/no-go decision on better estimates. (p. 8)

Additionally, Lock (2007) describes the importance of estimating the project's cost as follows:

> Reliable cost estimates are necessary for all projects, whether or not they are to be sold for a fixed price to an external customer. Without a cost estimate, it would be impossible to carry out financial appraisal, prepare a business plan, establish detailed budgets, control spending, assess manpower requirements, or perform many other management procedures. (p. 49)

Moreover, PMI (2008, p. 165) identifies that the "project cost process includes the processes involved in estimating, budgeting, and controlling costs so that the project can be completed within the approved budget."

PMI (2008, p. 165) details these processes as follows:

1- Estimate Costs is the process of developing an approximation of the monetary resources needed to complete project activities.

2- Determine Budget is the process of aggregating the estimated costs of individual activities or work packages to establish an authorized cost baseline.

3- Control Costs is the process of monitoring the status of the project to update the project budget and managing changes to the cost baseline.

3.4.5 Project Quality

Project quality has been explained and divided into two parts by Wysocki and McGray (2002) who assume that

> These two types of quality are part of every project: The first is *product quality*. This refers to the quality of the deliverable from the project. The traditional tools of quality control are used to ensure product quality. The second type of quality is *process quality*, which is the quality of the project management process itself. The focus is on how well the project management process works and how can it be improved. Continuous quality improvement

and process quality management are the tools used to measure process quality. (p. 8)

This concept is supported by Anderson et al. (2009) who argue

> We want quality in project work because it has benefits for the entire base organization; high quality in project work improves the organization. We can distinguish between two categories of projects that affect quality in organizations in different ways:
>
> - Projects where the results change operations internal to the base organization; this means that the quality of the project has direct consequences for the quality of the base organization.
> - Projects where the results are delivered to an external organization and the quality of the results determines whether or not the base organization has fulfilled its terms of delivery; this means that the quality has significance for the base organization's reputation and provides opportunities for future contracts. (p. 169)

Further, PMI (2008) identifies the project quality process as

The processes and activities of the performing organization that determine quality policies, objectives, and responsibilities so that the project will satisfy the needs for which it was undertaken. It implements the quality management

system through policy and procedures with continuous process improvement activities conducted throughout, as appropriate. (p. 189)

PMI (2008) also details these processes as follows:

1. Plan Quality is the process of identifying quality requirements and/or standards for the project and product and documenting how the project will demonstrate compliance.
2. Perform Quality Assurance is the process of auditing the quality requirements and the results from quality control measurements to ensure appropriate quality standards and operational definitions are used.
3. Perform Quality Control is the process of monitoring and recording results of executing the quality activities to assess performance and recommend necessary changes. (p. 189)

3.5 Logistics Strategy

Farahani et al. (2011, p. 43) define strategy as follows: "Strategy originates from the Greek word strategos ("general" of the army), but its contemporary definition refers to a plan for achieving chosen objectives. Therefore, strategy as planning and positioning is the traditional definition of strategy."

In addition, according to Harrison and Hoek (2008), "Strategy is about planning as distinct from doing. It is about formulating a long-term plan for the supply chain, as distinct from solving the day-to-day issues and problems that

inevitably occur" (p. 26). Logistics management and strategy—competing through the supply chain.

Further, logistics strategy has been defined by Harrison and Hoek (2008, p. 26) as "Logistics strategy is the set of guiding principles, driving forces and ingrained attitudes that help to coordinate goals, plans and policies, and which are reinforced through conscious and subconscious behavior within and between partners across a network."

3.6 Lean Logistics

Wu (2002, p. 20) defines lean logistics as "Lean logistics refers to the superior ability to design and administer systems to control movement and geographical positioning of raw materials, work-in-process, and finished inventories at the lowest cost."

Farahani et al. (2011, p. 55) identify lean logistics as "Waste is the basic concept of lean philosophy. Lean philosophy uses a number of simple concepts and tools to eliminate waste in all supply-chain activities."

They explain eight types of waste that lean aims to eliminate:

1. Defects: money and time wasted for finding and fixing mistakes and defects.
2. Over-production: making products faster, sooner, and more than needed.
3. Waiting: time lost because of people, material, or machines waiting.

4. Not using the talent of our people: not using experiences and skills of those who know the processes very well.
5. Transportation: movement of people, materials, products, and information.
6. Inventory: raw materials, works in process (WIP), and finished goods more than the one piece required for production.
7. Motion: Any people and machines movements that add no value to the product or service.
8. Over-processing: Tightening tolerances or using better materials than what are necessary. (p. 57)

Womack et al. (2007) describe lean as follows: "Lean gives you the ability to produce more by using less – less human effort, equipment, time and place, while at the same time getting closer to the objective, which is to provide the clients exactly what they want."

Further, Wronka (2016, p. 57) identifies lean logistics as the following:

> The concept of Lean Logistics is becoming more and more common in world literature. It is defined in various ways, mainly depending on the scope and context of the study. Most generally, it is a logistic dimension of production, in line with the Lean Management concept. Internal and external logistic processes are designed to support the continuous flow of production materials and complet[e] the delivery to end customers, at the same time maintaining

the appropriate time, place, quality, and cost. In addition, all logistic processes taking place in the organization must be constantly improved, especially with regard to the elimination of unnecessary waste and activities not generating added value. (Baudin, 2004).

In addition, Sopadang et al. (2014) believe there are nine areas in logistics where waste occurs:

In practice, there can be nine logistic area pointed out in which the typical losses for Lean can occur. These are logistics service and customer support, forecasting demand and planning, procurement and purchasing, stock management, deliveries and communication, packaging of materials, transportation, storage, and reverse logistics.

Further, Overboom et al. (2013) explain the benefits of using lean in these areas as follows:

Applying Lean principles in relation to the listed areas, apart from identification and elimination of losses, leads to many tangible benefits. The most important of them include: balancing production lines and reducing lead time factor (measured from the order time to the delivery time), reduction of stock levels, elimination of downtime, delays and unwanted variability, as well as greater availability of products together with flexibility throughout the supply chain. Applying the guidelines of Lean Logistics on a regular basis

> helps to prevent any process shortages, mainly bas[ed] on a systematic analysis of processes, production control compatible with the pull system, and supporting ongoing operations. The adaptation of Lean principles to the management of logistics processes [is] to contribute to the improvement of flows occurring in them.

Thus, we can deduce that the main target of lean is to control resources and guarantee the best method of using them effectively and efficiently, irrespective of whether these resources are raw materials, money, services, human resources, or even time.

3.7 Development of the Research Hypothesis Model

This study is concerned with the concept, value, and importance of logistics services planning with respect to construction projects. According to Muya (1999, p. 1), "Management of construction materials on well-grounded logistics and supply chain management principles has the potential to yield results and augment efforts being made in other areas at making construction more efficient."

According to Fadiya (2012),

> Efficient logistics practice can significantly enhance efficient construction process. It will reduce waste substantially or eliminate it completely. For instance, it will reduce material or component waste by ensuring their safe delivery, storage, and protection from theft and damage. It will also reduce

> waste of time by removing non-value-adding activities or even adding value-adding activities.

In addition, Anane et al. (2019, p. 4) state that, "procurement policy has an effect on service delivery, especially electricity service delivery, by the very nature and complexity in politics and law governing all phases of service delivery from the standpoint of the provider and consumer." They further say that

> procurement planning contributes to the enhancement of service delivery in an efficient and effective manner in public organizational sectors.

Additionally, the researchers also state that "sustainable economic procurement ensures that procured goods and services will deliver high-quality services to customers" (p. 8).

Further, Anane et al. (2019) state the following regarding the relationships between hypotheses found in their study:

> The study revealed a strong significant positive correlation between procurement policy and service delivery. Moreover, the result showed a strong significant positive correlation between procurement planning and service delivery. Again, the study found a significant positive correlation between sustainable procurement and service delivery." (p.2)

They developed a framework model to explain the relationship between these variables, as follows:

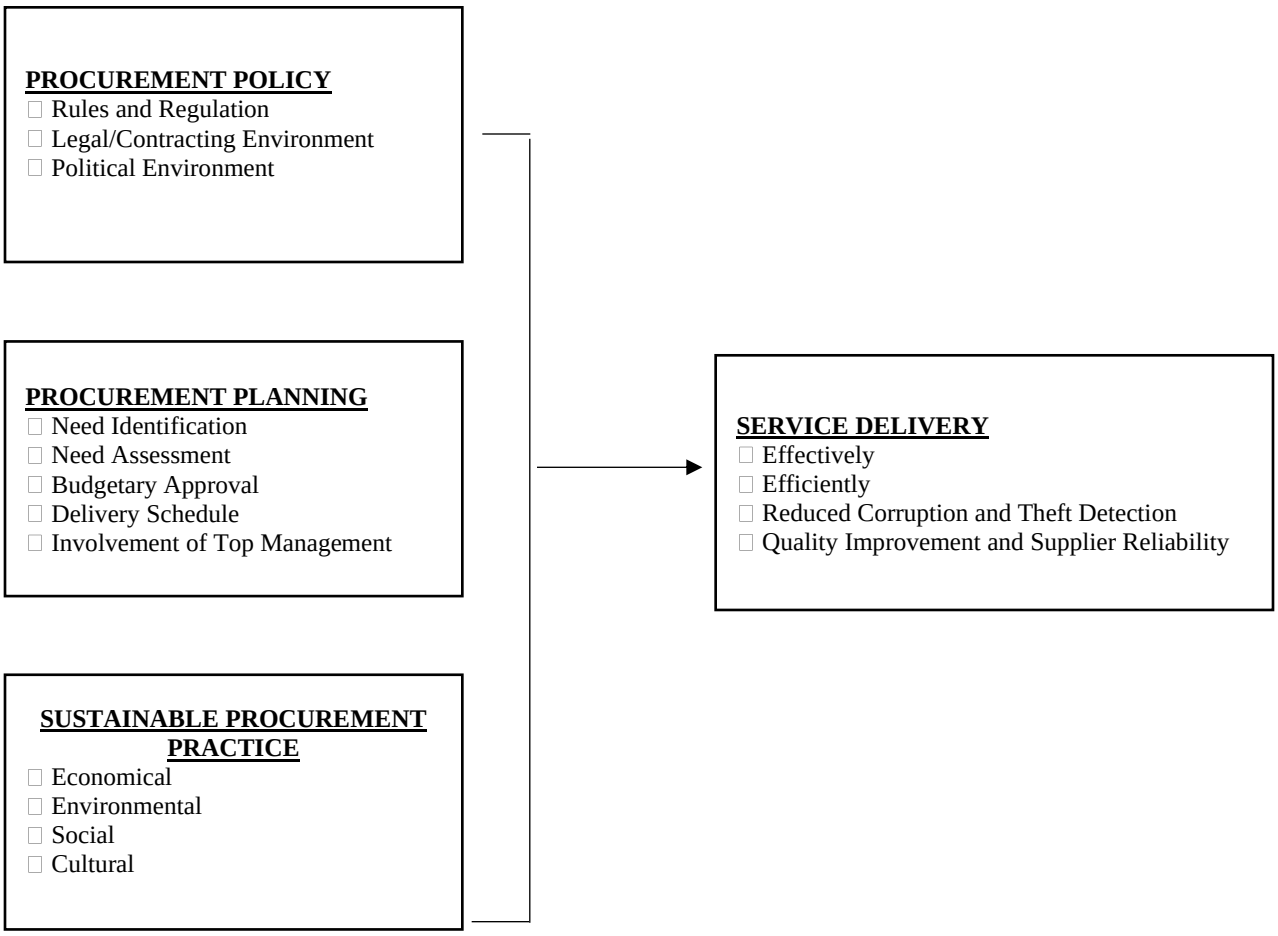

Figure 3.1: *Research Model by Anane et al. (2019). Note.* Anane et al. (2019, p. 5)

Eriksson and Westerberg (2012) state the following:

> Both practitioners and academics argue that many of the problems in construction projects are linked to inadequate procurement procedures where the focus is on short-term individual sub-optimization rather than on long-term project team performance. In order to increase the efficiency of the construction industry development and improvement of procurement procedures is therefore vital. (p. 1)

They developed a framework model (Figure 3.2) that outlines the relationship between collaborative procurement procedures and construction project performance.

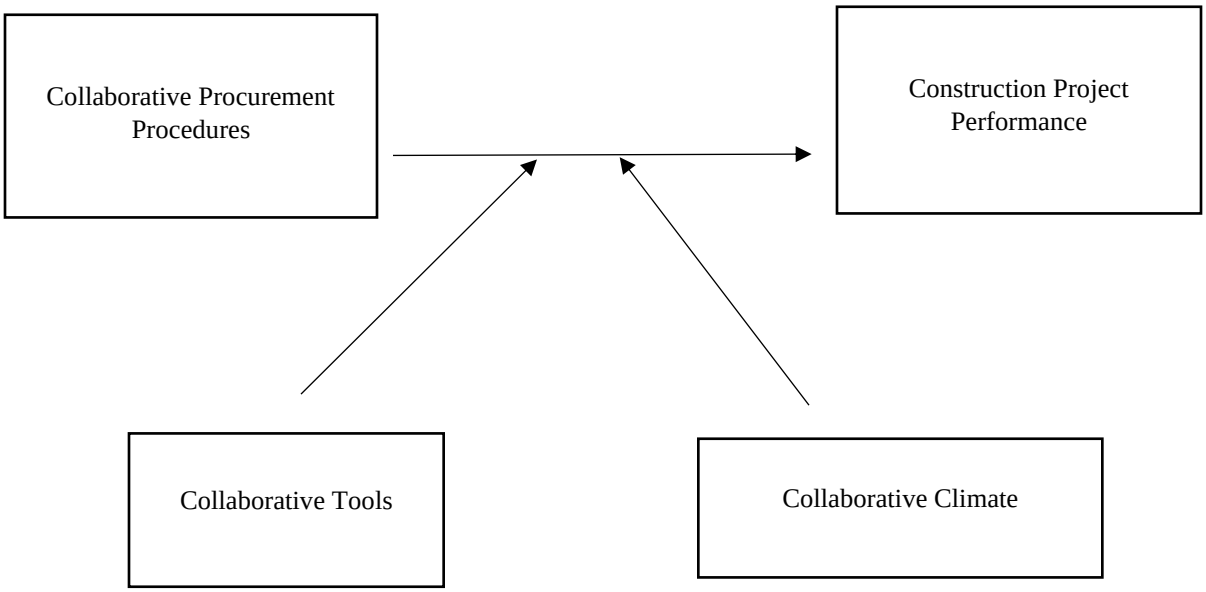

Figure 3.2: *Research Model by Eriksson and Westerberg (2019). Note.* Eriksson & Westerberg (2012, p. 14)

This will provide us with a clear vision for framing the study's hypotheses regarding developing a logistics planning strategy to control defects and maintain the perfect execution of construction projects.

To achieve this, this study is concerned with the following hypotheses:

1. There is a positive relation between logistics planning and the successful execution of a construction project in terms of the time, cost, and quality of the project.
2. There is a positive relation between logistics planning and logistics strategy management.
3. There is a positive relation between logistics strategy management and the successful execution of a construction project in terms of time, cost, and quality of the project.
4. Logistics strategy management mediates the relation between logistics planning and the execution of a construction project in terms of time, cost, and quality of the project.
5. Lean logistics moderates the relation between logistics strategy management and the execution of a construction project.

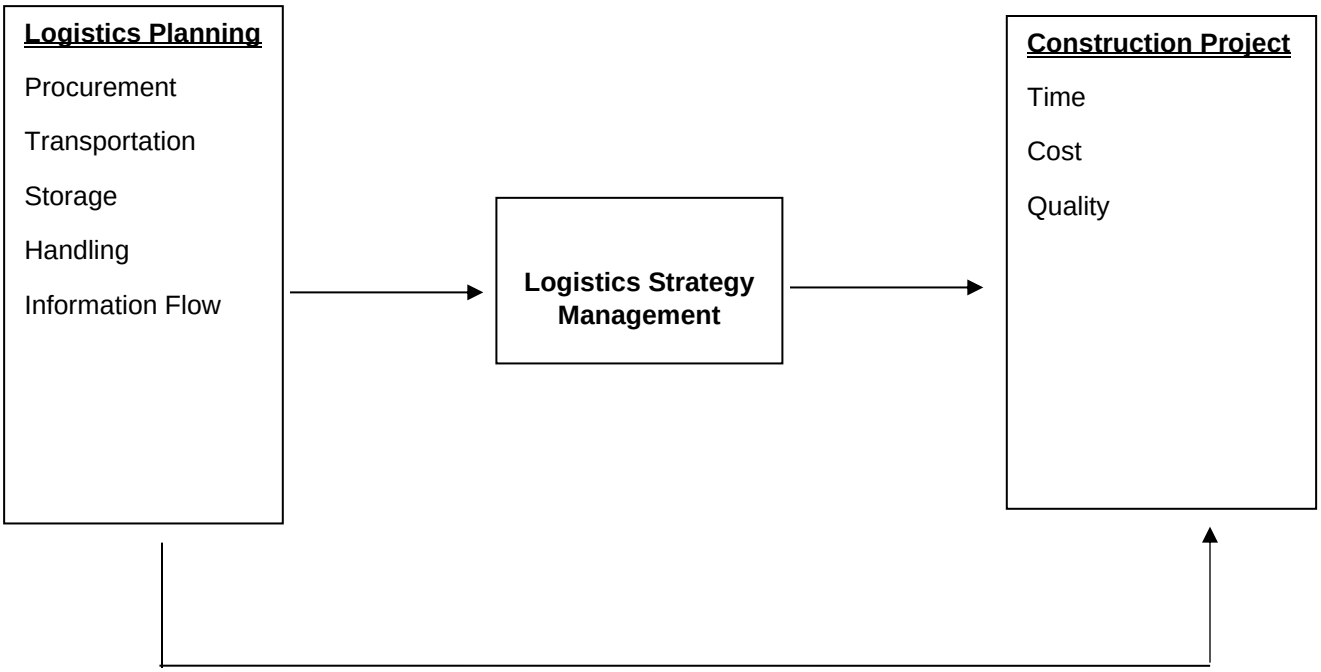

Figure 3. 3: *Research Model. Note*. Prepared by the Researcher (2021).

3.8 Descriptive Framework

This research discusses the impact of logistics services planning on the success of construction projects in Khartoum State; precisely, it will focus on the residential complexes in Khartoum. Therefore, the descriptive framework of this study will also focus on Khartoum State and the residential complexes in the city of Khartoum.

3.8.1 Khartoum State

According to Pantuliano (2011),

Khartoum was established as an outpost of the Egyptian army and as a regional trading post in 1821, and was proclaimed the capital of the Anglo-

Egyptian Condominium in 1899. Khartoum is Sudan's primary city, not only in terms of absolute population, but also politically, economically and socially. Greater Khartoum today consists of three cities in one: Khartoum, Omdurman and Khartoum North (Bahri). Khartoum, south of the Blue Nile, is often identified as the commercial hub, while Bahri, on the northern bank, is traditionally considered the industrial centre; Omdurman, to the west of the White Nile, is known for its political history and agricultural links. Khartoum's downtown centre, characterised by its colonial architecture, has until recently been the commercial heart of the city. The recent relocation of the central bus station and associated markets further out has diminished its importance and resulted in changing market habits and greater commercial competition in upper-class areas of Amarat and Al Riyadh, as well as in Mayo, El- Salama and Haj Yousif. Omdurman and Bahri are both expanding, with low-level housing, infrastructure development and associated planning challenges. The old Mahdist capital, Omdurman, with a UNESCO world heritage site marketplace at its centre, retains its traditional character, with narrower streets and houses built with local materials. (p. 3)

Pantuliano (2011) further adds the following:

Specific urban development plans for Khartoum have also been developed, with the first dating from the early years of the twentieth century, during the

British colonial administration. The first post-independence master plan was drawn up in 1960 by an international agency, Dioxidais, which later became involved in the third master plan in collaboration with Abdelmoneim Mustafa Associates. The intervening master plan of 1975 was written by the Italian company MEFFIT, and another master plan was drawn up in 2000. None of these different plans has been implemented. A fragile economy, ineffective government institutions, environmental problems, conflict and vested economic and political interests are among the key factors behind their failure. The inability to implement plans has led to uncontrolled urban sprawl and land misuse. A former State Governor of Khartoum, Ismail Al-Mutaafi, tried to develop a new plan to put an end to irregularities in land use in Khartoum, the Khartoum Structural Plan (2007–2033). The MPPPU was entrusted with the preparation of the plan, which was designed by MEFFIT between 2007 and 2010. The plan was developed on the basis of wide consultations and in collaboration with academic institutions in Sudan. The main aim of the plan is to integrate different neighbourhoods by connecting the various parts of the city with road networks and transport systems. A key government aim is also to ensure that current patterns of ethnic concentration in the city are broken up. The plan's main objective is to ease congestion in the centre, remove squatter settlements and replace them with so-called 'popular housing', and

relocate government institutions, military barracks and educational institutions to the city's periphery. (p. 7)

Based on the above, we have seen many different kinds of housing projects built in Khartoum State. Among these housing projects, residential complexes are a new type of housing to be approached in Khartoum. Therefore, this study is concerned with the construction process of housing projects.

3.8.2 Residential Complexes in Khartoum

Residential complexes have emerged as a new type of housing in Khartoum in recent decades. This type of construction project becomes more familiar and favorable for a lot of people in Khartoum State. As a result, many residential complexes have been constructed in Khartoum. This study will be conducted by gathering data from the 10 largest and most important residential complexes in Khartoum State, which are as follows:

1. Al-Nasr Residential Complex
2. Doha Residential Complex
3. Al-Azizia Residential Complex
4. Bashaer Residential Complex
5. Al-Ruwad Residential Complex
6. El Yasmine Residential Complex
7. Ennma Residential Complex

8. Alzafir Residential Complex
9. Midtown Residential Complex
10. Araak Residential Complex

Chapter Four

Research Methodology

Chapter Four

Research Methodology

4.1 Overview

This chapter discusses the research methodology chosen by the researcher to present valuable and practical results that can help develop the process of planning logistics services and the execution of the construction projects in terms of adapting the best method for logistics planning. To do this, the general concept of research and business research, as well as research methodology, will be discussed to gain a general idea about the research methodology. Then, the chosen descriptive-analytical research methodology shall be discussed to delineate its role and importance in developing scientific research. Furthermore, the scope of the research will be introduced, and the research population and sample will be identified. In addition, the selected data collection method, which is the questionnaire, will be discussed to show the procedures and techniques used in developing the questionnaire. Finally, the coefficient of determination (R^2) and path coefficient will be identified as tools to evaluate the structural results.

4.2 Research Methodology

Before introducing the methodology used in this research, we will highlight the definitions of research, business research, and research methodology.

Sekaran (2016) defines research as follows:

Research is the process of finding solutions to a problem after a thorough study and analysis of the situational factors. In simple words, research is an organized, systematic, data-based, critical, objective inquiry into a specific problem that needs a solution. (p. 1)

Moreover, as we are dealing with a specific type of research in this study, business research, it will be better to present a definition of it. Sekaran (2016) defines it as follows:

> Business research can be described as a systematic and organized effort to investigate a specific problem encountered in the work setting, which needs a solution. It comprises a series of steps that are designed and executed with the goal of finding answers to the issues that are of concern to them. (p. 2)

In addition to defining research and business research, it is very important to distinguish the method of research from the research methodology to show the concept of the research methodology. Koc (2000) distinguished between a method and a methodology by describing a method as follows:

> method is, simply, the research technique or tool used to gather data and, methodology is the philosophy of the research process. Therefore, methodology can be said to include the assumptions and values that serve as

a rationale for the research and the standards or criteria used for interpreting data and reaching conclusions. (p. 134)

This has been supported by Diweedry (2008), who said the following:

The idea of "Method" in the currently known terminology had been developed in the Seventeenth Century by Francis Bacon, John Stuart Mill and other scholars to mean the technique that leads to discover the truth in science by different public rules that control the orientation of mind and determining its operation until getting given result. (p. 189–129)

Diweedry (2008) continues to explain research methodology as follows:

And, the science that looks for the techniques used by the researchers to study the problem and find the truth is "Methodology". And this science has become a terminology that used in many fields. Some of that fields are the procedures that used by any science to collect data and gaining knowledge. However, the basic meaning that denoted by the terminology of "Methodology" is the impartial study of the logical bases of the specific science. And this usage make Methodology equal the Philosophy of Science. (p. 129)

Thus, it is clear that the word *method* is used when we want to describe the procedure that we are going to use to collect data that can help us get scientific results and develop solutions for a specific problem. On the other hand, the word "methodology" is used to describe the philosophy or process that is used to describe

the scientific problem and suggest the best way to diagnose, present, discuss, and treat that problem.

4.2.1 Descriptive Methodology

For the purpose of this research, the researcher used the descriptive-analytical approach because it is compatible with this type of study and its objectives. The descriptive methodology or approach is considered one of the main famous and important methodologies of research in the field of human studies. Diweedry (2008) has defined descriptive methodology as

> One of analytical method that focuses on enough and accurate information about phenomenon, specific topic, or a determinant period or periods of time in order to get scientific results that could be explained in objective manner that harmonies with the actual facts of phenomenon. (p. 183)

Thus, a descriptive approach is one that is concerned with determining the current situation of a problem and then working on describing, analyzing, interpreting, and linking it to other phenomena. We are going to do this in the current study, which seeks to describe the impact of logistics services planning on the success of a construction project. The study also includes a field study for collecting data through a questionnaire. The questionnaire will be prepared to suit the study in terms of ease of using statistical analysis to test and prove the validity of the study hypotheses.

4.3 Scope of the Research

Having introduced the methodology used in this research, we define the scope of this research, which includes the following four points:

- Logistics service planning.
- Execution of a construction project as a measure of company's success.
- Logistics strategy management.
- Lean logistics.

Further, the research hypotheses include the following variables:

- Independent variable: Logistics service planning.
- Dependent variable: Execution of a construction project as a measure of a company's success.
- Mediator variable: Logistics strategy management; the researcher seeks to know the effect of the average logistical strategy on the success of the execution of the construction project.
- Moderator variable: Lean logistics, the tool to eliminate waste from logistical activities.

4.4 Research Population and Sample

Sekaran (2016) defines the research population as follows:

The population refers to the entire group of people, events, or things of interest that the researcher wishes to investigate. It is the group of people, events, or

things of interest for which the researcher wants to make inferences (based on sample statistics). (p. 235)

Smith (2010) defines population in the following manner:

A population, also known as a universe, is defined as the totality of all units or elements (individuals, households, organizations, etc.) to which one desires to generalize study results. While seemingly an easy task, an imprecise research problem definition often leads to an imprecise population definition. (p. 123)

Smith (2010) also identifies how to determine the population:

Specifying a population involves identifying which elements (in terms of kind) are included, as well as where and when. For example, a group medical practice that is considering expanding into sports medicine might acquire information from any or all of the distinct population groups. The population element is the unit of analysis, and may be defined as an individual, household, institution, patient visit, and so on. (p. 123)

Sekaran (2016, p. 237) defines a research sample as "A sample is a subset of the population. It comprises some members selected from it. In other words, some, but not all, elements of the population form the sample."

Furthermore, Sekaran (2016) identifies the reason behind selecting a sample rather than testing the whole population:

The *reasons* for using a sample, rather than collecting data from the entire population, are self-evident. In research investigations involving several hundreds and even thousands of elements, it would be practically impossible to collect data from, or test, or examine, every element. Even if it were possible, it would be prohibitive in terms of time, cost, and other human resources. Study of a sample rather than the entire population is also sometimes likely to produce more reliable results. This is mostly because fatigue is reduced and fewer errors, therefore, result in collecting data, especially when a large number of elements is involved. In a few cases, it would also be impossible to use the entire population to gain knowledge about, or test, something. (p. 235).

Smith (2010) supports this claim:

Once the population has been defined, the investigator must decide whether to conduct the survey among all members of the population, or only a sample subset of the population. The desirability and advantages of using a sample rather than a census depend on a variety of factors such as geographic location, the absolute size of the population, and the sample size required for results sufficiently accurate and precise to achieve the required purposes. (p. 125)

Therefore, the process of determining the research population and sample is guided to achieve the objective of the research. Developing a good flow of logistics

services for the construction project will be the target of determining the population. The sample of the study will concern all those who develop logistics service planning and execute logistical tasks in the field of construction projects. In this study, career specification (the type of interviewees studied) will not be focused on; rather, the job that people do in a project will be under study. That is, the study will not focus on the professions that people have, such as engineer, project manager, or designer. A major focus will be the people who work in the field of logistics support regardless of their career in the project. For example, if the project manager does not participate in designing the logistics service and is not concerned with the logistics planning and service execution, they will not be valuable for this study. However, we will aim to interview or question every member who deals with the logistics service of the construction project and who can make a difference in the process of logistics planning and the execution of different logistical tasks. Therefore, the population of this study is the personnel working in the logistics services of construction projects in residential complexes in the state of Khartoum. This population includes logistics planners, project engineers, and employees who execute logistical tasks, mediators, contractors, and logistics service providers for construction projects.

4.4.1 Sample Size

Sekaran (2016, p. 241) asks, “Is a sample size of 40 large enough? Or do you need a sample size of 75, 180, 384, or 500? Is a large sample better than a small sample; that is, is it more representative? The decision about how large the sample size should be can be a very difficult one. The author identifies some issues regarding the determination of the sample size:

> Too large a sample size, (say, over 500) could become a problem inasmuch as we would then be prone to committing Type II errors. That is, we would accept the findings of our research, when in fact we should reject them. In other words, with too large a sample size, even weak relationships (say a correlation of 0.10 between two variables) might reach significance levels, and we would be inclined to believe that these significant relationships found in the sample were indeed true of the population, when in reality they may not be. Thus, neither too large nor too small sample sizes help research projects. (p. 264)

Sekaran (2016) further points to the importance of statistical and practical significance:

> Another point to consider, even with the appropriate sample size, is whether statistical significance is more relevant than practical significance. For instance, a correlation of 0.25 may be statistically significant, but since this

explains only about 6% of the variance (0.252), how meaningful is it in terms of practical utility? p. 264

Finally, Sekaran (2016) suggests rules of thumb for determining the sample size:

1. Sample sizes larger than 30 and less than 500 are appropriate for most research.
2. Where samples are to be broken into subsamples (males/females, juniors/seniors, etc.), a minimum sample size of 30 for each category is necessary.
3. In multivariate research (including multiple regression analyses), the sample size should be several times (preferably ten times or more) as large as the number of variables in the study.
4. For simple experimental research with tight experimental controls (matched pairs, etc.), successful research is possible with samples as small as 10 to 20 in size. (p. 264)

Therefore, for the purpose of this study, a purposive symbol will be selected for the data collection process. The symbol will be among logistics personnel from 10 companies that execute residential complexes in Khartoum State. The overall size of this population is estimated at 220 individuals. The questionnaire will be

distributed to 150 individuals to collect rich data and obtain accurate and valuable results.

4.5 Data Collection Method

The questionnaire is used as the method to collect field data. It is designed to include questions relating to demographic information and the variables of the study, logistics service planning, execution of construction projects, logistics strategy, and lean logistics; the questions are based on the expressions used in previous studies, as shown in Table 4.1 below, to measure these variables. The Arabic language used to explain the questionnaire could be easily understood by potential respondents. The questionnaire was basically addressed in English and translated first from English to Arabic and then from Arabic to English to increase its perceived meaning. Then, the questionnaire was arbitrated by a group of academics and specialists, as shown in Appendix D of this research. The questionnaire is divided into two sections, demographical and study variables. The personal demographic section included 6 dimensions related to gender, age group, academic qualification, the department in which the individuals work, years of employment experience, and career level in the logistics field. While the second section included four variables. The independent variable, logistics service planning, included 42 phrases covering the stages and areas of logistics service planning, while the dependent variable, execution of construction projects, which was used as a measure of the company's

success, included 28 phrases covering execution time, reasonable cost, percentage of losses and damages, and the quality of construction projects. Further, the mediator variable, logistics strategy, included 13 phrases. Finally, the moderator variable, lean logistics, included 6 phrases.

Table 4.1: *Questionnaire Phrases Source*

No	Variable	Indicator	Source
1	Logistics Planning	Procurement	Eriksson and Westerberg (2011), Kayapınar and Lorcu (2020), Hilletofth and Hilmola (2010).
		Transportation	Kayapınar and Lorcu (2020), Asnaashari (2011).
		Storage	Hilletofth and Hilmola (2010), Asnaashari (2011).
		Handling	Hilletofth and Hilmola (2010), Asnaashari (2011).
		Information Flow	Hilletofth and Hilmola (2010),
2	Logistics Strategy	Logistics Strategy	Hilletofth and Hilmola (2010), Brat and Raghu (2012).
3	Lean Logistics	Lean Logistics	Asnaashari (2011), Labib (2016).
4	Project	Time	Eriksson and Westerberg (2011), Labib (2016).
		Cost	Liu and Zhao (2008), Eriksson and Westerberg (2011), Chavez (2015). Labib (2016).
		Quality	Eriksson and Westerberg (2011), Kayapınar and Lorcu (2020), Baird (2011), Labib (2016).

4.5.1 Study Tool Application

Questionnaire statements are formulated according to a 5-point Likert scale (Strongly Agree, Agree, Neutral, Disagree, Strongly Disagree) based on the following weights:

Table 4.2: *Likert Scale Weights*

Weight	Scale
1	Strongly Disagree
2	Disagree
3	Neutral
4	Agree
5	Strongly Agree

The researcher, then, calculated the weighted arithmetic mean as follows:

Table 4.3: *Weighted Arithmetic Mean*

Weighted Arithmetic Mean	Scale
From 1 to 1.79	Strongly Disagree
From 1.80 to 2.59	Disagree
From 2.60 to 3.39	Neutral
From 3.40 to 4.19	Agree
From 4.20 to 5	Strongly Agree

Through the table, it is noted that the length of the period used is 4/5, or about 0.80, and the period was calculated based on the numbers 1, 2, 3, 4, and 5, including 4 spaces.

4.6 Evaluation of Measurement Models

The evaluation of measurement models used to analyze the collected data is very significant for the purpose of this research. This measurement evaluation will help us test the consistency and reliability of our collected data as well as the obtained research results. Hair et al. (2021) describes the importance of this evaluation as follows:

> Model estimation delivers [an] empirical measure of the relationship between the indicators and the constructs (measurement models) as well as between the construct (structural model). The estimates enable us to evaluate the quality of the measures and assess whether the model provides satisfactory results in explaining and predicting the target constructs. The model evaluation follows a two-step process. The process involves separate assessments of the measurement models and the structural model. (p. 110)

4.6.1 Assessments of the Reflective Measurement Models

As we use the partial least square structural equation model (PLS-SEM), the assessment of reflective measurement models will include individual indicator

reliability, composite reliability (CR) to evaluate internal consistency, and average variance extracted (AVE) to evaluate convergent validity. Assessment of measurement models also includes discriminant validity. In addition, the Fornell–Larcker criterion and the Heterotrait-Monotrait (HTMT) ratio of correlations will be used to examine discriminant validity.

4.6.1.1 Indicator Reliability (Outer Loadings)

Hair et al. (2021) identified the accepted outer loading as follows:

> At a minimum, the outer loadings of all indicators should be significant. Because a significant outer loading could still be fairly weak, a common rule of thumb is the standardized outer loading should be 0.708 or higher. The rationale behind this rule can be understood in the context of the square of a standardized indicator's outer loading, referred to as the communality of an item. The square of a standardized indicator's outer loading represents how much of the variation in an item is explained by the construct and is described as the variance extracted from the item. An established rule of thumb is that latent variable should explain a substantial part of each indicator's variance, usually at least 50%. The remaining portion represents an indicator's unexplained variance (measurement error). Explaining at least 50% of an indicator's variance implies that the variance shared between the construct

and its indicator is large than measurement error. Hence, an indicator's standardized outer loading, should be 0.708 or above since that number squared (0.708^2) equals 0.50. Note that in most instances, 0.70 is considered close enough to 0.708 to be acceptable. (p. 117)

4.6.1.2 Internal Consistency Reliability

Hair et al. (2021, p. 118) states, "The traditional criterion for measuring internal consistency reliability is Cronbach's alpha. The alpha criterion provides an estimate of reliability based on the inter-correlation of the observed indicator variables."

Moreover, identifying the weaknesses of Cronbach's alpha, Hair et al. (2021) state the following:

one weakness of Cronbach's alpha is that it assumes all indicators are reliable (i.e., all indicators have equal outer loadings on the construct). Moreover, Cronbach's alpha is sensitive to the number of items in the scale and generally trends to underestimate the internal consistency reliability. (p. 118)

Based on the above, Hair et al. (2021) believe that another criterion should be used along with the Cronbach's alpha to obtain better results:

therefore, due to the limitation of Cronbach's alpha, it is technically more appropriate to apply a different measure of internal consistency reliability,

referred to as Composite Reliability. This measure of reliability takes into account the different outer loadings of the indicator variables. (p. 118)

Finally, Hair et al. (2021) identified the accepted Cronbach's alpha and CR as follows:

> Cronbach's alpha and composite reliability vary between 0 and 1, with higher values indicating higher level of reliability. Specifically, values of 0.60 to 0.70 are accepted in exploratory research, while in more advanced stages of research, values between 0.70 and 0.90 can be regarded as satisfactory. Values above 0.90 (and definitely 0.95) are not desirable because they are typically the result of semantically redundant items, which highly rephrase the very same question. (p. 118)

4.6.1.3 Convergent Validity

Hair et al. (2021) describe convergent validity as follows:

> Convergent validity is the extent to which a measure correlates positively with alternative measures of the same construct. Using the domain sampling model, indicators of reflective construct are treated as different (alternative) approaches to measure the same construct. Therefore, the items that are indicators (measures) of a specific reflective construct should converge or share a high proportion of variance. (p. 120)

The most-used measure for establishing convergent validity on the construct level is the Average Variance Extracted (AVE).

Hair et al. (2021) describe AVE as the following:

> A common measure to establish convergent validity on the construct level is the Average Variance Extracted (AVE). This criterion is defined as the grand mean value of the squared loadings of the indicators associated with the construct (i.e., the sum of the squared loadings divided by the number of indicators.). (p. 120)

They identify an accepted AVE as follows:

> An AVE value of 0.50 or higher indicate that, on average, the construct explains more than half of the variance of its indicators. Conversely, an AVE less than 0.50 indicates that, on average, more variance remains in error of the items than in the variance explained by the construct. (p. 120)

4.6.1.4 Discriminant Validity

Hair et al. (2021) identify discriminant validity as follows:

> Discriminant validity is the extent to which the construct is truly distinct from other constructs by empirical standards. Thus, establishing discriminant validity implies that a construct is unique and captures phenomena not represented by the other construct in the model. Traditionally, researchers have relied on the Fornell–Larcker criterion to assess discriminant validity.

> Fornell–Larcker criterion compares the square root of the AVE values with the latent variable correlations. Specifically, square root of each construct's AVE should be greater than its highest correlation with any other construct. The logic of the Fornell–Larcker method is based on the idea that a construct shares more variance with its associated indicator than with any other construct. (p. 120–121)

Another criterion to measure discriminant validity is the heterotriate-monotriat ratio (HTMT). Hair et al. (2021) describe HTMT as follows:

> HTMT is the ratio of the between-trait correlations to the within-trait correlations. HTMT is the mean of all correlations of indicators across construct measuring different constructs. Technically, the HTMT approach is an estimate of what the true correlation between two constructs will be, if they were perfectly measured (i.e., if they were perfectly reliable). This true correlation is also referred to as deattenuated correlation. A deattenuated correlation between two constricts close to 1 indicates a lack of discriminant validity. (p. 122)

4.6.2 Structural Model Results Evaluation

For the purpose of this research, evaluation of the structural results would be done by assessing the coefficient of determination (R^2) and path coefficient.

4.6.2.1 Coefficient of Determination (R^2)

According to Hair et al. (2021)

The most commonly used measure to evaluate the structural model's explanatory power is the Coefficient of Determination (R^2) value, which is calculated as the square correlation between a specific endogenous construct's actual and predicted values. The coefficient represents the exogenous (independent) latent variables' combined effect on the endogenous (dependent) latent variable. That is, the coefficient represents the amount of variance in the endogenous construct explained by all of the exogenous construct linked to it. (p. 195)

They identify the accepted value of the R^2 as follows:

The R^2 range from 0 to 1, with higher level indicating higher levels of explanatory power. Acceptable R^2 values are based on the context. In some disciplines an R^2 values as low as 0.10 is considered satisfactory, for example when predicting stock returns. More importantly, the R^2 is a function of predictor constructs – the greater the number of predictor constructs, the higher the R^2 value. Therefore, the R^2 should always be interpreted in the relation to the context of the study, based on the R^2 values from related studies and models of similar complexity. (p. 195)

4.6.2.2 Path Coefficient

Hair et al. (2021, p. 319) define path coefficient as the "Estimated path relationships in the structural model (i.e., between construct in the model). They correspond to standardize betas $_{p}$ in a regression analysis." Further, they identify the accepted value of the path coefficient as follows:

> Most researchers use $_{p}$ value to assess significant levels. A $_{p}$ is equal to the probability of obtaining a $_{t}$ value at least as extreme as the one that is actually observed, conditional on the null hypothesis being supported. On other words, the $_{p}$ value is the probability of erroneously rejecting a true null hypothesis (i.e., assuming a significant path coefficient when in fact it is not significant). When assuming level of 5%, the $_{p}$ value must be smaller than 0.05 to conclude that the relationship under consideration is significant at 5% level. For example, when assuming level of 5% and the analysis yields a $_{p}$ value of 0.03 for a certain coefficient, we would conclude that the coefficient is significant at a 5% level. (p. 192)

Chapter Five

Data Analysis

Chapter Five

Data Analysis

5.1 Overview

This chapter presents the findings of the data analysis. The presentation will be done in three sections. The first section presents the process followed for the measurement and validation of various constructs. It will describe the descriptive statistics of the sample data, followed by respondents' demographic information. The second section will elaborate on the measurement and validation process of the constructs. Lastly, the third section will show the results of the path analysis and hypotheses testing.

5.2 Descriptive Statistics

As far as the measurement and validation of the research instrument are concerned, before evaluating the psychometric properties of various constructs, it becomes necessary to describe and understand the descriptive statistics of the sample data. Descriptive statistics examine the accuracy of the data entry process, measure the variability of responses, and reveal the spread of data points across the sides of the distribution. The understanding of descriptive statistics helps in the interpretation and generalization of the research results.

5.2.1 Date Cleaning

The process of data cleaning involves detecting and removing errors and inconsistencies from the data to improve its quality. Dealing with missing data is common and always expected in the process of collecting and entering data, due to the possibilities of lack of concentration, misunderstanding among respondents, and missing information or invalid data during data entry. Missing data can lead to several problems. The most apparent one is the unavailability of enough data points to run the analysis, particularly in a structural equation model (SEM). Moreover, in the case of unengaged responses, where some respondents give the same answer for all the questions, and which seem to be random answers; in this case use, the standard deviation is used to find out such responses. This means that any standard deviation of responses less than 0.5 when Likert's 5-point scale is just deleted. Therefore, we removed question number 30, as 46 respondents did not answer it; question number 59 because 56 respondents did not answer it; question number 66, as it was not answered by 18 respondents; and finally, question number 64 because 10 respondents did not answer it.

The results of the analysis can also be influenced by outliers. If the sample size is high, outliers will need to be removed. If the analysis is being run on a smaller dataset, one may want to be less liberal about deleting records. However, outliers will influence smaller datasets more than the largest ones. In this study, the data was

checked for outliers, but no change was made as the dataset seems logical. There were no outliers in the dataset, and the dataset looks very logical. The result for outliers is shown in Figure 5.1.

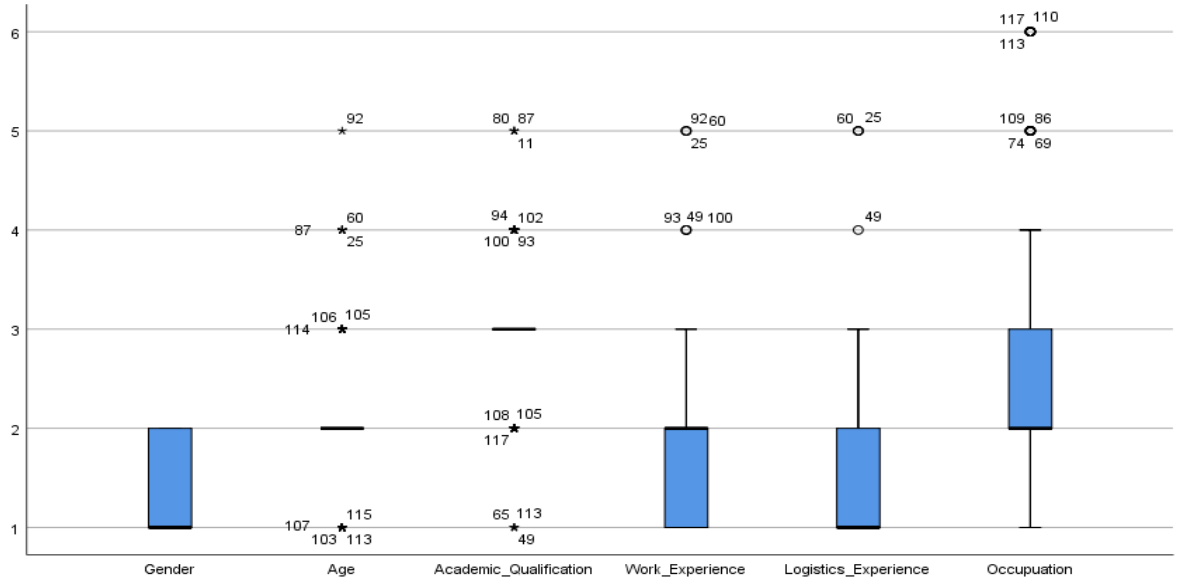

Figure 5.1 *Research Outliers. Note. Prepared by the researcher from data (2021).*

Moreover, skewness and kurtosis observed a fairly normal distribution for our indicator of latent factor and for all other variables (e.g., gender and age). In terms of skewness, however, mild kurtosis was observed in some variables. These kurtosis values ranged from benign to 3. While this does violate the strict rules of normality, it is within more relaxed rules suggested by Sposito (1983) who recommend 3.3 as the upper threshold for normality. The assessment of descriptive statistics (Table 5.1) reveals that all the variables fall within the predefined important values.

Table 5.1: *Descriptive Statistics*

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Gender	119	1.00	2.00	1.4370	.49811	.257	.222	-1.967	.440
Age	119	1.00	5.00	2.0588	.78432	.860	.222	1.450	.440
Academic Qualification	119	1.00	5.00	3.0168	.74769	-.027	.222	.859	.440
Work Experience	119	1.00	5.00	1.8235	.93561	1.309	.222	1.895	.440
Logistics Experience	119	1.00	5.00	1.6303	.90071	1.725	.222	3.364	.440
Occupation	119	1.00	6.00	2.8487	1.60845	.847	.222	-.507	.440
Procurement1	119	3.00	5.00	4.4202	.54455	-.157	.222	-1.034	.440
Procurement2	119	2.00	5.00	4.3866	.58381	-.585	.222	.927	.440
Procurement3	119	3.00	5.00	4.4538	.59301	-.563	.222	-.598	.440
Procurement4	119	2.00	5.00	4.3109	.69803	-.816	.222	.625	.440
Procurement5	119	3.00	5.00	4.4370	.60560	-.569	.222	-.578	.440
Procurement6	119	2.00	5.00	4.3529	.72003	-.924	.222	.535	.440
Procurement7	119	2.00	5.00	4.0756	.86514	-.627	.222	-.337	.440
Procurement8	119	2.00	5.00	4.0168	.77002	-.369	.222	-.359	.440
Procurement9	119	1.00	5.00	3.9832	.88282	-1.170	.222	2.054	.440
Procurement10	119	1.00	5.00	3.6723	1.23583	-.829	.222	-.213	.440
Procurement11	119	1.00	5.00	4.0840	.85944	-1.223	.222	2.129	.440
Procurement12	119	1.00	5.00	4.0420	.87716	-.772	.222	.420	.440
Procurement13	119	2.00	5.00	4.2017	.83949	-1.010	.222	.646	.440
Procurement14	119	1.00	5.00	3.8739	.98768	-.601	.222	-.378	.440
Procurement15	119	2.00	5.00	4.0252	.86810	-.682	.222	-.097	.440
Procurement16	119	2.00	5.00	4.2521	.72741	-.697	.222	.142	.440
Transportation1	119	2.00	5.00	4.2185	.73829	-.758	.222	.471	.440
Transportation2	119	1.00	5.00	4.1008	.81714	-1.042	.222	1.598	.440
Transportation3	119	2.00	5.00	4.0840	.73161	-.792	.222	1.075	.440
Transportation4	119	1.00	5.00	4.0672	.79969	-.931	.222	1.475	.440
Transportation5	119	1.00	5.00	4.0168	.74769	-.893	.222	1.967	.440

Transportation6	119	2.00	5.00	4.1933	.75101	-.823	.222	.711	.440
Storing1	119	2.00	5.00	4.3950	.72741	-1.171	.222	1.327	.440
Storing2	119	2.00	5.00	4.2773	.68796	-.741	.222	.647	.440
Storing3	119	2.00	5.00	4.2521	.70372	-.547	.222	-.259	.440
Storing4	119	2.00	5.00	4.3529	.65856	-.707	.222	.286	.440
Storing5	119	2.00	5.00	4.3445	.69425	-1.047	.222	1.560	.440
Storing6	119	2.00	5.00	4.3193	.73569	-.845	.222	.258	.440
Handling1	119	2.00	5.00	4.2521	.69158	-.693	.222	.540	.440
Handling2	119	2.00	5.00	4.2269	.63027	-.630	.222	1.376	.440
Handling3	119	1.00	55.00	4.6134	4.71224	10.527	.222	113.488	.440
Handling4	119	2.00	5.00	4.2689	.74444	-.733	.222	.021	.440
Handling5	119	2.00	5.00	4.1597	.78095	-.832	.222	.596	.440
Handling6	119	1.00	5.00	4.1765	.89865	-1.141	.222	1.091	.440
Handling7	119	1.00	5.00	4.1849	.81268	-1.124	.222	1.780	.440
Handling8	119	1.00	5.00	4.0924	.91124	-1.142	.222	1.410	.440
Information_Flow1	119	2.00	5.00	4.3529	.68381	-1.069	.222	1.771	.440
Information_Flow2	119	2.00	5.00	4.2941	.64247	-.748	.222	1.313	.440
Information_Flow3	119	2.00	5.00	4.2353	.68527	-.500	.222	-.134	.440
Information_Flow4	119	1.00	5.00	4.1681	.76268	-.994	.222	1.947	.440
Information_Flow5	119	2.00	5.00	4.1765	.75517	-.786	.222	.597	.440
Information_Flow6	119	2.00	5.00	4.2101	.71157	-.473	.222	-.381	.440
Time1	119	1.00	5.00	3.9580	1.03658	-.704	.222	-.465	.440
Time2	119	1.00	5.00	3.4202	1.22472	-.544	.222	-.614	.440
Time3	119	1.00	5.00	3.2941	1.14502	-.359	.222	-.581	.440
Time4	119	1.00	5.00	3.3361	1.12955	-.229	.222	-.821	.440
Time5	119	1.00	5.00	3.4790	1.12633	-.454	.222	-.481	.440
Time6	119	1.00	5.00	3.9076	.92050	-1.008	.222	1.271	.440
Time7	119	1.00	5.00	3.9160	.82933	-.748	.222	.804	.440
Time8	119	1.00	5.00	3.8992	.90568	-.912	.222	.903	.440
Time9	119	1.00	5.00	3.1597	1.10456	.023	.222	-.834	.440
Cost1	119	1.00	5.00	3.8655	1.06504	-.711	.222	-.196	.440
Cost2	119	1.00	5.00	4.0420	.91499	-.962	.222	.946	.440
Cost3	119	1.00	5.00	4.1933	.90458	-.953	.222	.418	.440
Cost4	119	1.00	5.00	3.6723	1.09783	-.684	.222	-.080	.440
Cost5	119	1.00	5.00	3.3782	1.15708	-.516	.222	-.525	.440

Cost6	119	1.00	5.00	3.2941	1.11502	-.382	.222	-.538	.440
Cost7	119	1.00	5.00	3.1092	1.14825	-.149	.222	-.794	.440
Cost8	119	1.00	5.00	3.2521	1.21585	-.412	.222	-.738	.440
Cost9	119	1.00	5.00	4.0084	.98717	-1.146	.222	1.084	.440
Cost10	119	1.00	5.00	4.0504	.90055	-1.092	.222	1.710	.440
Cost11	119	1.00	5.00	3.7731	1.01210	-.726	.222	.067	.440
Cost12	119	1.00	5.00	3.4790	1.04028	-.242	.222	-.630	.440
Quality1	119	2.00	5.00	4.2605	.75310	-.836	.222	.425	.440
Quality2	119	2.00	5.00	4.2101	.76882	-.950	.222	.964	.440
Quality3	119	2.00	5.00	4.1008	.79612	-.594	.222	-.116	.440
Quality4	119	2.00	5.00	4.0756	.82503	-.603	.222	-.189	.440
Quality5	119	1.00	5.00	4.0672	.86093	-.941	.222	.953	.440
Quality6	119	1.00	5.00	3.9664	.93820	-.934	.222	.735	.440
Quality7	119	1.00	5.00	3.3613	1.19838	-.342	.222	-.722	.440
Logistics_Strategy1	119	1.00	5.00	4.2773	.80174	-1.248	.222	2.104	.440
Logistics_Strategy2	119	3.00	5.00	4.2941	.66833	-.420	.222	-.760	.440
Logistics_Strategy3	119	2.00	5.00	4.2521	.72741	-.831	.222	.717	.440
Logistics_Strategy4	119	1.00	5.00	4.1429	.76231	-.832	.222	1.437	.440
Logistics_Strategy5	119	1.00	5.00	4.1597	.77002	-.963	.222	1.761	.440
Logistics_Strategy6	119	2.00	5.00	4.1681	.71686	-.541	.222	.069	.440
Logistics_Strategy7	119	1.00	5.00	4.1765	.88917	-1.239	.222	1.812	.440
Logistics_Strategy8	119	1.00	5.00	4.1849	.76984	-1.011	.222	1.875	.440
Logistics_Strategy9	119	1.00	5.00	4.2605	.84835	-1.461	.222	2.873	.440
Logistics Strategy10	119	1.00	5.00	4.1008	.84768	-1.214	.222	2.231	.440
Logistics Strategy11	119	1.00	5.00	3.4622	1.24049	-.671	.222	-.444	.440
Logistics Strategy12	119	1.00	5.00	3.4790	1.28781	-.643	.222	-.664	.440
Logistics Strategy13	119	1.00	5.00	3.4202	1.32445	-.548	.222	-.814	.440
Lean_Logistics1	119	1.00	5.00	4.1765	.89865	-1.284	.222	1.863	.440
Lean_Logistics2	119	1.00	5.00	4.1513	.72062	-1.065	.222	2.857	.440
Lean_Logistics3	119	2.00	5.00	4.1681	.71686	-.682	.222	.610	.440
Lean_Logistics4	119	1.00	5.00	4.0756	.83524	-1.653	.222	4.507	.440
Lean_Logistics5	119	1.00	5.00	4.1849	.78077	-1.098	.222	2.056	.440
Lean_Logistics6	119	1.00	5.00	4.1513	.74377	-1.132	.222	2.740	.440
Valid N (listwise)	119								

Note. All items were measured on a 5-point Likert type scale

5.3 Response Rate

The researcher employed convenience sampling where a self-administrated survey was used to distribute 150 questionnaires to companies that run, own, and execute projects of residential complexes in Khartoum State. Logistics personnel were asked to fill out the questionnaire. The overall response rate was 83%; this was considered high, as the questionnaires were given to respondents one by one, and in research, a self–administered survey has been used (Sekaran, 2003). Regarding those who did not respond to filling out the questionnaire, some mentioned that they were not authorized to fill out questionnaires, while others were not transparent in their justifications. Table 5.2 shows the summary of the questionnaire response rate.

Table 5. 2: *Response rate of questionnaire*

Total distributed questionnaires	
Total questionnaires distributed	150
Total questionnaires received from respondents	125
Valid questionnaires received from respondents	119
Invalid questionnaires	6
Questionnaires not received	25
Overall response rate	83%
Usable response rate	95%

Note. Prepared by the researcher from data (2021).

5.3.1 Profile of the Responded Firms and Respondents

Based on the description, this section investigates the respondents' profile.

Table 5.3 *Respondents' Demographic Characteristics*

		Frequency	**Percent**
Gender	Male	67	56.3
	Female	52	43.7
	Total	119	100.0
Age		Frequency	Percent
	Less Than 25 Years	25	21.0
	26–35	69	58.0
	36–45	19	16.0
	46–55 Years	5	4.2
	More Than 55	1	0.8
	Total	119	100.0
Academic Qualification		Frequency	Percent
	High School	3	2.5
	Diploma	20	16.8
	Bachelor	71	59.7
	Master	22	18.5
	PhD	3	2.5
	Total	119	100.0
Work Experience		Frequency	Percent
	Less Than 5 Years	52	43.7
	6–10 Years	45	37.8
	11–15 Years	16	13.4
	16–20 Years	3	2.5
	More Than 20 Years	3	2.5
	Total	119	100.0
Logistics Experience		Frequency	Percent
	Less Than 5 Years	68	57.1
	6–10 Years	34	28.6
	11–15 Years	13	10.9
	16–20 Years	1	0.8
	More Than 20 Years	3	2.5
	Total	119	100.0
Occupation		Frequency	Percent
	1.00	21	17.6
	2.00	45	37.8
	3.00	25	21.0
	4.00	1	0.8
	5.00	13	10.9
	6.00	14	11.8
	Total	119	100.0

Note. Prepared by the researcher from data (2021).

5.4 Goodness of Measures

This section presents the results of the validity and reliability tests conducted as a means to assess the goodness of measure of the constructs in this study (Sekaran, 2003).

5.4.1 Rules of Thumb for Selecting CB-SEM or PLS-SEM

Understanding the assumptions underlying these statistical methods can help the researcher determine which statistical method is appropriate for use. According to Hair et al. (2011), the selection between CB-SEM and PLS-SEM can be made based on factors such as research objective, types of measurement model specification, modeling of the structural model, data characteristics, and model evaluation. The authors suggest useful rules of thumb, which can be used as guidance when choosing between PLS-SEM and CB-SEM.

First, when selecting between these two methods, the researcher must identify the objective of conducting the research. CB-SEM is an appropriate method to use when the research objective is to test or confirm a theory. This is because testing a theory requires the ability to demonstrate how well a theoretical model fits the observed data (Barclay et al., 1995). According to Barclay et al. (1995), CB-SEM is more appropriate for hard modeling, where the aim is to minimize the covariance matrix. This has been the strength of CB-SEM. Meanwhile, PLS-SEM is suitable when the research objective involves prediction and theory development. This is also

known as soft modeling. In soft modeling, the focus is on identifying the best prediction of relationships between variables and maximizing the amount of covariance between LVs to increase the model interpretation (Sosik et al., 2009).

Second, the use of CB-SEM is limited only to research models that use reflective constructs. Although formative measures have been used within the structural model in previous studies, they usually lead to identification problems (Henseler et al., 2009). For instance, the use of formative constructs within CB-SEM would create a situation in which the explanation of the covariance of all indicators is not possible (Chin, 1998b). Further, the use of CB-SEM in handling both reflective and formative constructs is relatively complicated (Urbach & Ahlemann, 2010). On the other hand, PLS-SEM can be used to analyze a research model that consists of both reflective and formative constructs (Chin, 1998b). Using PLS allows researchers to use either reflective, formative, or a combination of both constructs at the same time.

Third, in the case of CB-SEM, a set of assumptions needs to be fulfilled before further analysis can be conducted using CB-SEM software. The assumptions involve the assessment of 1) data multivariate normality, 2) observation independence, and 3) variable metric uniformity (Sosik et al., 2009).

Fourth, using CB-SEM requires data with normal distribution and a large sample size. If one of the assumptions is violated, CB-SEM results will be highly

imprecise (Hair et al., 2011). On the other hand, PLS-SEM is a more robust approach and can be used to analyze data with a non-normality distribution. In the case of PLS-SEM, data normality is not a requirement because PLS uses calibration mechanisms, which can transform any non-normal data into data that adheres to the central limit theorem (Beebe et al., 1998).

Finally, regarding structural model evaluation, PLS' main objective is to test/predict the theoretical model that has been suggested based on the literature and not to test which alternate model fits the data better (Sosik et al., 2009). The residuals on manifested and latent variables are correlated in PLS, thus allowing PLS to "estimate" (Falk & Miller, 1992, p. 10).

5.4.2 Sample Size Requirements

Goodhue et al. (2012) and Marcoulides and Saunders (2006) oftentimes believe there is some "magic" in the PLS-SEM approach that allows them to use a very small sample (e.g., less than 100).

5.4.3 Measurement Model Assessment

The research model for this study is tested using PLS. Smart PLS 3.0 M3 (Ringle et al., 2004) is used to assess the measurement and structural model for this study. This statistical program assesses the psychometric properties of the measurement model and estimates the parameters of the structural model.

The validity and reliability of the measurement model for this study are evaluated using the following analyses: internal consistency reliability, indicator reliability, convergent validity, and discriminant validity. The following subsections present the findings for each analysis performed to evaluate the validity of the measurement model for this study.

5.4.4 Measurement Model

Assessment of reflective measurement models includes CR to evaluate internal consistency, individual indicator reliability, and AVE to evaluate convergent validity. Assessment of reflective measurement models also includes discriminant validity. The Fornell–Larcker criterion, cross-loadings, and, especially, the HTMT ratio of correlations can be used to examine discriminant validity.

5.4.5 Indicator Reliability (Outer Loadings)

The indicator reliability of the measurement model is measured by examining the items' loadings. A measurement model is said to have satisfactory indicator reliability when each item's loading is at least 0.7, with a significance level of at least 0.05. Based on the analysis, all items in the measurement model exhibited loadings exceeding 0.700, ranging from a lower bound of 0.672 to an upper bound of 0.895. All items are significant at the level of 0.001. Table 5.4 shows the loading for each item. Based on the results, all items used for this study have demonstrated satisfactory indicator reliability.

Table 5.4 *Indicator Reliability (Outer Loadings)*

	Cost	Handling	Information Flow	Lean Logistics	Logistics Strategy	Procurement	Quality	Storing	Time	Transportation
Cost10	0.729									
Cost2	0.790									
Cost3	0.743									
Handling5		0.763								
Handling6		0.798								
Handling7		0.789								
Handling8		0.768								
Information Flow1			0.772							
Information Flow2			0.777							
Information Flow4			0.747							
Information Flow5			0.672							
Lean Logistics3				0.807						
Lean Logistics4				0.895						
Lean Logistics5				0.777						
Logistics Strategy2					0.811					
Logistics Strategy3					0.884					
Logistics Strategy4					0.774					
Logistics Strategy5					0.788					
Procurement12						0.811				
Procurement13						0.776				
Procurement7						0.687				
Quality3							0.764			
Quality4							0.894			
Quality5							0.732			
Storing2								0.869		
Storing4								0.756		
Storing5								0.724		
Time6									0.843	
Time7									0.887	
Transportation3										0.799
Transportation4										0.722
Transportation5										0.729
Transportation6										0.746

Note. Prepared by researcher from data (2021).

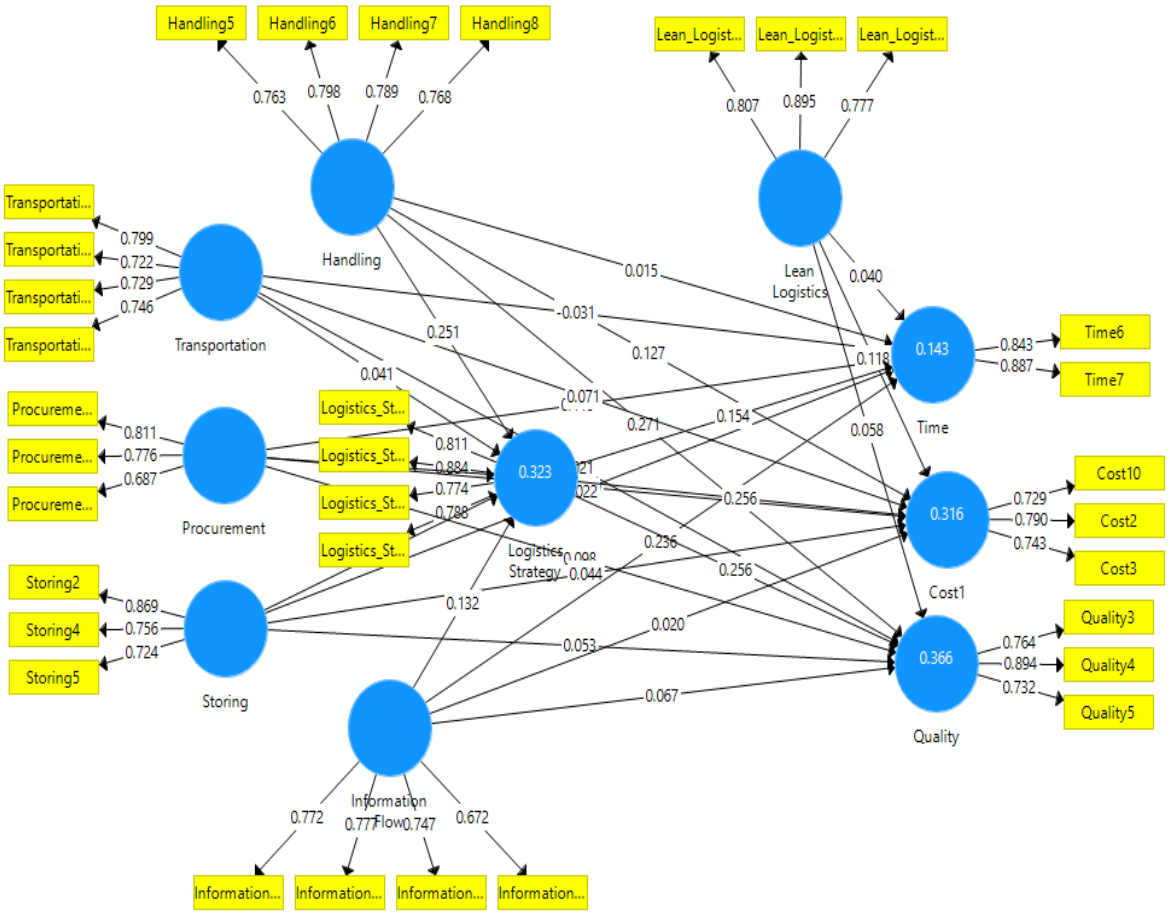

Figure 5.2 *Indicator Reliability (Outer Loadings). Note. Prepared by the researcher from data (2021).*

5.4.6 Internal Consistency Reliability

A measurement model is said to have satisfactory internal consistency reliability when the CR of each construct exceeds the threshold value of 0.7. Table 5.5 shows that the CR of each construct for this study ranges from 0.798 to 0.888, which is above the recommended threshold value of 0.7. Thus, the results indicate that the items used to represent the constructs have satisfactory internal consistency reliability.

Table 5.5 ***Construct Reliability and Validity***

	Cronbach's Alpha	Composite Reliability
Cost	0.624	0.798
Handling	0.785	0.861
Information Flow	0.737	0.831
Lean Logistics	0.769	0.867
Logistics Strategy	0.832	0.888
Procurement	0.641	0.803
Quality	0.717	0.841
Storing	0.689	0.828
Time	0.667	0.857
Transportation	0.74	0.837

Note. Prepared by the researcher from data (2021).

The value of CR above the recommended threshold of 0.7 appears in the figure below.

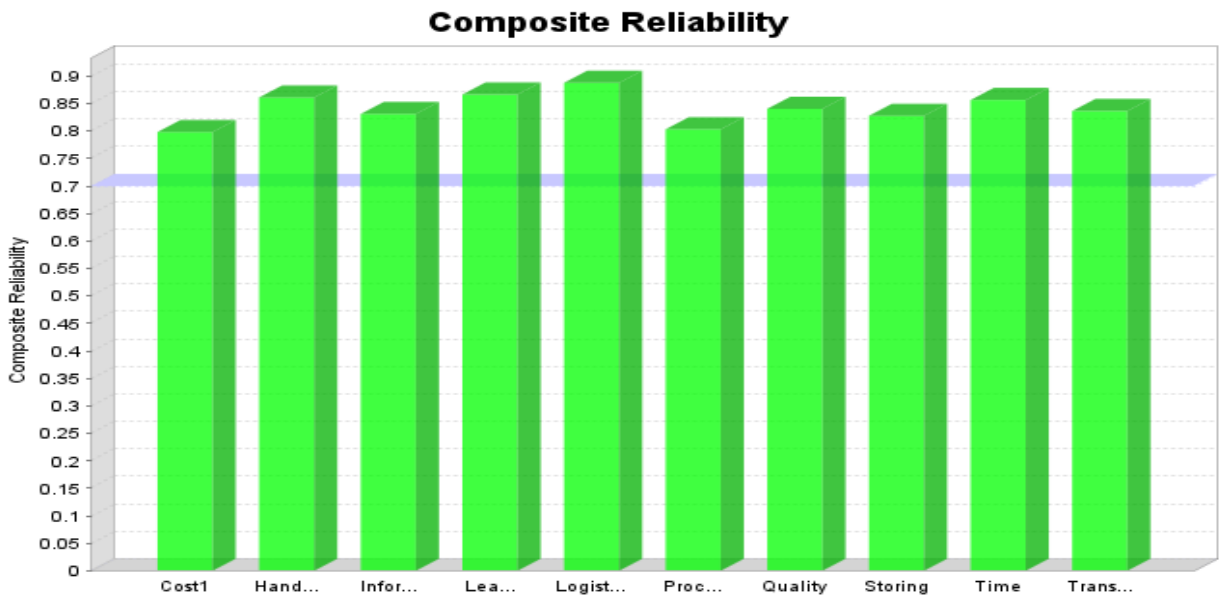

Figure 5.3 *Composite Reliability. Prepared by the researcher from data (2021).*

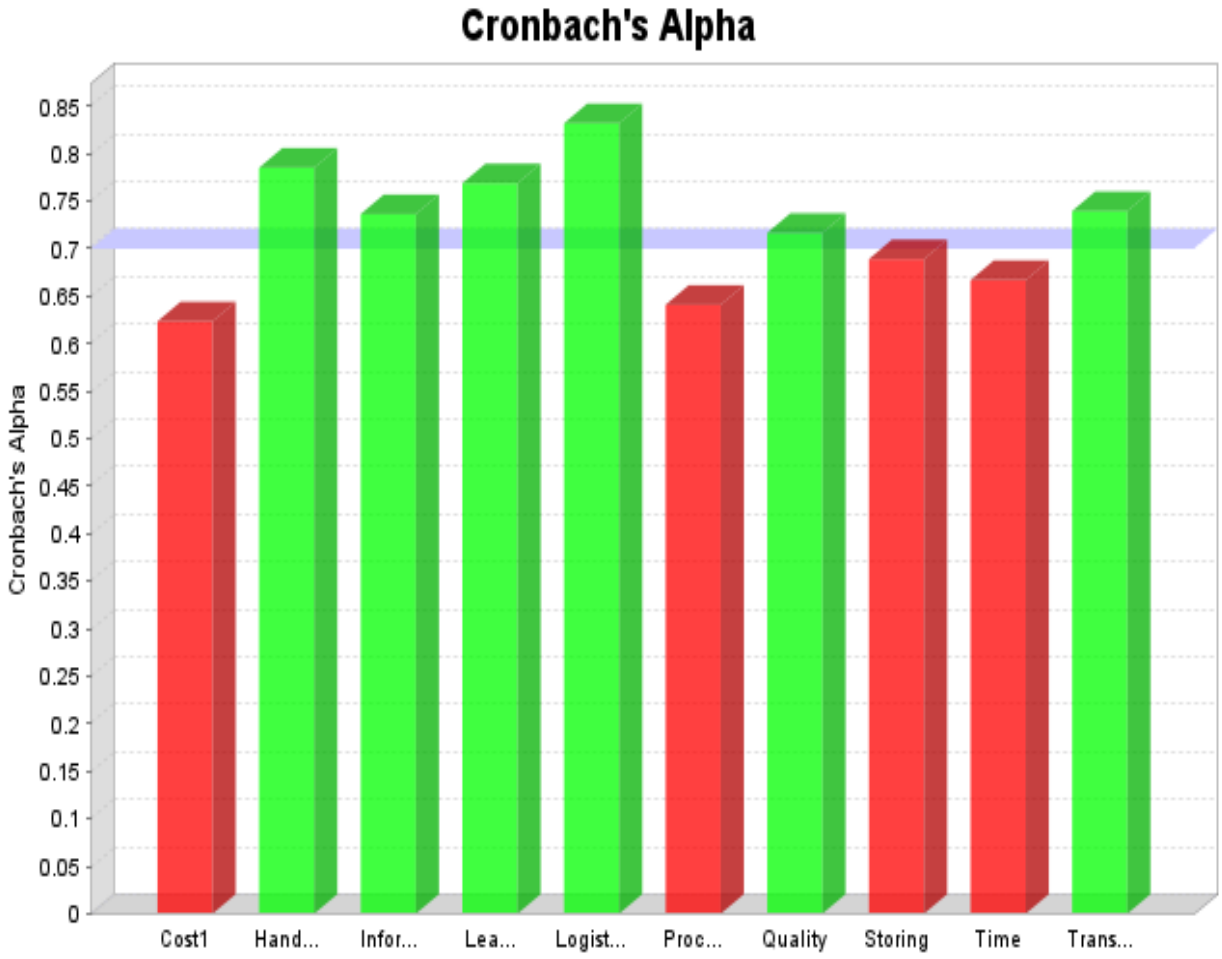

Figure 5.4 *Cronbach's Alpha. Note. Prepared by the researcher from data (2021).*

5.4.7 Convergent Validity

In this study, the measurement model's convergent validity is assessed by examining its AVE value. Convergent validity is adequate when constructs have an AVE value of at least 0.5 or more. Table 5.6 shows that all constructs have an AVE ranging from 0.553 to 0.749, which exceeds the recommended threshold value of 0.5. This result shows that the study's measurement model demonstrates adequate convergent validity.

Table 5.6 *Average Variance Extracted (AVE)*

	Average Variance Extracted (AVE)
Cost	0.569
Handling	0.608
Information Flow	0.553
Lean Logistics	0.685
Logistics Strategy	0.665
Procurement	0.578
Quality	0.639
Storing	0.617
Time	0.749
Transportation	0.562

Note. Prepared by the researcher from data (2021).

The value of AVE exceeds the recommended threshold value of 0.5, as shown in the next figure.

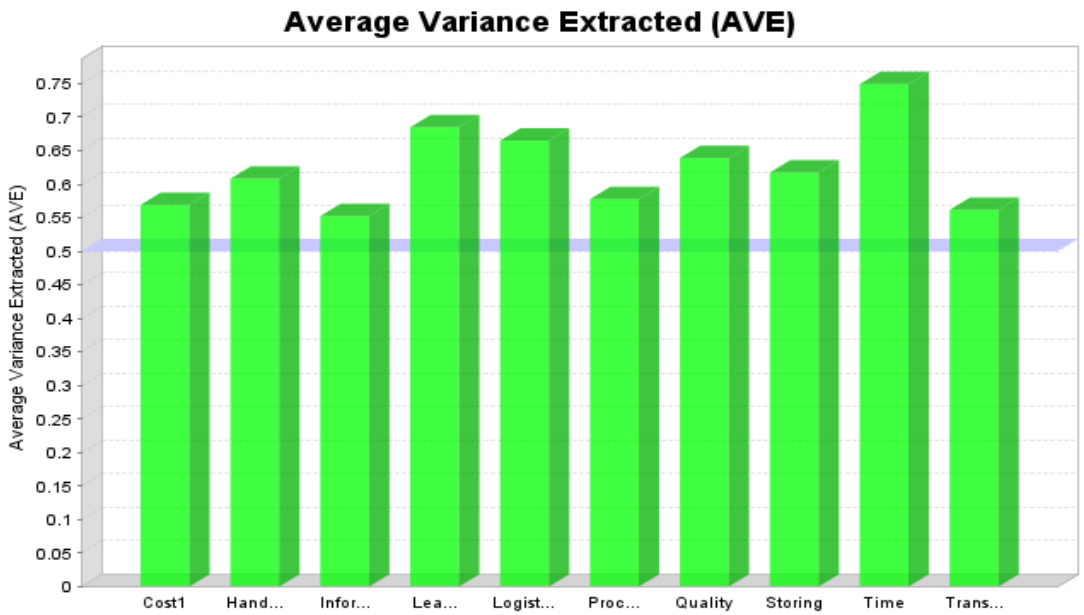

Figure 5.5 *Average Variance Extracted. Note. Prepared by the researcher from data (2021).*

5.4.8 Discriminant Validity

In this study, the measurement model's discriminant validity is assessed by using two measures: 1) the criterion of Fornell–Larcker (1981) and 2) cross-loading. As the measurement model has discriminant validity when 1) the square root of AVE exceeds the correlations between the measure and all other measures, and 2) the indicators' loadings are higher against their respective constructs, compared to other constructs. Thus, to determine the first assessment of the measurement model's discriminant validity, the AVE value of each construct is generated using the smart PLS algorithm function. Then, the square roots of AVE are calculated manually. Based on the results, all square roots of AVE exceeded the off-diagonal elements in their corresponding row and column. The bolded elements in Table 5.7 represent the square roots of the AVE, and the non-bolded values represent the intercorrelation value between constructs. Based on Table 5.7, all off-diagonal elements are lower than the square roots of AVE (bolded on the diagonal). This result confirmed that the Fornell–Larcker criterion is met.

Table 5.7 *Discriminant Validity—Fornell-Larcker's criterion*

	Cost	Handling	Information Flow	Lean Logistics	Logistics Strategy	Procurement	Quality	Storing	Time	Transportation
Cost	0.754									
Handling	0.403	0.780								
Information Flow	0.242	0.304	0.743							
Lean Logistics	0.352	0.274	0.339	0.828						
Logistics Strategy	0.477	0.464	0.277	0.451	0.815					
Procurement	0.421	0.505	0.218	0.291	0.493	0.760				
Quality	0.390	0.503	0.288	0.323	0.494	0.426	0.799			
Storing	0.295	0.346	0.344	0.346	0.243	0.454	0.307	0.786		
Time	0.380	0.202	0.301	0.209	0.283	0.232	0.185	0.150	0.866	
Transportation	0.346	0.474	0.386	0.302	0.338	0.456	0.350	0.483	0.170	0.749

Note. Prepared by the researcher from data (2021).

Table 5.8 *Heterotrait-Monotrait Ratio (HTMT)*

	Cost	Handling	Information Flow	Lean Logistics	Logistics Strategy	Procurement	Quality	Storing	Time	Transportation
Cost										
Handling	0.572									
Information Flow	0.326	0.405								
Lean Logistics	0.499	0.354	0.427							
Logistics Strategy	0.640	0.573	0.337	0.571						
Procurement	0.632	0.702	0.298	0.402	0.661					
Quality	0.567	0.662	0.406	0.426	0.625	0.604				
Storing	0.434	0.465	0.512	0.439	0.314	0.701	0.437			
Time	0.586	0.275	0.392	0.285	0.361	0.332	0.264	0.223		
Transportation	0.495	0.628	0.540	0.405	0.430	0.654	0.472	0.674	0.254	

Note. Prepared by the researcher from data (2021).

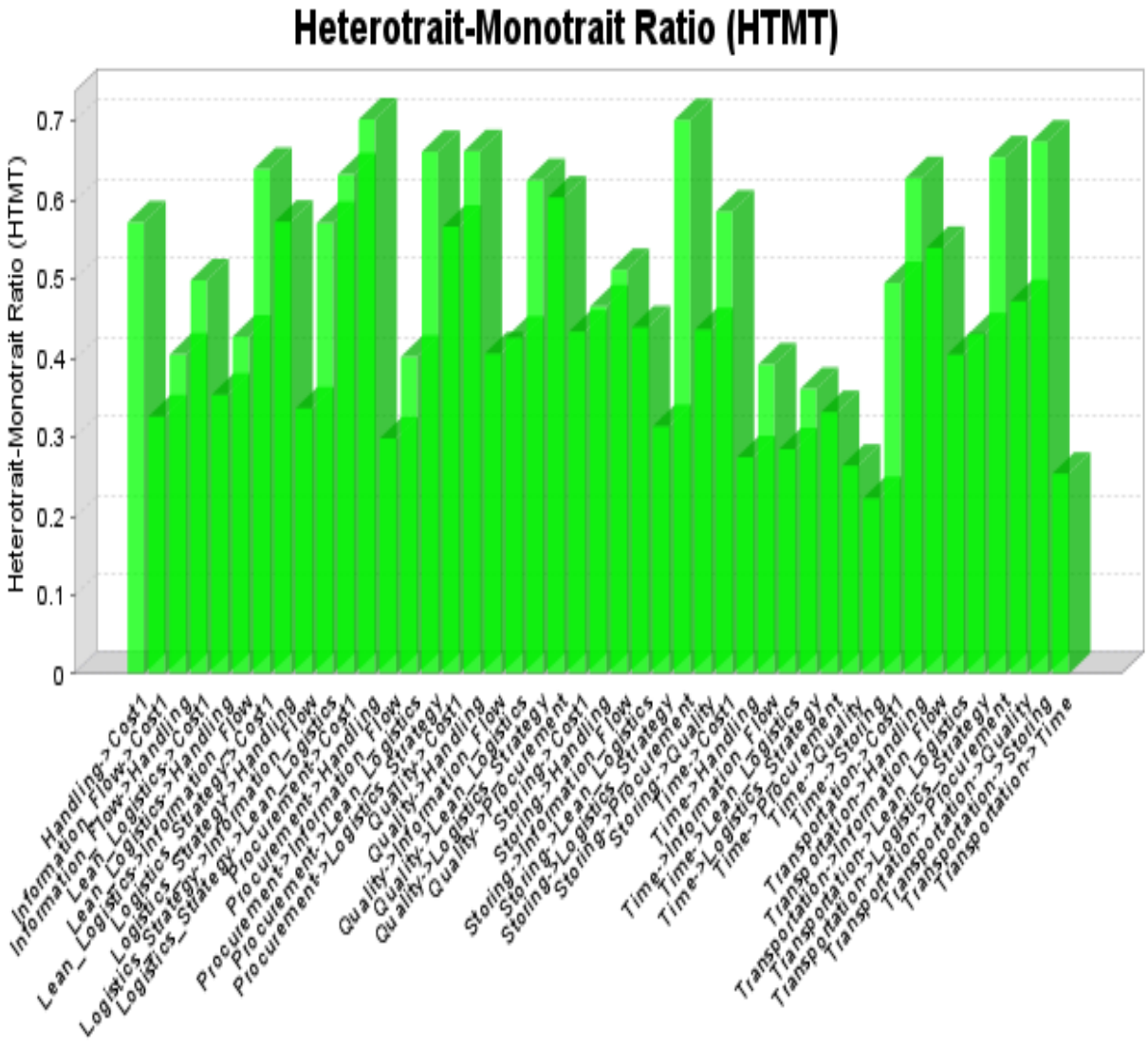

Figure 5.6 *Heterotrait-Monotrait Ratio. Note. Prepared by the researcher from data (2021).*

5.5 Descriptive Statistics of Variables

In this section, descriptive statistics such as mean and standard deviation were used to describe the characteristics of the surveyed to all variables (independent, dependent, mediators, and moderator) under study. Table 5.9 shows the mean and standard deviation values for all variables.

Table 5.9 *Descriptive Statistics of All Variables*

	Mean	Median	Min.	Max.	Standard Deviation	Excess Kurtosis	Skewness	Number of Observations Used
A project's cost planning process is done with the participation of all parties involved in managing the project's execution process.	4.050	4.000	1.000	5.000	0.897	1.710	-1.092	119.000
A project's cost considers market situations and the competitive advantages of other projects implemented by competitors.	4.042	4.000	1.000	5.000	0.911	0.946	-0.962	119.000
A project's cost planning takes into consideration unstable economic situations and prepares alternatives for unexpected risks.	4.193	4.000	1.000	5.000	0.901	0.418	-0.953	119.000
The handling process is achieved by using modern and highly technical tools and equipment.	4.160	4.000	2.000	5.000	0.778	0.596	-0.832	119.000
The handling process is achieved by highly trained and skillful individuals.	4.176	4.000	1.000	5.000	0.895	1.091	-1.141	119.000
Handling plans are developed to decrease unnecessary inventory.	4.185	4.000	1.000	5.000	0.809	1.780	-1.124	119.000
Handling planning developed with the support and use of computer software.	4.092	4.000	1.000	5.000	0.907	1.410	-1.142	119.000

Modern electronic tools are used to exchange project information	4.353	4.000	2.000	5.000	0.681	1.771	-1.069	119.000
The information flow process is updated continuously to decrease the time of transforming the information.	4.294	4.000	2.000	5.000	0.640	1.313	-0.748	119.000
Project information is updated smoothly and quickly and without affecting the process of project execution.	4.168	4.000	1.000	5.000	0.759	1.947	-0.994	119.000
The information flow planning process is developed with the contribution of all parties concerned, and those who participate in the execution process.	4.176	4.000	2.000	5.000	0.752	0.597	-0.786	119.000
The waste control process removes unnecessary transportation.	4.168	4.000	2.000	5.000	0.714	0.610	-0.682	119.000
The waste control process reduces unnecessary material storage.	4.076	4.000	1.000	5.000	0.832	4.507	-1.653	119.000
The waste control processes reduce a construction project's implementation errors.	4.185	4.000	1.000	5.000	0.777	2.056	-1.098	119.000
Logistics strategy contributes to controlling the defect of resources during the	4.294	4.000	3.000	5.000	0.666	-0.760	-0.420	119.000

procurement process.								
Logistics strategy contributes to accomplishing materials' transportation efficiently and decreases materials' waste.	4.252	4.000	2.000	5.000	0.724	0.717	-0.831	119.000
Logistics strategy contributes to maintaining material during the storing process and decreases the requirements of storing extra materials.	4.143	4.000	1.000	5.000	0.759	1.437	-0.832	119.000
Logistics strategy contributes to obtaining high efficiency in the handling process.	4.160	4.000	1.000	5.000	0.767	1.761	-0.963	119.000
The procurement system includes contractual conditions that compromise the rules and conditions.	4.042	4.000	1.000	5.000	0.873	0.420	-0.772	119.000
Project materials are clearly and accurately determined among the basic requirements of goods, materials, and services.	4.202	4.000	2.000	5.000	0.836	0.646	-1.010	119.000
The entire material procurement process is done by qualified suppliers and through fair competition.	4.076	4.000	2.000	5.000	0.861	-0.337	-0.627	119.000
Quality control and quality tests are done by using modern and developed tools and	4.101	4.000	2.000	5.000	0.793	-0.116	-0.594	119.000

equipment to ensure the best quality of projects' final outputs.								
Continuous routine tests are conducted for the project quality during the execution process as well as at the end of each phase of a project.	4.076	4.000	2.000	5.000	0.822	-0.189	-0.603	119.000
A project's output quality conforms to Sudanese Standards and Metrology requirements.	4.067	4.000	1.000	5.000	0.857	0.953	-0.941	119.000
Storing environment is good and meets all requested conditions for storing construction materials.	4.277	4.000	2.000	5.000	0.685	0.647	-0.741	119.000
Storing records are updated continuously to provide project management with information on inventory and the quantity of available materials.	4.353	4.000	2.000	5.000	0.656	0.286	-0.707	119.000
Storing equipment is updated continuously to guarantee smooth and quick storing processes.	4.345	4.000	2.000	5.000	0.691	1.560	-1.047	119.000
Computer software is used to determine the required time to execute the project.	3.908	4.000	1.000	5.000	0.917	1.271	-1.008	119.000
A project's time planning process is done with the participation of all parties involved in	3.916	4.000	1.000	5.000	0.826	0.804	-0.748	119.000

managing the execution process.								
The transportation process is completed effectively to maintain the quality of the materials.	4.084	4.000	2.000	5.000	0.729	1.075	-0.792	119.000
The transportation planning system contributes to decreasing the waiting time needed to complete the supply processes.	4.067	4.000	1.000	5.000	0.796	1.475	-0.931	119.000
The transportation planning system contributes to decreasing the number of shipments without affecting the materials' quality.	4.017	4.000	1.000	5.000	0.745	1.967	-0.893	119.000
The transportation of sensitive and fragile materials is done effectively to maintain these materials.	4.193	4.000	2.000	5.000	0.748	0.711	-0.823	119.000

Note: All variables used a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree)

5.6 Structural Model

The following subsections discuss the tests used to assess the validity of the structural model for this study. The validity of the structural model is assessed using the coefficient of determination (R^2) and path coefficients. In addition, this study also assesses the mediation relationships that are proposed in the research model. The mediation relationships are tested using the guidelines proposed by Baron and

Kenny (1986), and the significance of the mediating relationships is assessed using Sobel's test (Z).

5.6.1 Coefficient of Determination (R^2)

The R^2 value indicates the amount of variance in dependent variables explained by the independent variables. Thus, a larger R^2 value increases the predictive ability of the structural model. In this study, the Smart PLS algorithm function is used to obtain the R^2 values, while the Smart PLS bootstrapping function is used to generate the statistics values. For this study, the bootstrapping function generated 500 samples from 100 cases. The result of the structural model is presented in Figure 5.7. and Table 5.10

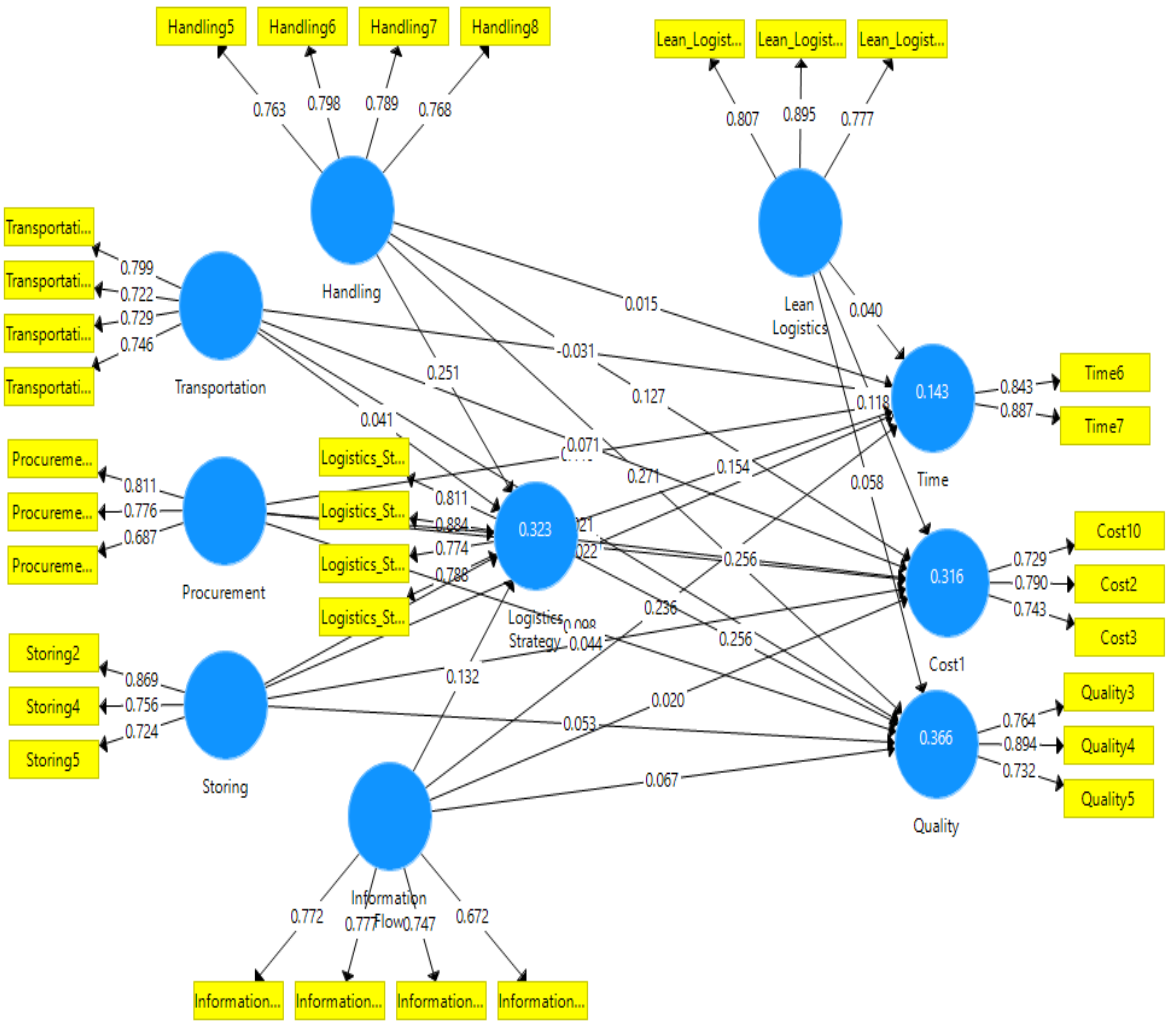

Figure 5.7 *Coefficient of Determination (R^2). Note. Prepared by the researcher from data (2021).*

Table 5.10 *Coefficient of Determination (R^2)*

	R Square	R Square Adjusted
Cost	0.316	0.273
Logistics Strategy	0.323	0.293
Quality	0.366	0.326
Time	0.143	0.089

Note. Prepared by the researcher from data (2021).

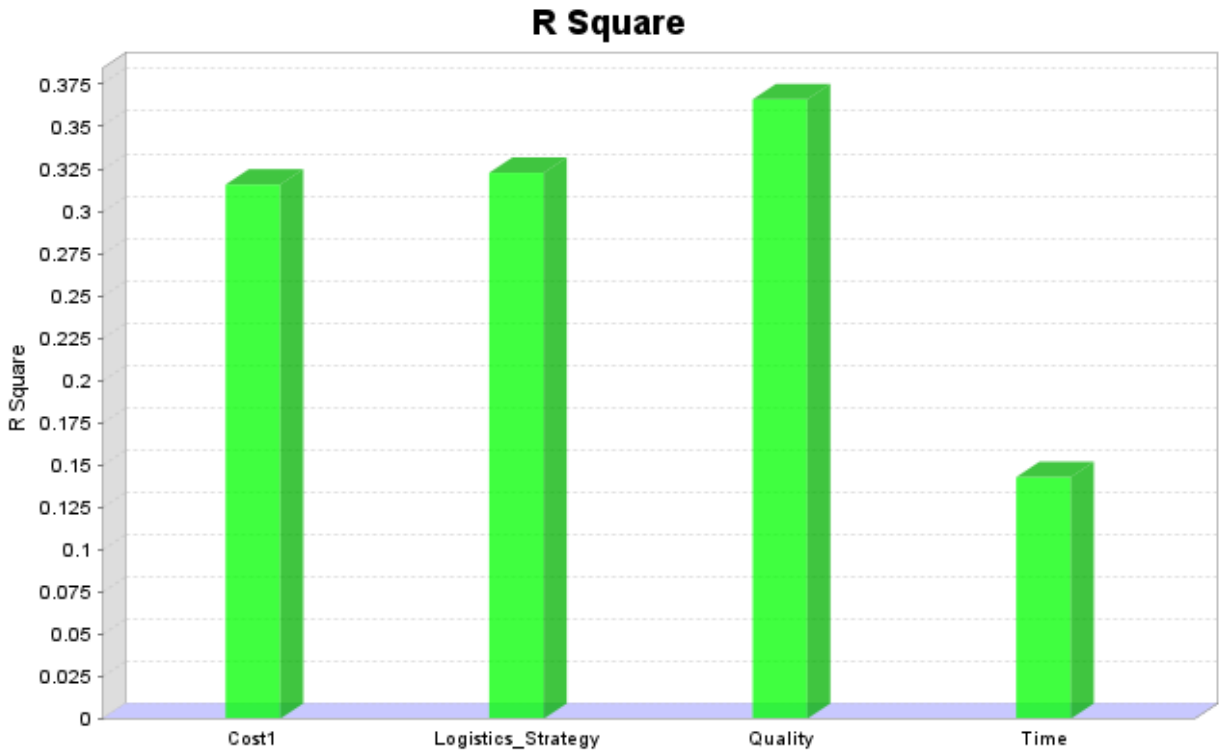

Figure 5.8 *Coefficient of Determination (R^2). Note. Prepared by the researcher from data (2021).*

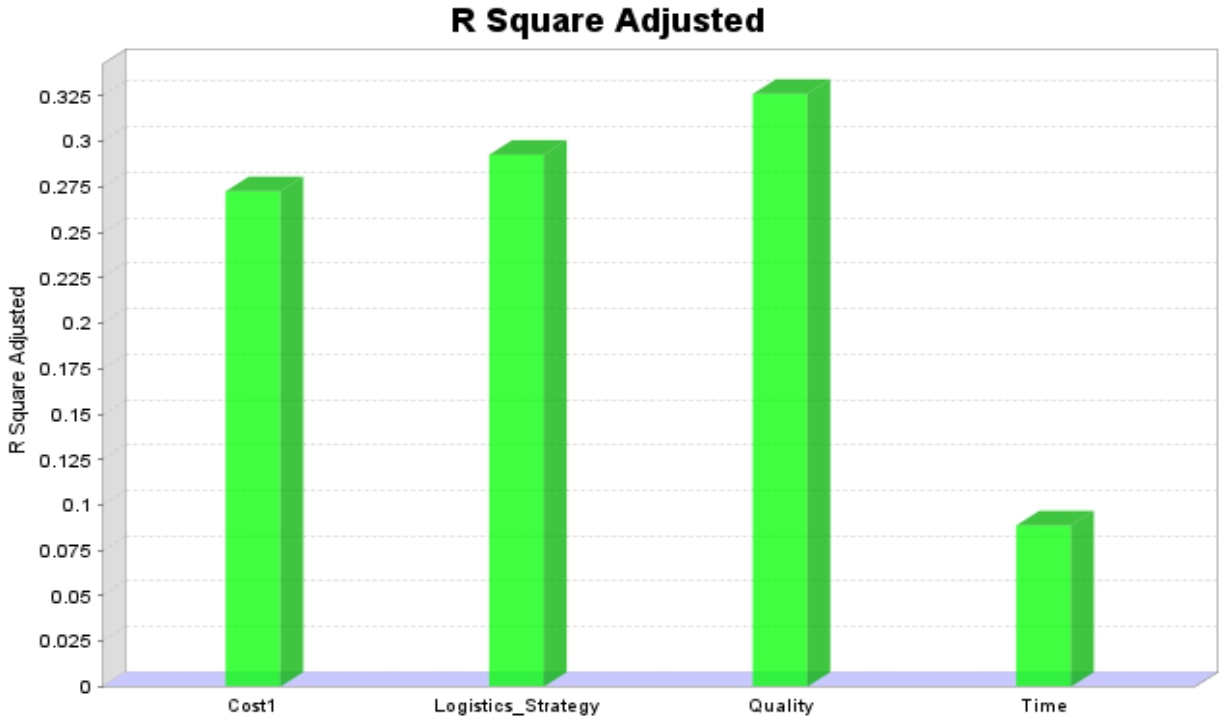

Figure 5.9 *R Square Adjusted. Note. Prepared by the researcher from data (2021).*

5.6.2 Path Coefficients

Within the structural model, each path connecting two latent variables represented a hypothesis. Based on the analysis conducted on the structural model, it allows the researcher to confirm or disconfirm each hypothesis as well as understand the strength of the relationship between dependent and independent variables.

The relationships between the independent, dependent, and mediator variables were examined using the Smart PLS algorithm output. However, to test the significance level, Smart PLS generates t-statistics for all paths using the Smart PLS bootstrapping function. The significance level of each relationship is determined based on the t-statistics output.

5.6.2.1 Relationship between Logistics Planning and Construction Projects' Execution.

To assess the impact of logistics planning on construction projects' execution, structural equation modeling has been employed, and a measurement model of these constructs has been assessed. Figure 5.10 reveals, by drawing a path, that reflective indicators have been used for the measurement of latent constructs and the non-causal relationship has been studied among different constructs.

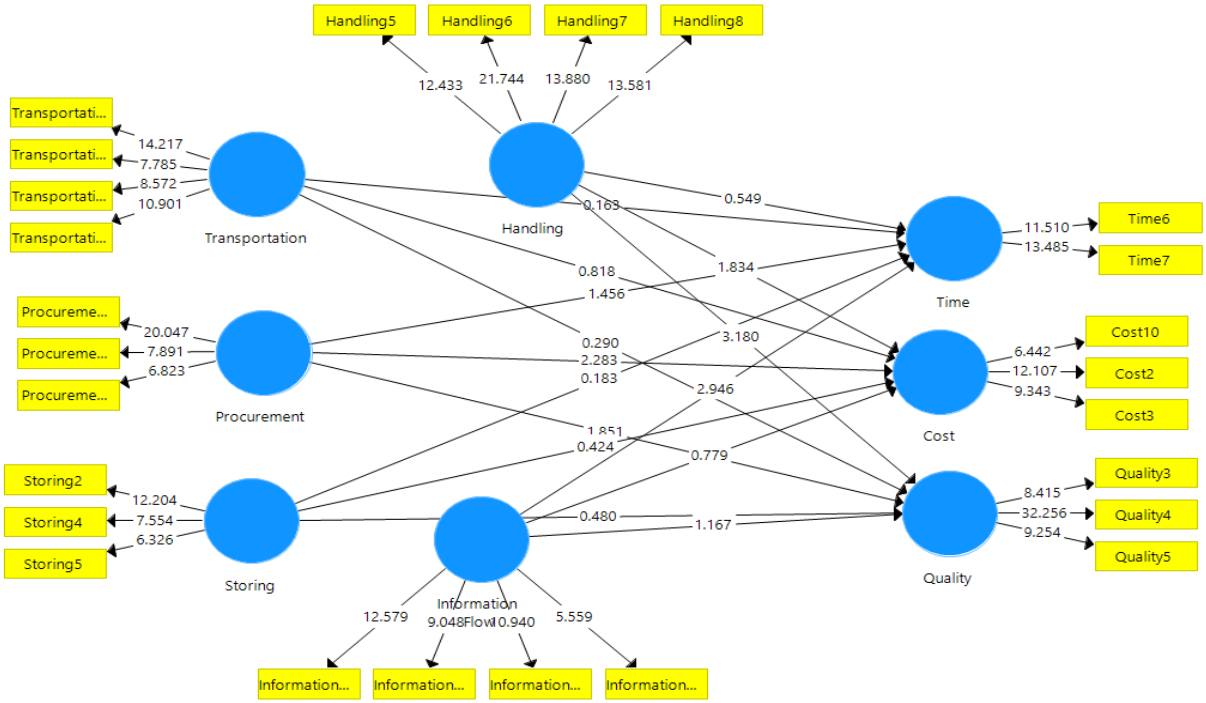

Figure 5.10 *H1/Structural Model Estimation for Logistics Planning on Construction Projects' Execution. Note. Prepared by the researcher from data (2021).*

The structural model reveals the same value of model fit as shown in Table 5.11; all the model fit indices for the structural model were not only significant but also remain the same as in the measurement model. The low index of R square in the range of 0.5 to 0.8 justifies the underlying theoretical model. All details are shown in Table 5.11. The complete Smart PLS output is displayed in Appendix C1.

Table 5.11 *Model Fit Indices and Path Coefficients of the Relationship between Logistics Planning and Construction Projects' Execution*

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P-Value
Handling -> Cost	0.198	0.202	0.108	1.834	0.067
Handling -> Quality	0.336	0.337	0.106	3.18	0.002
Handling -> Time	0.054	0.062	0.098	0.549	0.583
Information Flow -> Cost	0.076	0.09	0.098	0.779	0.437
Information Flow -> Quality	0.112	0.107	0.096	1.167	0.244
Information Flow -> Time	0.258	0.272	0.088	2.946	0.003
Procurement -> Cost	0.25	0.252	0.109	2.283	0.023
Procurement -> Quality	0.198	0.199	0.107	1.851	0.065
Procurement -> Time	0.171	0.174	0.118	1.456	0.146
Storing -> Cost	0.044	0.051	0.104	0.424	0.672
Storing -> Quality	0.047	0.054	0.097	0.48	0.631
Storing -> Time	-0.02	-0.017	0.109	0.183	0.855
Transportation -> Cost	0.086	0.08	0.105	0.818	0.414
Transportation -> Quality	0.035	0.044	0.122	0.29	0.772
Transportation -> Time	-0.019	-0.028	0.117	0.163	0.871

Note. Prepared by the researcher from data (2021).

Path coefficients, observed t-statistics, significance level for some hypothesized paths under 0.05 p-value or 1.96 t-statistics.

5.6.2.2 Relationship between Logistics Planning and Logistics Strategy Management.

To assess the impact of logistics planning on logistics strategy, structural equation modeling has been employed, and a measurement model of these constructs has been assessed. Figure 5.11 reveals, by drawing a path, that reflective indicators have been used for the measurement of latent constructs and a non-causal relationship has been studied among different constructs.

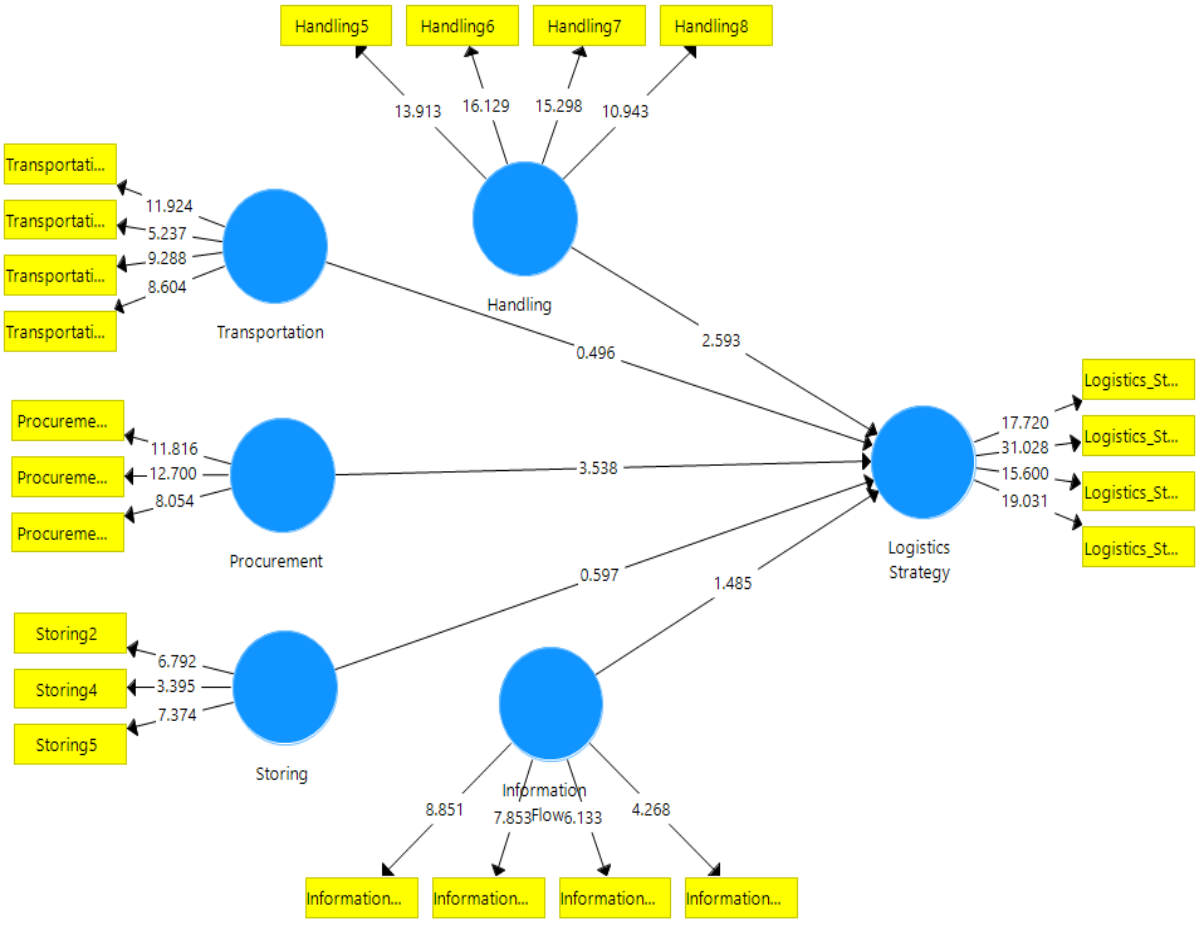

Figure 5.11 *H2/Structural Model Estimation for Logistics Planning on Logistics Strategy Management. Note. Prepared by the researcher from data (2021).*

The structural model reveals the same value of model fit as shown in Table 5.12; all the model fit indices for the structural model were not only significant but also remain the same as in the measurement model. The low index of R square in the range of 0.5 to 0.8 justifies the underlying theoretical model. All details are shown in Table 5.25. The complete Smart PLS output is displayed in Appendix C2.

Table 5.12 *Model Fit Indices and Path Coefficients of Relationship between Logistics Planning and Logistics Strategy Management*

	Original Sample (O)	**Sample Mean (M)**	**Standard Deviation (STDEV)**	**T-Statistics (|O/STDEV|)**	**P-Value**
Handling -> Logistics Strategy	0.248	0.253	0.096	2.593	0.01
Information Flow -> Logistics Strategy	0.135	0.151	0.091	1.485	0.138
Procurement -> Logistics Strategy	0.343	0.333	0.097	3.538	0.000
Storing -> Logistics Strategy	-0.052	-0.033	0.088	0.597	0.551
Transportation -> Logistics Strategy	0.043	0.048	0.088	0.496	0.62

Note. Prepared by the researcher from data (2021).

5.6.2.3 Relationship between Logistics Strategy Management and Construction Projects' Execution.

To assess the impact of logistics strategy on construction projects' execution, structural equation modeling has been employed and a measurement model of these

constructs has been assessed. Figure 5.12 reveals, by drawing a path, that reflective indicators have been used for the measurement of latent constructs, and a non-causal relationship has been studied among different constructs.

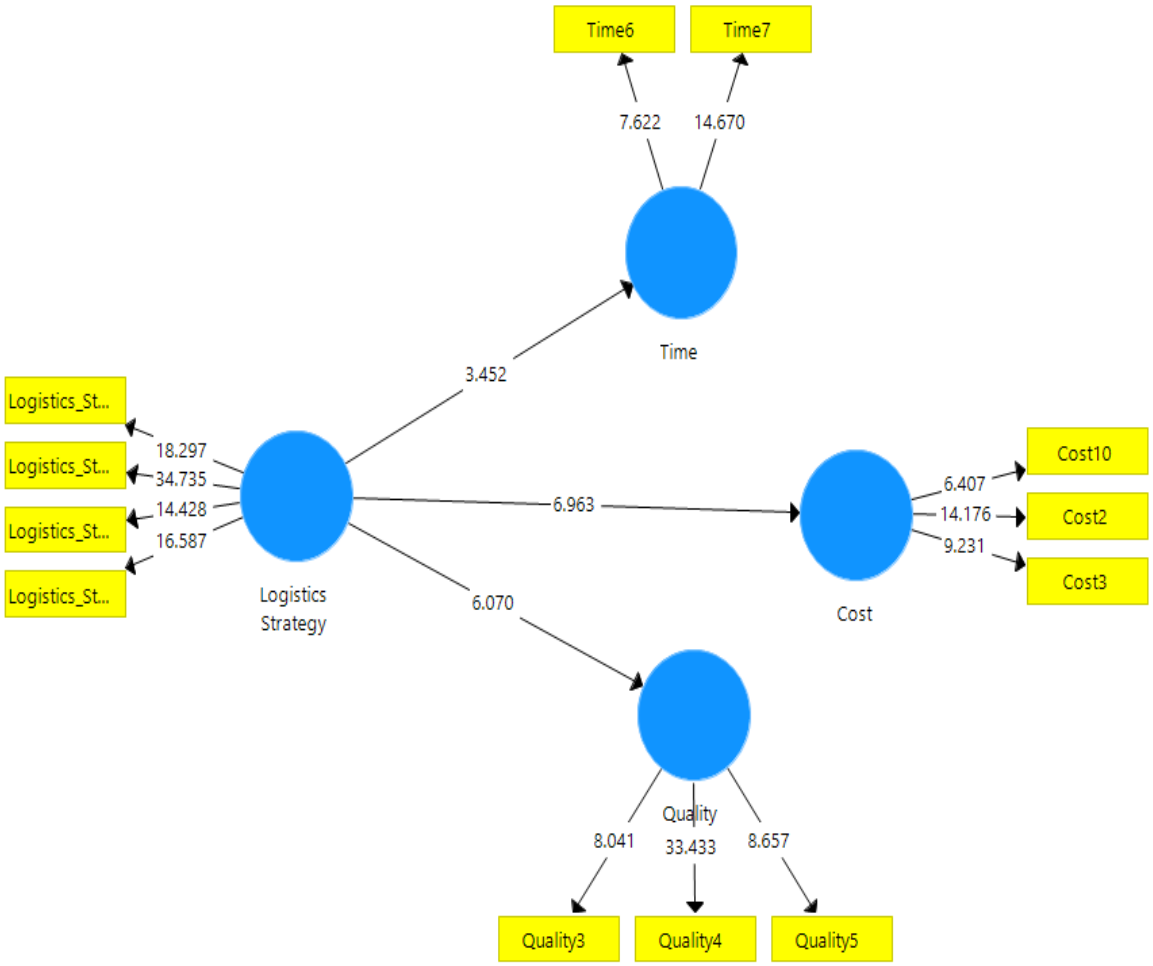

Figure 5.12 *H3/Structural Model Estimation for Logistics Strategy Management on Construction Projects' Execution. Note. Prepared by researcher from data (2021).*

The structural model reveals the same value of model fit shown in Table 5.13; all the model fit indices for the structural model were not only significant but also

remain the same as in the measurement model. The low index of R square in the range of 0.5 to 0.8 justifies the underlying theoretical model. All details are shown in Table 5.13. The complete Smart PLS output is displayed in Appendix C3.

Table 5.13 *Model Fit Indices and Path Coefficients of Relationship between Logistics Strategy Management and Construction Projects' Execution*

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T-Statistics (|O/STDEV|)	P-Value
Logistics Strategy -> Cost	0.479	0.489	0.069	6.963	0.000
Logistics Strategy -> Quality	0.498	0.516	0.082	6.07	0.000
Logistics Strategy -> Time	0.284	0.288	0.082	3.452	0.001

Note. Prepared by the researcher from data (2021).

5.6.2.4 Mediation Model.

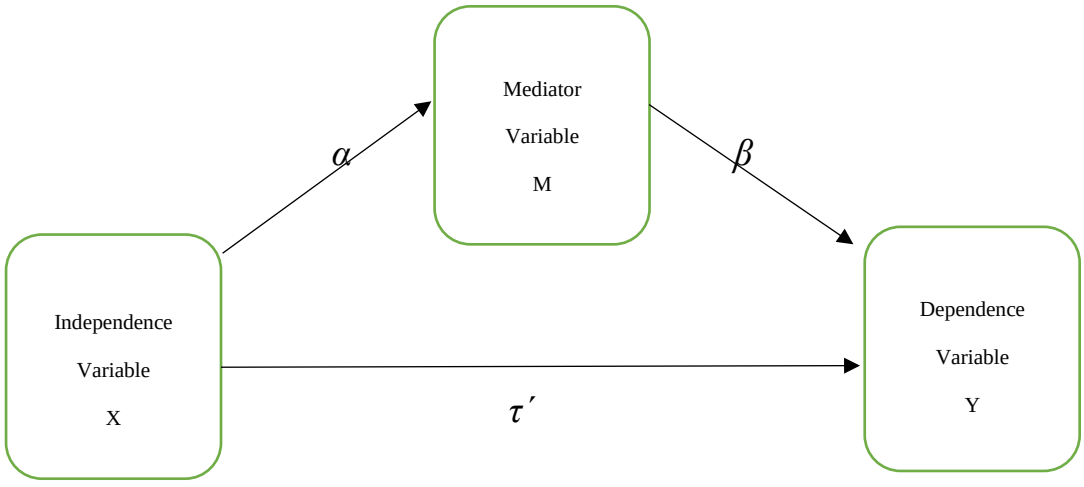

Figure 5.13 *Mediation model*

The mediation model seeks to discover and explicate the underlying mechanism of an observed relationship existing between a dependent and an independent variable by including a third explanatory variable, usually called the mediator variable. However, the hypothesis of a meditational model is not related to a direct causal relationship between the dependent and the independent variable. Instead, the hypothesis assumes that the independent variable is the main cause of the mediator variable, which, consequently, results in the dependent variable. Therefore, it can be claimed that the mediator variable seeks to explain the nature of the relationship between the dependent and the independent variable (MacKinnon, 2008).

Direct effect = τ'

Indirect effect = $\alpha\beta$

Total effect = $\alpha\beta + \tau'$

Figure 5.13 displays a simple mediation model. The simplest mediation model indicates the addition of a third variable to the relationship between the independent and dependent variables, which enables the independent variable (X) to cause the mediator (M), and the resulting mediator variable (M) to cause the dependent variable (Y), namely:

Independent variable → Mediator variable → Dependent variable

It should be noted that the relationship between X and Y is via the direct and mediated effect indirectly causing X to affect Y through M. The mediation model can be dichotomized into two more models: a theoretical model, corresponding to an unobservable relationship among indicators, and an empirical model, corresponding to the statistical analysis of actual data (MacCorquodale & Meehl, 1963). The relevant study tries to infer the true state of mediation from observations. However, some qualifications are attributable to this simple dichotomy, which is, generally, interested in the justification of a research program to conclude that a third variable is mediating in the relationship.

Mediation Regression Equations

There are three main approaches that are commonly employed for the analysis of a statistical mediation model. These approaches are 1) causal (first step); 2) difference in coefficients (second step); and 3) product of coefficients (third step). The required data used in these three approaches is mainly obtained from the three regression equations, displayed below:

$$Y = \alpha 1 + \beta 1 X + \varepsilon 1 \qquad (1)$$

$$Y = \alpha 2 + \beta 2 X + \beta M M + \varepsilon 2 \qquad (2)$$

$$M = \alpha 3 + \beta 3 X + \varepsilon 3 \qquad (3)$$

In the above equations, Y is considered as the dependent variable; α1, α2, and α3 are intercepts; M indicates the mediator; X represents the independent variable;

β1 indicates the coefficient related to the dependent and independent variables; β2 represents the coefficient connecting the dependent variable to the independent one, and, ultimately, adjusting them for the mediator; βM represents the coefficient linking the mediator indicator to the dependent variable adjusted for the independent one; β3 indicates the coefficient connecting the independent to the mediator variable; and, finally, ε1, ε2, and ε3 indicate the residual terms. Nevertheless, it is noteworthy to mention that the mediation functions can be modified to produce both nonlinear and linear effects as well as M and X interactions in Equation (2).

The most common approach employed for the assessment and evaluation of the mediation model is the first or causal steps approach. The causal steps approach has been delineated in the works of some researchers, such as Baron and Kenny (1986); Kenny and Kashy (1998); Judd and Kenny (1981); and Judd and Kenny (1981). For establishing the mediation model, Baron and Kenny's (1986) approach suggests four steps. In the first step, Equation (1) requires a strong relationship between the dependent and independent variables. In the second step, Equation (3) requires a significant relationship between the hypothesized mediator and the independent indicator. Next, in the third step, a significant mediator variable is required to be related to the dependent variable. However, both mediating and independent variables predict the dependent variable in Equation (2). Finally, in the fourth step, the coefficient connecting the dependent variable to the independent one

is required, and it must be greater (in absolute value) than the coefficient connecting the dependent variable to the independent one in the regression analysis in which both the mediating and independent variables, in the unique equation, are predictors of the dependent variable.

The causal steps approach, mentioned above, is the most common method utilized for the assessment of a mediation model. However, this approach has a number of limitations, which are elaborated upon in this section. In a single-mediator model, the mediation effect can be computed in two ways, namely, $\beta 3\beta M$ or $\beta 1 - \beta 2$ (MacKinnon & Dwyer, 1993). The indirect or mediated effect value, calculated through the coefficient difference, $\beta 1 - \beta 2$, in Equations (1) and (2), adjusts with a decrease of the independent factor's effect on the dependent factor while corresponding to the mediation factor.

The product of coefficients is generated from the mediated or indirect effect, which involves assessment of the product of $\beta 3$ and βM, $\beta 3\beta M$ and estimation of Equations (2) and (3) (Alwin, 1970). This is because mediation depends on the extent of modification made in the mediator, $\beta 3$, by the program and the extent of the effect of the mediator on the produced variable, βM. Next, the significance is checked by dividing the result by the standard error of the ratio, which is compared and contrasted to a standard normal distribution.

MacKinnon and Warsi (MacKinnon, 1995) presented the algebraic equivalence of the $\beta 1 - \beta 2$ and $\beta 3\beta M$ measures of mediation for normal theory OLS and MLE of the mediation regression models. Concerning multilevel modeling, probity or logistic regression modeling (MacKinnon & Dwyer, 1993), and analysis with survival data, the estimators of the mediated effect, $\beta 3\beta M$ and$\beta 1 - \beta 2$, are not always equivalent, and the two similar yields need to undergo some transformation (MacKinnon & Dwyer, 1993).

Standard Error of the Mediated Effect

The multivariate delta method can be used as a common formula to find the standard error of the mediated effect (Sobel, 1982, 2002). The indirect effect of the asymptotic standard error can be obtained through Equation (4) below (Bishop, 1975):

$$\sigma\beta 3\beta M = \sqrt{\sigma\beta 3/2 * \beta 3/2 + \sigma\beta M\ 2 * \beta 3/2} \qquad (4)$$

Another formula that can be utilized to obtain the standard error of $\beta 1 - \beta 2$ and $\beta 3\beta M$ has been elaborated and delineated by MacKinnon et al. (2002). However, the research, which is based on simulation, shows that the standard error of the estimator in Equation (4) reveals that the sample size low bias should be a minimum of 50 in models of single-mediation (MacKinnon, 1993). In case a model's mediator number is more than one, a standard error of at least 100–200 sample size is accurate (Stone, C.A. & M.E, 2002). The consequent outcomes with similar

features can also be applied to standard errors of positive and negative path values, while larger models contain multiple dependent, independent, and mediating indicators (MacKinnon, 1990).

Confidence Limits for the Mediated Effect

The standard error of $\beta 3\beta M$ is also applicable for examining its statistical significance as well as constructing confidence for the mediated effect restrictions, as shown in Equation (5) below:

$$\beta 3\beta M \pm z1-w\ 2/ * \sigma\beta 3\beta M \qquad (5)$$

Some scholars who support bootstrap analysis and simulation studies of the mediated effect reveal that confidence limits based on the mediated effect normal distribution (MacKinnon, 1993) can hardly be precise and errorless. In the case of positive mediating effects, the confidence intervals of the mediating effect strongly lean to move toward the left side of the true value of the mediating effect. They also have a strong tendency toward the right side of the negative mediating effects (Bollen, 1990; Stone, 1990). The limits of asymmetric confidence based on the estimation of bootstrap and product distribution can contribute to the process in a more effective fashion than the aforementioned tests (MacKinnon, 1993).

Modeling the Mediating/Intervening Effect

The mediating effect can also be called the intervening effect. A mediator is a predictor link in the relationships between two variables. Normally, a mediator

variable can become an exogenous and endogenous variable at the same time. By testing for mediating effects, a researcher can explore and examine the influences between these variables. According to Zainudin Awang (2010), mediation has three types, full mediation, partial mediation, and non-mediation.

For full mediation:

1. *The regression coefficient of X1 on Y (or B1) is not significant.*
2. *The regression coefficient of X1 on X2 (or B3) is significant.*
3. *The regression coefficient of X2 on Y (or B2) is significant.*

For partial mediation:

1. *The regression coefficient of X1 on Y (or B1) is significant.*
2. *The regression coefficient of X1 on X2 (or B3) is significant.*
3. *The regression coefficient of X2 on Y (or B2) is significant.*
4. *The value of B1 is lower than the product of B3 and B2.*

For non-mediation:

1. *The regression coefficient of X1 on Y (or B1) is not significant.*
2. *The regression coefficient of X1 on X2 (or B3) is not significant.*
3. *Both regression coefficients, B1 and B2, are significant but B1 is higher than B3*B2.*

5.6.2.5 The Mediating Role of Logistics Strategy Management on the Relationship between Logistics Planning and Construction Projects' Execution.

To assess the mediating role of logistics strategy on the relationship between logistics planning and construction projects' execution, SEM has been employed and a measurement model of these constructs has been assessed. Figure 5.14 reveals that reflective indicators have been used for the measurement of latent constructs, and a non-causal relationship has been studied among different constructs, by drawing a path.

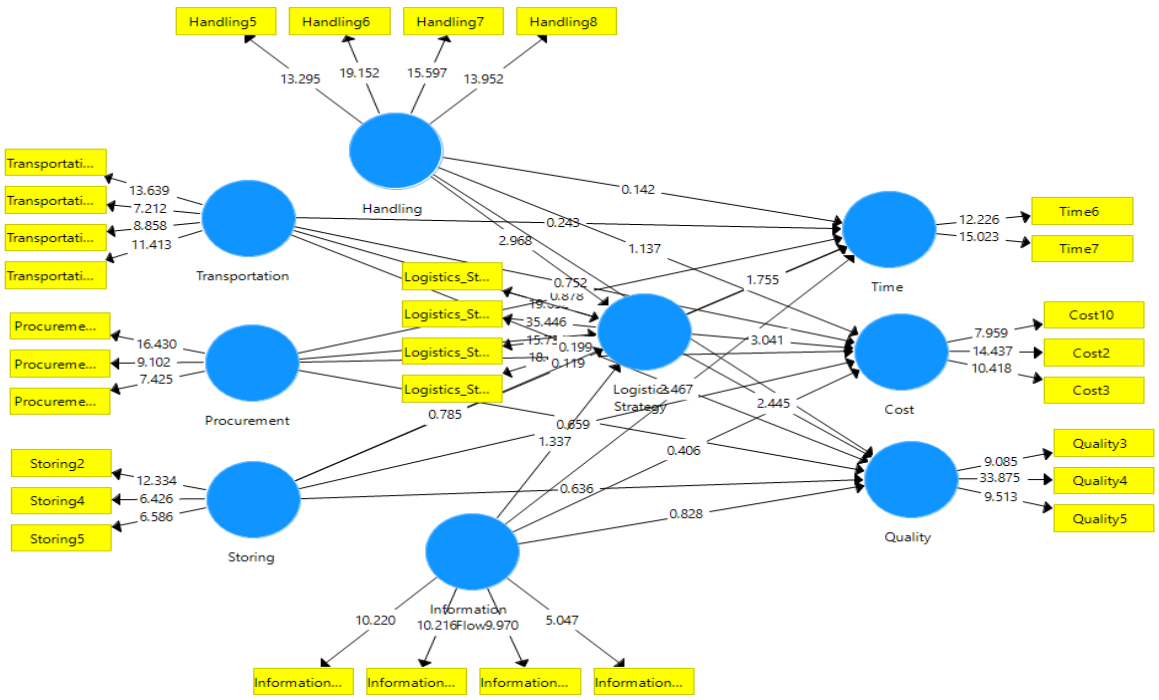

Figure 5.14: *H4/Structural Model Estimation for the Mediating Role of Logistics Strategy Management on the Relationship between Logistics Planning and Construction Projects' Execution. Note. Prepared by the researcher from data (2021).*

The structural model reveals the same value of model fit shown in Table 5.13; all the model fit indices for the structural model were not only significant but also remain the same as in the measurement model. The low index of R square in the range of 0.5 to 0.8 justifies the underlying theoretical model.

The results for direct effects without a mediator

Table 5.14 shows the estimates to be extracted to check for direct effects without a mediator after establishing model fit. This is done by observing regressions weights and standardized regression weights in the table. The significant relationships (i.e., based on the p-values and the estimates) are extracted to explain the direct effects without a mediator, as shown in table 5.14. These are compared with the direct effect results when the mediator is added.

Table 5.14 *Standardized Regression Weights for a Path Model Without a Mediator*

		Original Sample (O)	**Sample Mean (M)**	**Standard Deviation (STDEV)**	**T-Statistics (|O/STDEV|)**	**P-Value**
Handling Cost	->	0.124	0.122	0.109	1.137	0.256
Handling Logistics Strategy	->	0.251	0.252	0.085	2.968	0.003
Handling Quality	->	0.269	0.272	0.116	2.311	0.021
Handling Time	->	0.014	0.021	0.096	0.142	0.887
Information Flow -> Cost		0.039	0.047	0.097	0.406	0.685
Information Flow	->	0.132	0.132	0.099	1.337	0.182

Logistics Strategy Information Flow -> Quality	0.077	0.078	0.093	0.828	0.408
Information Flow -> Time	0.243	0.245	0.098	2.467	0.014
Logistics Strategy -> Cost	0.299	0.297	0.098	3.041	0.002
Logistics Strategy -> Quality	0.277	0.268	0.113	2.445	0.015
Logistics Strategy -> Time	0.169	0.169	0.096	1.755	0.08
Procurement -> Cost	0.137	0.148	0.114	1.204	0.229
Procurement -> Logistics Strategy	0.35	0.342	0.094	3.702	0.000
Procurement -> Quality	0.097	0.102	0.1	0.972	0.331
Procurement -> Time	0.109	0.113	0.124	0.878	0.38
Storing -> Cost	0.067	0.068	0.102	0.659	0.51
Storing -> logistics Strategy	-0.068	-0.063	0.087	0.785	0.433
Storing -> Quality	0.064	0.066	0.101	0.636	0.525
Storing -> Time	-0.014	-0.012	0.116	0.119	0.905
Transportation -> Cost	0.076	0.071	0.1	0.752	0.452
Transportation -> logistics Strategy	0.041	0.045	0.098	0.419	0.675
Transportation -> Quality	0.024	0.031	0.121	0.199	0.843
Transportation -> Time	-0.03	-0.028	0.122	0.243	0.808

Note. Prepared by the researcher from data (2021).

Path Coefficients, Observed T- Statistics, Significant Level for some Hypothesized Paths under 0.05 P-value or 1.96 T Statistics

The mediation tests: Indirect effects using the bootstrap approach

The indirect effects using the bootstrap approach (Bollen & Stone, 1990; Preacher & Hayes, 2004; Shrout & Bolger, 2002) are different from Baron and Kenny's (1986) approach. Evidence for this is shown in Table 5.15 below.

Table 5.15: *The Mediating Role of Logistics Strategy Management in the Relationship Between Logistics Planning and Construction Projects' Execution*

	Original Sample (O)	**Sample Mean (M)**	**Standard Deviation (STDEV)**	**T-Statistics (|O/STDEV|)**	**P-Value**
Information Flow -> logistics Strategy -> Quality	0.037	0.036	0.032	1.147	0.252
Handling -> logistics Strategy -> Time	0.042	0.043	0.031	1.387	0.166
Procurement -> logistics Strategy -> Quality	0.097	0.091	0.046	2.127	0.034
Storing -> logistics Strategy -> Time	-0.011	-0.01	0.017	0.657	0.511
Handling -> Logistics Strategy -> Cost	0.075	0.074	0.035	2.165	0.031
Transportation -> Logistics Strategy -> Cost	0.012	0.013	0.03	0.406	0.685

Handling -> Logistics Strategy -> Quality	0.069	0.07	0.041	1.692	0.091
Transportation -> Logistics Strategy -> Quality	0.011	0.016	0.03	0.379	0.705
Procurement -> Logistics Strategy -> Time	0.059	0.058	0.037	1.596	0.111
Storing -> Logistics Strategy -> Cost	-0.02	-0.018	0.027	0.763	0.446
Storing -> Logistics Strategy -> Quality	-0.019	-0.018	0.027	0.699	0.485
Information Flow -> Logistics Strategy -> Time	0.022	0.023	0.023	0.956	0.34
Transportation -> Logistics Strategy -> Time	0.007	0.007	0.02	0.35	0.727
Procurement -> Logistics Strategy -> Cost	0.105	0.102	0.045	2.32	0.021
Information Flow -> Logistics Strategy -> Cost	0.04	0.039	0.033	1.212	0.226

Note. Prepared by the researcher from data (2021).

5.6.2.6 The Moderator Role of Lean Logistics in the Relationship between Logistics Strategy Management and Construction Projects' Execution.

To assess the moderator role of lean logistics in the relationship between logistics strategy management and construction projects' execution, SEM has been employed and a measurement model of these constructs has been assessed. Figure 5.15 reveals, by drawing a path, that reflective indices have been used for the measurement of

latent constructs, and a non-causal relationship has been studied among different constructs.

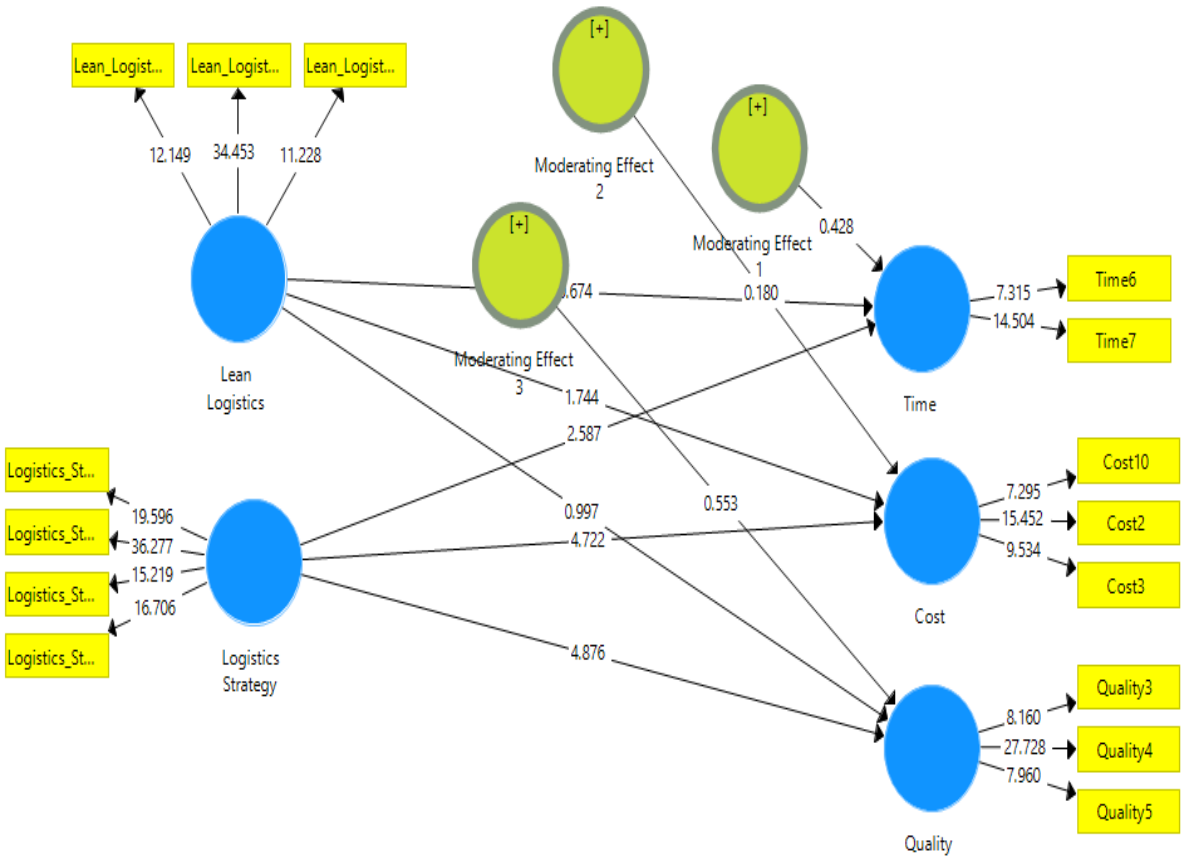

Figure 5.15 *H5/Structural Model Estimation for the Moderator Role of Lean Logistics in the Relationship Between Logistics Strategy Management and Construction Projects' Execution. Note. Prepared by the researcher from data (2021).*

The structural model reveals the same value of model fit shown in Table 5.16; all the model fit indices for the structural model were not significant and remain the same as in the measurement model. The low index of R square in the range of 0.5 to

0.8 justifies the underlying theoretical model. All details are shown in Table 5.16. The complete Smart PLS output is displayed in Appendix C5.

Table 5.16 *Model Fit Indexes and Path Coefficients of the Moderator Role of Lean Logistics in the Relationship Between Logistics Strategy Management and Construction Projects' Execution*

	Original Sample (O)	**Sample Mean (M)**	**Standard Deviation (STDEV)**	**T-Statistics (|O/STDEV|)**	**P-Values**
Lean Logistics -> Cost	0.178	0.184	0.102	1.744	0.082
Lean Logistics -> Quality	0.106	0.112	0.106	0.997	0.319
Lean Logistics -> Time	0.08	0.104	0.119	0.674	0.501
Logistics Strategy -> Cost	0.403	0.411	0.085	4.722	0.000
Logistics Strategy -> Quality	0.436	0.445	0.089	4.876	0.000
Logistics Strategy -> Time	0.234	0.232	0.09	2.587	0.001
Moderating Effect 1 -> Time	-0.04	-0.034	0.093	0.428	0.669
Moderating Effect 2 -> Cost	0.013	0.004	0.07	0.18	0.857
Moderating Effect 3 -> Quality	-0.037	-0.052	0.067	0.553	0.581

Note. Prepared by the researcher from data (2021).

Path Coefficients, Observed T- Statistics, Significant Level for some Hypothesized Paths under 0.05 P-value or 1.96 T Statistics

The table below summarizes the results of testing the hypotheses concerning the impact of logistics services planning on the success of construction projects in Khartoum State. The table reveals that one of the hypotheses is fully supported, while some are partially supported.

Table 5.17: *Hypotheses Test Summary*

H1	**T-Statistics (|O/STDEV|)**	**P-Values**	**Hypotheses result**
Handling -> Cost	1.834	0.067	Not supported
Handling -> Quality	3.18	0.002	Supported
Handling -> Time	0.549	0.583	Not supported
Information Flow -> Cost	0.779	0.437	Not supported
Information Flow -> Quality	1.167	0.244	Not supported
Information Flow -> Time	2.946	0.003	Supported
Procurement -> Cost	2.283	0.023	Supported
Procurement -> Quality	1.851	0.065	Not supported
Procurement -> Time	1.456	0.146	Not supported
Storing -> Cost	0.424	0.672	Not supported
Storing -> Quality	0.48	0.631	Not supported
Storing -> Time	0.183	0.855	Not supported
Transportation -> Cost	0.818	0.414	Not supported
Transportation -> Quality	0.29	0.772	Not supported
Transportation -> Time	0.163	0.871	Not supported
H2	T-Statistics (|O/STDEV|)	P-Values	

Handling -> Logistics Strategy	2.593	0.01	Supported
Information Flow -> Logistics Strategy	1.485	0.138	Not supported
Procurement -> Logistics Strategy	3.538	0	Supported
Storing -> Logistics Strategy	0.597	0.551	Not supported
Transportation -> Logistics Strategy	0.496	0.62	Not supported
H3	T-Statistics (|O/STDEV|)	P-Values	
Logistics Strategy -> Cost	6.963	0.000	Supported
Logistics Strategy -> Quality	6.07	0.000	Supported
Logistics Strategy -> Time	3.452	0.001	Supported
H4	T-Statistics (|O/STDEV|)	P-Values	
Information Flow -> Logistics Strategy -> Quality	1.147	0.252	No mediation
Handling -> Logistics Strategy -> Time	1.387	0.166	No mediation
Procurement -> Logistics Strategy -> Quality	2.127	0.034	Full mediation
Storing -> Logistics Strategy -> Time	0.657	0.511	No mediation
Handling -> Logistics Strategy -> Cost	2.165	0.031	Full mediation
Transportation -> Logistics Strategy -> Cost	0.406	0.685	No mediation
Handling -> Logistics Strategy -> Quality	1.692	0.091	No mediation
Transportation -> Logistics Strategy -> Quality	0.379	0.705	No mediation

Procurement -> Logistics Strategy -> Time	1.596	0.111	No mediation
Storing -> Logistics Strategy -> Cost	0.763	0.446	No mediation
Storing -> Logistics Strategy -> Quality	0.699	0.485	No mediation
Information Flow -> Logistics Strategy -> Time	0.956	0.34	No mediation
Transportation -> Logistics Strategy -> Time	0.35	0.727	No mediation
Procurement -> Logistics Strategy -> Cost	2.32	0.021	Full mediation
Information Flow -> Logistics Strategy -> Cost	1.212	0.226	No mediation
H5	T-Statistics (|O/STDEV|)	P-Values	
Moderating Effect 1 -> Time	0.428	0.669	Not moderator
Moderating Effect 2 -> Cost	0.18	0.857	Not moderator
Moderating Effect 3 -> Quality	0.553	0.581	Not moderator

Note. Prepared by the researcher from data (2021).

5.7 Summary of the Chapter

The above discussion on data analysis explores the process of data analysis followed for the measurement and validation of various constructs. It begins by describing the descriptive statistics of the sample data, followed by the respondents' demographic information. Then, the process of measuring and validating the constructs has been presented. Finally, the results of the path analysis and hypotheses

testing have been developed. The next chapter focuses on the proposed research discussion and conclusion.

The modified research model will be developed below to illustrate the final research model based on the findings.

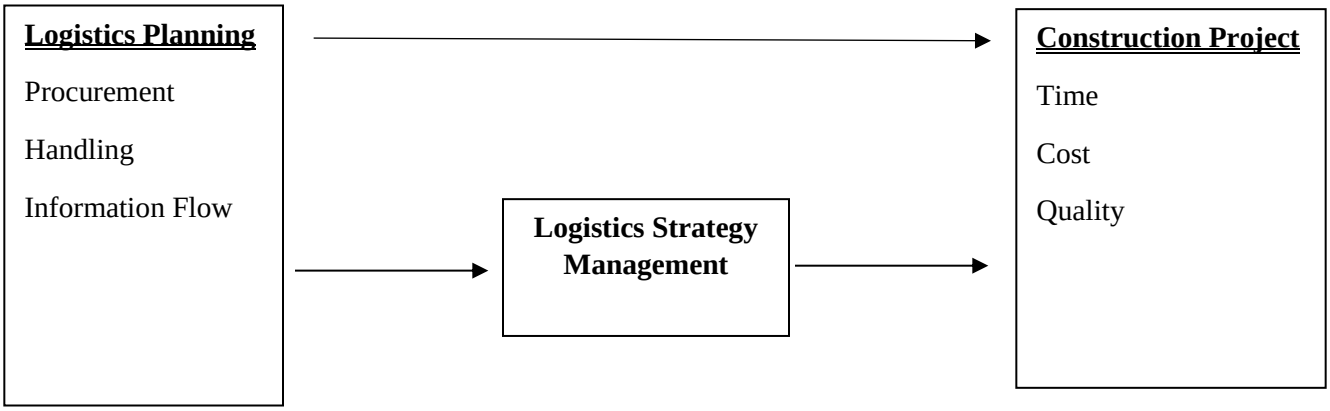

Figure 5.16 *Modified Research Model Note. Prepared by the researcher from data (2021).*

Chapter Six

Conclusion and Recommendations

Chapter Six

Conclusion and Recommendations

6.1 Overview

This chapter discusses the summary of the findings of this study, in which the researcher, through a theoretical study and analysis of the field study data, has obtained results by testing the study's hypotheses in the light of the objectives and research questions. Moreover, it includes general and special recommendations, as well as recommendations for future studies. The structure of this chapter will be as follows:

1. First: Findings Discussion
2. Second: Recommendations, which will include the following:
    1.1 General recommendations
    1.2 Recommendations for future studies

6.2 Findings Discussion

The hypotheses of the study were tested using field study data collected from logistics personnel (119 individuals) working at construction companies and residential complexes in Khartoum State; 150 questionnaires were distributed, of which 125 questionnaires were collected. The questionnaires were found valid for analysis by 95%. The analysis was carried out using PLS. Smart PLS 3.0 M3 software is used to assess the measurement and structural model for this study. The

validity and reliability of the measurement model in this study are evaluated using the following analyses: internal consistency reliability, indicator reliability, convergent validity, and discriminant validity. Further, the validity of the structural model is assessed using the coefficient of determination (R2) and path coefficients. All these tools are used to answer the following study questions:

1. To what extent does the logistics services planning affect the execution of the construction projects of the researched companies?
2. To what extent does the logistics planning of transportation, procurement, storing, handling, and information flow affect the logistics strategy management of the researched companies?
3. What is the impact of the logistics strategy management on the execution of the construction projects in Khartoum State?
4. Does logistics strategy management mediate the relationship between logistics service planning and the execution of construction projects?
5. Does the adoption of lean logistics (moderator variable) affect the quality of the relationship between logistics strategy management and the execution of construction projects?

To answer the study questions, the relationship between the independent variable (logistics service planning) and the dependent variable (execution of construction projects) was tested. In addition, the mediator role of logistics strategy

management between the independent and dependent variables was also tested. Moreover, the impact of adopting lean logistics (moderator variable) on the quality of the relationship between logistics strategy and the execution of the construction projects is, finally, tested. To answer the study questions, five hypotheses were developed. Following are the results of the study's hypotheses:

1. Discussion of the results of the first hypothesis: The relationship between logistics planning and execution of construction projects.

The purpose of this relationship is to test the hypothesis of the study, which states that "logistics planning affects the execution of the construction projects of residential complexes and enhances the opportunities of the companies owning and implementing these projects to improve the results of their work. Therefore, this hypothesis states that "logistics service planning affects the execution of the construction projects in terms of implementation time, cost of construction, and quality of the project." This hypothesis aims to answer the research question: Does the logistics services planning affect the execution of constructions projects of the researched companies? Accordingly, the implementation time, construction cost, and quality of the project were chosen as a standard for the success of the construction project due to the nature of these activities. Based on the results, the first hypothesis is partially supported. The results show that there is a positive relationship between logistics planning of handling and the successful execution of

construction projects (quality), and the level of significance is 0.002. In addition, there is a positive relationship between logistics planning of information flow and the successful execution of construction projects (time), and the level of significance is 0.003. Further, there is a positive relationship between logistics planning of procurement and the successful execution of construction projects (cost), and the level of significance is 0.023. These findings are consistent with the studies of Duiyoung et al. (2014), Matouzko et al. (2012), Muya (1999), Ogunsanmi (2013), Ristovskai et al. (2017), Anane et al. (2019), Kaiman et al. (2019), and Eriksson and Westerberg (2012), who found a positive correlation between logistics management and the performance of construction projects. However, the other parts of the hypothesis were not supported, and their level of significance ranged from 0.065 for the relationship between logistics planning of procurement and the quality of execution of the construction project to 0.871 for the relationship between logistics planning of transportation and the time of execution of the construction project.

2. Discussion of the results of the second hypothesis: The relationship between logistics planning and logistics strategy management.

The second hypothesis states that the successful administrative practices in the field of logistics should be based on scientific knowledge; these practices contribute to achieving the company's vision and creating competitive advantages because of the information, measures, and strategies provided by the knowledge in

this field and its various applications that help in achieving success in construction projects. Thus, the second hypothesis states that "There is a positive correlation between the planning of logistics services and the effective logistics strategy management adapted by the surveyed companies."

After conducting the study, it was found that a strong positive relationship exists between the logistics planning of procurement and appropriate logistics strategy management and that the level of significance is 0.000. Moreover, there is a strong positive relationship between the logistics planning of handling and appropriate logistics strategy management, and the level of significance is 0.001. These findings are in line with those of Muya (1999) and Brat et al. (2012), who found that a positive relationship exists between logistics planning and logistics strategy management. However, the current study found that there is no significant correlation between the logistics planning of information flow and appropriate logistics strategy management, which had a significance level of 0.138. Further, no significant correlation was found between the logistics planning of storing and appropriate logistics strategy management, which had a significance level of 0.551). Finally, it was also found that there is no statistically significant relationship between the logistics planning of transportation) and the appropriate logistics strategy, which had a significance level of 0.62.

3. Discussion of the results of the third hypothesis: The relationship between logistics strategy management and the execution of construction projects.

The third hypothesis states that "There is a positive relationship between logistics strategy management and execution of construction project in terms of time, cost, and quality of the project." This hypothesis aims to answer the following research question: What is the impact of logistics strategy management on the success of construction projects?

The study results indicated that a strong positive relationship exists between the cost of the construction project and appropriate logistics strategy management, with a significance level of 0.000. Moreover, a strong positive relationship was found between the quality of execution of the construction project and appropriate logistics strategy management, with a 0.000 significance level. Further, a strong positive relationship was found between the time of execution of the construction project and appropriate logistics strategy management, with a 0.001 significance level. These results are consistent with the results obtained by Duiyoung et al. (2014), Andersson and Nilsson (2018), Dahlström (2011), Norton (2015), and Johansson and Mellgren (2021) who found that there is a positive relationship between logistics strategy and the performance of the construction projects.

4. Discussion of the results of the fourth hypothesis: Effective logistics strategy management mediates the relationship between logistics planning and the execution of construction projects.

Based on the results of the study, the logistics strategy has partially met the conditions for mediating the relationship between the two variables. The study found that logistics strategy management fully mediates the relationship between the logistics planning of procurement and the quality of the execution of the construction project and had a significance level of 0.034. Moreover, the study found that logistics strategy management fully mediates the relationship between the logistics planning of handling and the cost of execution of the construction project and had a significance level of 0.031. Finally, the study found that logistics strategy management fully mediates the relationship between logistics planning of procurement and the cost of the execution of the construction project and had a significance level of 0.021.

5. Discussion of the results of the fifth hypothesis: The effect of logistics strategy management on the successful execution of construction projects becomes strong considering the adoption of the accurate waste elimination procedure (lean logistics).

The study found no statistical significance in the direct relationship between lean logistics and the execution of the construction project in terms of cost, quality,

or time. The study found a significance level of 0.082 between lean logistics and the cost of the execution of the construction project; a significance level of 0.319 between lean logistics and the quality of the execution of the construction project; and a significance level of 0.501 between lean logistics and the time of the execution of the construction project. Based on this, the study found that lean logistics does not moderate the relationship between logistics strategy management and the execution of the construction project. Further, the following were found as well:

6. Effective logistics strategy management plays a significant role in controlling the financial resources of the construction projects and increasing the efficiency of logistics services during the execution of the construction projects.
7. Effective logistics strategy significantly contributes to increasing the efficiency of the material storage process and environment.
8. Lean logistics could have a huge added value in the execution process of construction projects by removing unnecessary logistical activities and decreasing execution errors; however, this concept is not applied effectively in Sudan, specifically in the execution of construction projects in Khartoum State.
9. The executive management of construction projects has more consideration of project management skills rather than logistics management.

10. There is a clear disregard for logistics planning in construction companies, which has been proven by statistical evidence.
11. The current business culture in the construction companies working in the field of residential complexes is not in harmony with the culture of logistics service planning.
12. Construction companies do not use specific and sustainable systems to remove construction wastes that populate the environment; they also do not use scientific methods to deal with such wastes.
13. The researched construction companies do not conduct adequate training workshops and programs to establish a culture of quality in their logistics service.
14. Individuals working in construction companies do not have a deep understanding of the logistical planning of the logistics services they practice.
15. The senior management in construction companies does not seek to save resources necessary for implementing training programs on logistics services; these programs are also mainly unavailable.
16. Construction companies do not adhere to the international safety standards and regulations in logistics activities, whether in transportation, storage, handling, or customer service.

6.3 Recommendations

Based on the study's findings, the following recommendations are suggested to make theoretical and practical contributions to the work and research in the field of logistics and construction.

6.3.1 General Recommendations

1. Construction companies should enhance and spread the culture of conducting logistics planning for construction projects during the early phases of a project.
2. Logistics service planning should receive more attention from the senior management of companies working in the construction field as well as other companies.
3. Construction companies should build well-organized and accurate logistics strategies to get maximum output from logistical operations, especially procurement, transportation, and handling.
4. Construction companies should focus on the planning and process of transportation and storage to save as much time and cost as possible and to ensure the best quality of construction materials.
5. The planning process regarding the quality, cost, and time of construction projects should be done in coordination with the logistics team to develop

appropriate logistics strategies that can help in creating maximum outputs and implementing the projects in the best way possible.

6. Construction companies should adapt administration and logistics processes to eliminate all aspects of waste relating to the implementation of construction projects and enhance the culture of using recycled products.
7. Construction companies should ensure the most efficient work processes in their logistics departments to enhance achieving construction projects as per the planned time, cost, and quality.
8. Construction companies should train their staff members, especially those working in the logistics department, develop their abilities in building logistics planning and strategies, and save the resources necessary for implementing these training programs.
9. Government authorities should enhance and motivate construction companies to use scientific methods to eliminate construction wastes and use recycled materials.
10. Government authorities should adapt regulations that force construction companies to use specific and sustainable systems to remove construction wastes that populate the environment.

11. Construction companies should conform to the international safety standards and regulations in all logistical activities.
12. Construction companies should motivate and reward individuals who personally train and improve themselves to better their understanding and practicing of the logistics service and planning.
13. Integrated management should get more consideration by executive construction projects' management.

6.3.2 Recommendations for Future Studies

The researcher recommends the following for future research:

1. The study model could work and be implemented in the field of transforming manufacturing related to food and agriculture, as there is a huge need to plan logistics services for procurement, transporting, and handling. Moreover, efficient planning for eliminating waste and conforming to standards of quality is needed.
2. The study model could be used to deal with logistics problems in the area of manufacturing and maintaining electronic and digital supplies, which is growing rapidly and where logistics services play a significant role.
3. The study model could also help companies plan and use logistics services to collect, sort, and recycle daily waste by conducting effective logistics planning and strategy.

4. This study model could also be useful in removing construction wastes. Using logistics planning could help decrease waste material, remove unwilling disposals, and relocate recycled materials.
5. The study found that independent variables cause changes in the dependent variables. These changes are 31.6% on cost, 36.6% on quality, and 14.3% on time; the rest of the percentage is related to other variables, including random errors or other variables not mentioned in the study, such as the availability of finance. Therefore, the researcher thinks that it will be important to study the effect of finance availability on logistics service planning and performance in construction projects.

6.4 Significance of the Study

This study has the following theoretical and practical significance.

Theoretical Significance

The first sub-section presents the theoretical contribution of this research, which can be considered in terms of the following areas of knowledge:

1. This study contributed to the process of developing logistics services planning and filled the gap in the process of executing construction projects.
2. This study developed a conceptual framework that will contribute to theories as well as practice in the field of logistics and project management.

3. This study showed how logistics strategy as a mediator variable could help in the better execution of construction projects in terms of cost and quality by increasing the efficiency of procurement and handling processes.

Practical Significance

In addition to its theoretical significance, this study has some practical significance:

1. This study presented guidelines that could help managers and individuals concerned with the field of logistics and project management to apply logistics strategies for executing construction projects perfectly and decreasing defects in terms of time, quality, and material cost.
2. This study highlighted the importance of applying effective logistical plans, which can help avoid situations that may lead to an increase in the cost of executing construction projects or the time of implementing these projects.
3. This study worked to help logistics personnel and project management develop perfect planning to obtain project materials and prepare the best storing conditions and handling processes for those materials.

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Appendix A: Questionnaire (English):

Sudan University of Science & Technology

College of Graduate Studies

Department of Business Administration

A questionnaire submitted to fulfill the requirements for the degree of Doctor of Philosophy in Business Administration

Impact of Logistics Service Planning on the Success of Construction Project in Khartoum State

Prepared By: Supervisor

Omar Ismail Omar Mohammad Professor: Ali Abdullah Alhakem

A questionnaire directed to specialists in the field of logistics services in construction projects.

Dear Participant:

This study aims to highlight (**The Impact of Logistics Services Planning on the Success of Construction Projects in Khartoum State**). I would be very pleased and honored to receive your valuable contributions. If you could spare a few minutes of your precious time and scientific and practical experiences, this research will be a real addition to science and knowledge. We inform you that all information is strictly confidential and will be used only for academic purposes.

1. Please read each sentence carefully and then tick the category that reflects your agreement or disagreement with the sentence.

2. It is very important that you express your opinions as honestly as possible.

3. Please remember to be sure to give a check mark against each sentence and to never give more than one mark to a sentence.

Thank You Very Much

Part One: Personal Information:

1/Gender:

Male	Female

2/Age:

Less Than 25 Years	25–35 Years	36–45 Years	46–55 Years	More Than 55

3/Academic Qualification:

High School	Diploma	Bachelor	Master	PhD

4/Work Experience:

Less Than 5 Years	6–10 Years	11–15 Years	16–20 Years	More Than 20 Years

5/ Logistics Experience:

Less Than 5 Years	6–10 Years	11–15 Years	16–20 Years	More Than 20 Years

6/ Occupation:

Supervision	Middle Management	Top Management	Supplier	Contractor	Service Provider

Part Two: Logistics Planning (Procurement, Transport, Storage, Handling, and Information Flow)

Please answer the following questions by placing a ✓ against the suitable options.

Procurement

SN	Statement	Completely Agree	Agree	Neutral	Disagree	Completely Disagree
1	The procurement system of the project is totally and accurately based on the project scope.					
2	The procurement system includes contractual conditions that compromise the rules and conditions.					
3	The project's materials had been clearly and accurately determined among the basic requirements of goods, materials, and services.					
4	The procurement process contributes to obtaining materials at a suitable price.					
5	Project management continuously observes market prices and price trends.					
6	Procurement plans aim to obtain the highest price discounts.					
7	The entire material procurement process is done with qualified suppliers and fair competition.					
8	The procurement process is continuously improved and developed for obtaining better supplies and decreasing inventory.					
9	The procurement system contributes to decreasing the time					

	spent in supplying and receiving the purchased materials.					
10	Custom processes of imported materials are done quickly and efficiently.					
11	The procurement planning process helps in obtaining high-quality materials.					
12	There is a continuous investigation process to approve materials' quality during purchasing, receiving, and storing materials.					
13	Purchasing contracts aim to make the suppliers responsible for all costs of non-comfortable materials.					
14	The company applies incentives and a training system with suppliers.					
15	Procurement quality is based on conforming to local and international standards.					
16	The procurement planning system contributes to maintaining materials' quality and decreasing waste and disposal.					

Transportation

SN	Statement	Completely Agree	Agree	Neutral	Disagree	Completely Disagree
1	The transportation planning system contributes to decreasing the transportation cost.					
2	There is an alternative plan for transportation to deal with unstable economic situations.					

3	The transportation process is completed effectively to maintain the quality of the materials.					
4	The transportation planning system contributes to decreasing the waiting time needed to complete the supply process.					
5	The transportation planning system contributes to decreasing the number of shipments without affecting material quality.					
6	The transportation of sensitive and fragile materials is done effectively to maintain them.					

Storing

SN	Statement	Completely Agree	Agree	Neutral	Disagree	Completely Disagree
1	The selection process of storage location is determined and based on the type of materials being stored.					
2	The storage environment is good and meets all the requested conditions for storing construction materials.					
3	Stores are located close to the project location to decrease waiting risks and handling costs.					
4	Storage records are updated continuously to provide project management with information on the inventory situation and the quantity of available material.					
5	Storage equipment is updated continuously to guarantee smooth and quick storing processes.					
6	Computer software is used for planning and managing storing processes.					

Handling:

SN	Statement	Completely Agree	Agree	Neutral	Disagree	Completely Disagree
1	Handling planning is developed to avoid duplicating handling works.					
2	The handling planning process contributes to decreasing the time consumed in handling.					
3	The handling planning process contributes to decreasing the cost of handling.					
4	The handling planning process contributes to controlling the wastage of materials.					
5	The handling process is achieved by using modern and highly technical tools and equipment.					
6	The handling process is achieved by highly trained and skillful individuals.					
7	Handling plans are developed to decrease unnecessary inventory.					
8	Handling planning is developed with the support and use of computer software.					

Information Flow

SN	Statement	Completely Agree	Agree	Neutral	Disagree	Completely Disagree
1	Modern electronic tools are used to exchange project information					
2	The information flow process is updated continuously to decrease the time of transforming the information.					
3	Project information is exchanged horizontally and vertically in a smooth and quick manner.					

4	Project information is updated smoothly and quickly and without affecting the project's execution process.					
5	The information flow planning process is developed with the contribution of all those concerned with and participating in the project's execution process.					
6	Sharing project information with the public contributes to achieving project objectives and increasing the project's market value.					

Part Three: Construction Projects' Execution (Time, Cost, and Quality)

Please answer the following questions by placing a ✓ against the suitable options.

Project Time

SN	Statement	Completely Agree	Agree	Neutral	Disagree	Completely Disagree
1	All project works and activities are done at the planned time.					
2	The project had been achieved a few years after the planned time.					
3	The project had been achieved a few months after the planned time.					
4	The project had been achieved a few weeks after the planned time.					
5	The project had been achieved a few days after the planned time.					
6	Computer software is used to determine the required time to execute the project.					
7	The project's time planning process was done with the participation of all parties					

	involved in managing the execution process.					
8	The efficiency of logistics services affects the project's execution time positively.					
9	Logistics services had no effect on the project's execution time.					

Project Cost

SN	Statement	Completely Agree	Agree	Neutral	Disagree	Completely Disagree
1	The project's overall cost is suitable and did not exceed the cost of similar projects executed in the past.					
2	The project's cost considered the market situations and competitive advantages of other projects implemented by competitors.					
3	The project's cost planning takes into consideration unstable economic situations and prepared alternatives for unexpected risks.					
4	The overall actual cost of executing the project did not exceed the planned cost of the project.					
5	The overall actual cost of executing the project exceeded the planned cost by a little amount.					
6	The overall actual cost of executing the project exceeded the planned cost by an average amount.					
7	The overall actual cost of executing the project exceeded the planned cost by a large amount.					
8	The overall actual cost of executing the project exceeded the planned cost by a very large amount.					
9	Computer software is used to determine the required cost for executing the project.					

10	The project's cost planning process was done with the participation of all parties involved in managing the project's execution process.					
11	The efficiency of logistics services affected the project's execution cost positively.					
12	Logistics services had no effect on the project's execution cost.					

Project Quality

SN	Statement	Completely Agree	Agree	Neutral	Disagree	Completely Disagree
1	The project works and activities were achieved accurately and efficiently, and the project's final outputs conform to the planned and requested quality.					
2	The project's owners and stakeholders are completely satisfied with the project output's quality.					
3	Quality controls and tests were done by using modern and developed tools and equipment to ensure the best quality of the project's final outputs.					
4	There were continuous routine tests for the project's quality during the execution process and at the end of each phase of the project.					
5	The project's output quality conforms to the Sudanese Standards and Metrology requirements.					
6	The efficiency of logistics services affects the project's implementation quality positively.					
7	Logistics services had no effect on the project's implementation quality.					

Part Four: Logistics Strategy

Please answer the following questions by placing a ✓ against the suitable options.

SN	Statement	Completely Agree	Agree	Neutral	Disagree	Completely Disagree
1	Project management developed an effective strategic plan for all works related to the logistics services.					
2	The logistics strategy contributed to controlling the defect of resources during the procurement process.					
3	The logistics strategy contributed to accomplishing materials' transportation efficiently and decreased materials' waste.					
4	The logistics strategy contributed to maintaining material during the storing process and decreased the need for storing extra materials.					
5	The logistics strategy contributed to obtaining high efficiency in the handling process.					
6	The logistics strategy contributed to increasing the quality of the project's information flow and made it easier for all the project teams to receive the required information.					
7	The internal evaluation of logistical activities is done by analyzing the internal and external elements to determine the strengths and weaknesses of the company.					
8	Implementing the logistics strategy in the company means transferring the responsibilities from the planners to the logistical manager and associated departments.					

9	The evaluation, close follow-up, and review of the logistical strategy and associated plans positively affect the correction of implementation errors.	
10	Taking corrective actions in the company ensured that the performance conforms with the plans set in the implementation phase of the logistics strategy.	
11	The logistics strategy did not affect the process of implementing the project.	
12	The effect of the logistics strategy on the process of implementing the project was very limited.	
13	There was no logistics strategy at all.	

Part Five: Lean Logistics: (Defect Control)

Please answer the following questions by placing a ✓ against the suitable options.

SN	Statement	Completely Agree	Agree	Neutral	Disagree	Completely Disagree
1	Project management had worked to reduce unnecessary movement in project activities.					
2	The waste control process reduced the waiting times.					
3	The waste control process removed unnecessary transportation.					
4	The waste control process reduced unnecessary material storage.					
5	Waste control processes reduced the construction project's implementation errors.					
6	Waste control processes contributed to reducing overproduction processes.					

Appendix B: Questionnaire Arabic

بسم الله الرحمن الرحيم

جامعة السودان للعلوم والتكنولوجيا

كلية الدراسات العليا

قسم إدارة الأعمال

إســتبانة مقدمة لإستيفاء متطلبات درجة دكتوراة الفلسفة في إدارة الأعمال

بعنوان:

أثر تخطيط الخدمات اللوجستية علي نجاح المشروعات الإنشائية في ولاية الخرطوم

إعداد: الدارس

عمر إسماعيل عمر محمد

إشراف: البروفسور

علي عبد الله الحاكم

إستبانة موجه للمختصين في مجال الخدمات اللوجستية بالمشروعات الإنشائية

المشارك العزيز:

السلام عليكم ورحمة الله وبركاته.... وبعد

تهدف هذه الدراسة إلى إبراز **(أثر تخطيط الخدمات اللوجستية علي نجاح المشروعات الإنشائية في ولاية الخرطوم)** يسعدني ويشرفني جداً أن أتلقى مشاركاتكم القيمة من خلال بضع دقائق من وقتكم الغالي وخبراتكم العلمية والعملية حتى يكون هذا البحث إضافة حقيقية للعلم والمعرفة. ونفيدكم بأن كل المعلومات تعتبر سرية تماماً وستكون مستخدمة فقط للغرض الأكاديمي.

1. الرجاء قراءة كل جملة بتمعن وبعد ذلك صحح الفئة التى تعكس موافقتك أو عدم موافقتك للجملة.
2. المهم بأنك تبدى آرائك بأمانة بقدر الإمكان.
3. رجاءً تذكر أن تكون متأكداً بأن تعطي علامة صح لكل جملة، وبأنك لا تعطي أكثر من علامة واحدة لجملة واحدة أبداً.

مع خالص الشكر والتقدير لتعاونكم معي ،،،،،،،

القسم الأول: معلومات عن المشارك

1/ الجنس:

ذكر	أنثي

2/ العمر:

اقل من 25 سنة	26- 35 سنة	36- 45 سنة	46- 55 سنة	أكثر من 55 سنة

3/المؤهل العلمي:

ثانوي	دبلوم	بكلاريوس	ماجستير	دكتوراة

4/الخبرة العملية:

أقل من 5 سنوات	6 – 10 سنوات	11 – 15 سنة	16 – 20 سنة	أكثر من 20 سنة

5/ الخبرة في المجال اللوجستي (الإنشاءات ،البناء، النقل، التخزين ، خدمة العملاء ، المناولة سلاسل الإمداد)

أقل من 5 سنوات	6 – 10 سنوات	11 – 15 سنة	16 – 20 سنة	أكثر من 20 سنة

6/ الوظيفة

مشرف	إدارة وسطي	إدارة عليا	مورد	متعاقد	مقدم خدمة

القسم الثاني: تخطيط الخدمات اللوجستية (عمليات الشراء ،النقل، التخزين ،المناولة ،تدفق المعلومات)

عمليات الشراء:

م	العبارات	أوافق بشدة	أوافق	محايد	لا أوافق	لا أوافق بشدة
1	نظام الشراء في المشروع يستند إلى نطاق عمل المشروع بشكل سليم وأساسي					
2	يتضمن نظام الشراء الشروط المرجعية والتعاقدية بحسب القواعد والإجراءات					
3	تفاصيل الإحتياجات والمطلوبات للمشروع الإنشائي قد تم تحديدها بدقة ووضوح يبين المطلوبات الأساسية للسلع والمواد والخدمات.					
4	يساعد النظام المتبع في عملية الشراء على الحصول على المواد بسعر مناسب.					
5	تقوم إدارة المشروع بمراقبة حركة السوق بصورة متواصلة ومعرفة إتجاه الأسعار للحصول على المواد المطلوبة لتنفيذ المشروع بأفضل الأسعار					
6	خطط المشتريات تتم بصورة تضمن الحصول علي أكبر التخفيضات الممكنة.					
7	تتم عملية شراء المواد بالكامل بتأهيل الموردين الاكفاء والتنافس العادل					
8	هنالك عمليات تطوير وتحديث مستمرة للمشتريات وتوريد المواد الإنشائية					
9	يساعد النظام المتبع في عملية المشتريات على تقليل الوقت المستنفذ في عمليات التوريد واستلام المواد.					
10	إجراءات تخليص المواد المستوردة من الخارج تتم بصورة فعالة وسريعة.					
11	تتم عملية التخطيط للمشتريات بما يساعد على توريد مواد ذات جودة عالية.					
12	تتم عملية فحص دورية ومستمرة للمشتريات عند الشراء وعند الإستلام في المخازن للتأكد من جودة المواد ومطابقتها للمواصفات المطلوبة.					
13	تتم صياغة عقود المشتريات بصورة تضمن تحمل المورد ين للمسؤلية الكاملة في حالة عدم مطابقة المواد للمواصفات المطلوبة او ظهور عيوب في المواد.					
14	تطبق الشركة نظام الحوافز والتدريب مع الموردين					
15	تتم عملية تحديد جودة المشتريات بما يتوافق مع المواصفات والمقاييس المعمول بها محليا واقليميا.					
16	يساعد النظام المتبع في التخطيط للمشتريات في الحفاظ على المواد وتقليل التلف.					

النقل:

م	العبارات	أوافق بشدة	أوافق	محايد	لا أوافق	لا أوافق بشدة
1	يساعد النظام المتبع في تنفيذ عملية نقل المواد الإنشائية على تقليل تكلفة النقل.					
2	توجد خطط بديلة في عملية نقل المواد لمقابلة الظروف الإقتصادية غير المستقرة.					
3	عملية نقل المواد تتم بصورة فعالة تحافظ علي جودة المواد المنقولة.					
4	يساعد النظام المتبع في عمليات النقل على تقليل وقت الإنتظار اللازم لعمليات توريد المواد.					
5	يساعد النظام المتبع في عملية النقل على تقليل عدد الشحنات وبما لا يضر بالمواد المنقولة.					
6	تتم عمليات نقل المواد الحساسة وسريعة التلف بصورة فعالة بما يحافظ على تلك المواد.					

التخزين:

م	العبارات	أوافق بشدة	أوافق	محايد	لا أوافق	لا أوافق بشدة
1	تتم عملية إختيار مواقع التخزين بناءا على نوعية المواد المخزنة.					
2	يتم التخزين في بيئة ملائمة توفر كافة الشروط المطلوبة لعملية تخزين المواد الإنشائية.					
3	يتم تحديد مواقع التخزين بالقرب من موقع المشروع لتقليل مخاطر الإنتظار وتكلفة المناولة.					
4	يتم تحديث سجلات المخازن بصورة منتظمة لتزويد إدارة المشروع بحالة المخزون وكمية المواد المتاحة للإستخدام.					
5	تتم عملية تحديث معدات التخزين بصورة مستمرة لضمان سير عمليات التخزين بالسلاسة والسرعة المطلوبة.					
6	يتم استخدام برامج الحاسوب لتخطيط وإدارة عمليات التخزين.					

المناولة:

م	العبارات	أوافق بشدة	أوافق	محايد	لا أوافق	لا أوافق بشدة
1	تتم عملية تخطيط المناولة بطريقة تساعد على عدم تكرار عمليات المناولة					

2	تساعد عملية التخطيط للمناولة على تقليل الوقت المستنفذ في عمليات المناولة.					
3	تساعد عملية التخطيط للمناولة على تقليل تكلفة المناولة.					
4	تساعد عملية التخطيط للمناولة في السيطرة على تلف المواد.					
5	يتم استخدام المعدات والوسائل الحديثة والمتطورة في عملية المناولة للمواد.					
6	تتم عمليات المناولة بواسطة أفراد على مستوي عالي من التدريب والتأهيل.					
7	يتم تخطيط عملية المناولة بصورة تساعد على تقليل كمية المخزون غير الضرورية.					
8	يتم إستخدام برامج الحاسوب في التخطيط لعملية المناولة.					

تدفق المعلومات:

م	العبارات	أوافق بشدة	أوافق	محايد	لا أوافق	لا أوافق بشدة
1	يتم إستخدام الوسائل الألكترونية الحديثة في عملية تبادل المعلومات الخاصة بالمشروع.					
2	يتم تحسين وتحديث عملية تدفق المعلومات بصورة مستمرة لتقليل الوقت المستنفذ في عملية نقل المعلومات.					
3	يتم تبادل معلومات المشروع راسيا وأفقيا بين أقسام المشروع المختلفة وإدارة المشروع بصورة سريعة وسلسة.					
4	تتم عمليات التحديث الخاصة بمعلومات المشروع بصورة سريعة وسلسة لا تؤثر على عملية تنفيذ المشروع.					
5	تتم عملية التخطيط لتدفق المعلومات بمشاركة كافة الأطراف المرتبطة والمشاركة في عملية تنفيذ المشروع.					
6	تتم عملية نشر معلومات سير المشروع إلى الخارج بطريقة تساعد في الترويج للمشروع وتحقيق أهداف المشروع وزيادة القيمة التسويقية للمشروع.					

القسم الثالث: تنفيذ المشروع الإنشائي: (الوقت ،التكلفة ،الجودة)

وقت المشروع:

م	العبارات	أوافق بشدة	أوافق	محايد	لا أوافق	لا أوافق بشدة
1	تم تنفيذ كافة النشاطات والأعمال الخاصة بالمشروع والإنتهاء من تنفيذ المشروع بالكامل في الوقت المخطط له.					
2	نسبة الزيادة في وقت تنفيذ المشروع زادت عن الوقت المخطط له بسنوات					
3	نسبة الزيادة في وقت تنفيذ المشروع زادت عن الوقت المخطط له بشهور					
4	نسبة الزيادة في وقت تنفيذ المشروع زادت عن الوقت المخطط له باسابيع قليلة					
5	نسبة الزيادة في وقت تنفيذ المشروع زادت عن الوقت المخطط له بعدة أيام فقط					
6	تم إستخدام برامج الحاسوب في عملية التخطيط لتحديد الوقت المطلوب لتنفيذ المشروع.					
7	تمت عملية التخطيط لوقت المشروع بمشاركة مختلف الأطراف المرتبطة بإدارة عملية تنفيذ المشروع					
8	كفاءة الخدمات اللوجستية أثرت على وقت تنفيذ المشروع بصورة ايجابية.					
9	لم تؤثر الخدمات اللوجستية على وقت تنفيذ المشروع.					

تكلفة المشروع:

م	العبارات	أوافق بشدة	أوافق	محايد	لا أوافق	لا أوافق بشدة
1	التكلفة الكلية للمشروع مناسبة ولم تتجاوز الحد اللأقصي للتكلفة بالمقارنة مع المشروعات المشابهة.					
2	تم تحديد تكلفة المشروع بحيث تراعي أوضاع السوق والميزة التنافسية للمشروعات الأخري.					
3	عملية التخطيط لتكلفة المشروع وضعت في الإعتبار الأوضاع الإقتصادية غير المستقرة وأعدت بدائل لمقابلة المخاطر غير المتوقعة.					
4	لم تتجاوز تكلفة المشروع التكلفة الكلية المحددة لعملية التنفيذ.					
5	تجاوزت تكلفة المشروع التكلفة الكلية المحددة بنسبة زيادة قليلة					

6	تجاوزت تكلفة المشروع التكلفة الكلية المحددة بنسبة زيادة متوسطة
7	تجاوزت تكلفة المشروع التكلفة الكلية المحددة بنسبة زيادة كبيرة
8	تجاوزت تكلفة المشروع التكلفة الكلية المحددة بنسبة زيادة كبيرة جداً
9	تم إستخدام برامج الحاسوب في عملية التخطيط لتكلفة المشروع.
10	تم التخطيط لتكاليف المشروع بمشاركة كافة الأطراف المرتبطة بعملية تنفيذ المشروع والمشاركة في عمليات التنفيذ.
11	كفاءة الخدمات اللوجستية أثرت على تكلفة المشروع بصورة ايجابية.
12	لم تؤثر الخدمات اللوجستية على التكلفة النهائية للمشروع.

جودة المشروع

م	العبارات	أوافق بشدة	أوافق	محايد	لا أوافق	لا أوافق بشدة
1	تم تنفيذ عمليات وأنشطة المشروع بصورة دقيقة وفعالة ساعدت على إخراج المشروع بالجودة المطلوبة التي تم التخطيط لها.					
2	هناك رضاء تام لدي ملاك المشروع وأصحاب المصلحة في المشروع على مستوي الجودة التي تم بها تنفيذ المشروع.					
3	تمت عملية فحص الجودة للأعمال الإنشائية والهندسية للمشروع باستخدام وسائل ومعدات حديثة ومتطورة تساعد على التأكد الكامل من جودة مخرجات المشروع.					
4	هنالك عمليات فحص مستمرة للجودة اثناء تنفيذ المشروع وعند نهاية كل مرحلة من مراحل المشروع.					
5	الجودة التي تم بها إنجاز المشروع مطابقة لمواصفات الجودة المطلوبة للهيئة السودانية للمواصفات والمقاييس.					
6	كفاءة الخدمات اللوجستية أثرت علي جودة المشروع بصورة ايجابية.					
7	لم تؤثر الخدمات اللوجستية علي جودة للمشروع.					

القسم الرابع: الإستراتيجية اللوجستية

م	العبارات	أوافق بشدة	أوافق	محايد	لا أوافق	لا أوافق بشدة
1	تحرص إدارة المشروع علي وجود خطة إستراتيجية فعالة لكل ما يتعلق بالخدمات اللوجستية.					
2	وجود إستراتيجية لوجستية ساهم في السيطرة على الموارد المهدرة وضبط عمليات الشراء					
3	أدت الإستراتيجية اللوجستية الي تنفيذ عمليات نقل المواد بصورة فعالة وقللت من تلف المواد اثناء نقلها.					
4	ساهمت الإستراتيجية اللوجستية في الحفاظ على المواد خلال التخزين وقللت الحوجة لتخزين كميات أكثر من المطلوب.					
5	عملت الإستراتيجية اللوجستية على تحقيق كفاءة عالية لعلميات المناولة في كل مراحل المشروع.					
6	ساعدت الإستراتيجية اللوجستية في كفاءة عملية تدفق المعلومات وزادت من سرعتها وسهلت عملية الحصول على المعلومات المطلوبة لكافة أعضاء فريق المشروع.					
7	التقييم الداخلي للأنشطة اللوجستية يتم من خلال تحيل العناصر الداخلية والخارجية لتحديد جوانب القوة والضعف بالنسبة للشركة					
8	تطبيق الإستراتيجية اللوجستية في الشركة يعني انتقال المسؤوليات من المخططين إلي المدير اللوجستي والأقسام المرتبطة به					
9	التقييم والمتابعة والمراجعة الدقيقة للإستراتيجية اللوجستية والخطط المرتبطة بها يؤثر إيجاباً في تصحيح أخطاء التنفيذ					
10	إتخاذ الإجراءات التصحيحية بالشركة يؤدي إلي التأكد من أن الأداء يتماشى مع الخطط الموضوعة في مرحلة تنفيذ الإستراتيجية اللوجستية					

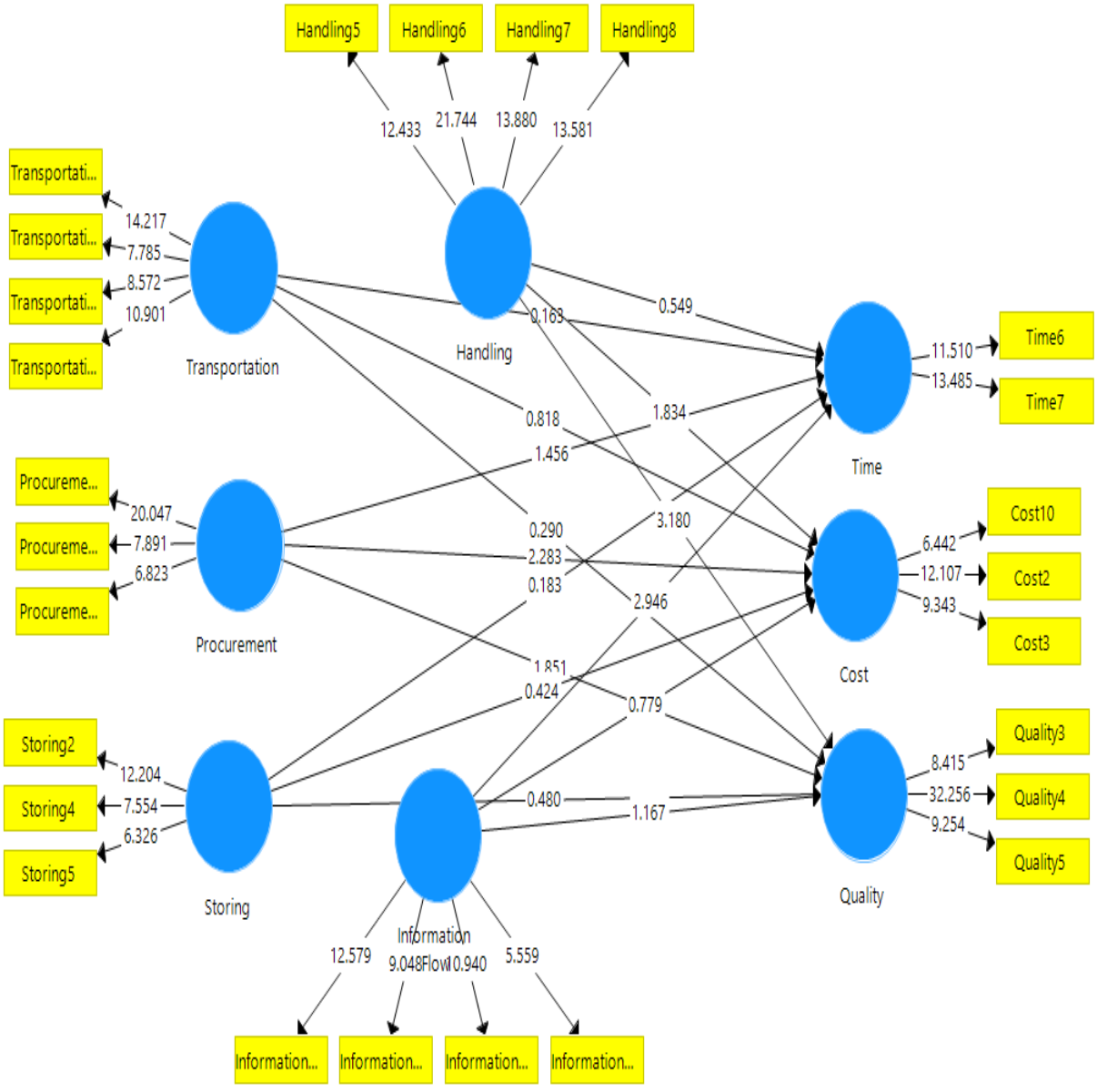
11	لم يؤثر وجود استراتيجية لوجستية على سير عمليات تنفيذ المشروع.
12	تأثير الإستراتيجية اللوجستية على سير عمليات المشروع كان محدودا.
13	لم يكن هنالك وجود لإستراتيجية تتعلق بالخدمات اللوجستية على الإطلاق.

القسم الخامس: اللوجستيات الخالية من الهدر: (السيطرة على الهدر) (أشكال الهدر ال 6)

م	العبارات	أوافق بشدة	أوافق	محايد	لا أوافق	لا أوافق بشدة
1	عملت إدارة المشروع على تقليل الحركة غير الضرورية في نشاطات المشروع.					
2	ساهمت عملية السيطرة على هدر الموارد في تقليل وقت الانتظار.					
3	أدت عملية محاربة الهدر إلى انعدام عمليات النقل غير ضرورية.					
4	ساعدت عملية السيطرة على الهدر في تقليل عمليات التخزين غير ضرورية للمواد.					
5	ساعدت عمليات السيطرة على هدر الموارد في تقليل أخطاء تنفيذ المشروع الإنشائي.					
6	ساهمت عمليات السيطرة علي هدر الموارد في تقليل عمليات الإنتاج الزائد عن اللزوم.					

Appendix C: Questionnaire Data

C1: Relationship Between Logistics Services Planning and Execution of Construction Projects



Path Coefficients

Mean, STDEV, T-Values, P-Values

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
Handling -> Cost	0.198	0.202	0.108	1.834	0.067
Handling -> Quality	0.336	0.337	0.106	3.180	0.002
Handling -> Time	0.054	0.062	0.098	0.549	0.583
Information_Flow -> Cost	0.076	0.090	0.098	0.779	0.437
Information_Flow -> Quality	0.112	0.107	0.096	1.167	0.244
Information_Flow -> Time	0.258	0.272	0.088	2.946	0.003
Procurement -> Cost	0.250	0.252	0.109	2.283	0.023
Procurement -> Quality	0.198	0.199	0.107	1.851	0.065
Procurement -> Time	0.171	0.174	0.118	1.456	0.146
Storing -> Cost	0.044	0.051	0.104	0.424	0.672
Storing -> Quality	0.047	0.054	0.097	0.480	0.631
Storing -> Time	-0.020	-0.017	0.109	0.183	0.855
Transportation -> Cost	0.086	0.080	0.105	0.818	0.414
Transportation -> Quality	0.035	0.044	0.122	0.290	0.772
Transportation -> Time	-0.019	-0.028	0.117	0.163	0.871

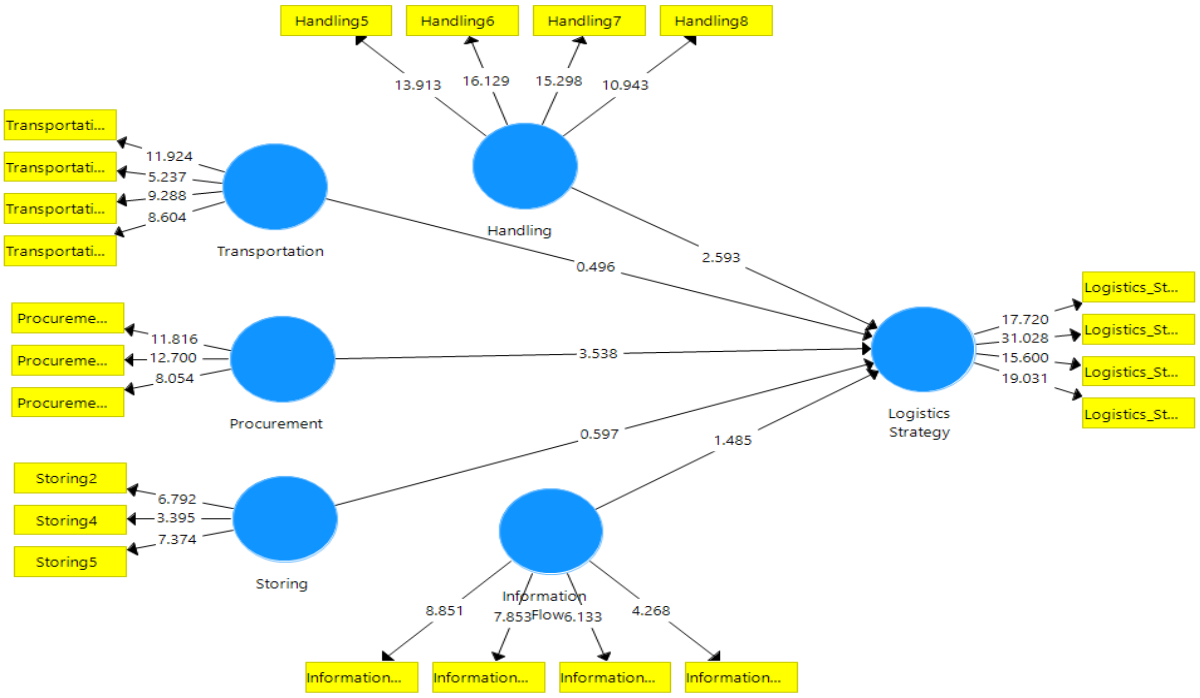
Confidence Intervals

	Original Sample (O)	Sample Mean (M)	2.5%	97.5%
Handling -> Cost	0.198	0.202	-0.012	0.387
Handling -> Quality	0.336	0.337	0.107	0.528
Handling -> Time	0.054	0.062	-0.132	0.237
Information_Flow -> Cost	0.076	0.090	-0.106	0.288
Information_Flow -> Quality	0.112	0.107	-0.075	0.289
Information_Flow -> Time	0.258	0.272	0.069	0.419
Procurement -> Cost	0.250	0.252	0.034	0.457
Procurement -> Quality	0.198	0.199	-0.031	0.392
Procurement -> Time	0.171	0.174	-0.068	0.397
Storing -> Cost	0.044	0.051	-0.160	0.239
Storing -> Quality	0.047	0.054	-0.144	0.254
Storing -> Time	-0.020	-0.017	-0.222	0.191
Transportation -> Cost	0.086	0.080	-0.127	0.289
Transportation -> Quality	0.035	0.044	-0.188	0.268
Transportation -> Time	-0.019	-0.028	-0.283	0.201

Confidence Intervals Bias Corrected

	Original Sample (O)	Sample Mean (M)	Bias	2.5%	97.5%
Handling -> Cost	0.198	0.202	0.004	-0.029	0.379
Handling -> Quality	0.336	0.337	0.001	0.092	0.520
Handling -> Time	0.054	0.062	0.008	-0.166	0.217
Information_Flow -> Cost	0.076	0.090	0.014	-0.119	0.257
Information_Flow -> Quality	0.112	0.107	-0.006	-0.066	0.308
Information_Flow -> Time	0.258	0.272	0.014	0.043	0.397
Procurement -> Cost	0.250	0.252	0.003	0.008	0.450
Procurement -> Quality	0.198	0.199	0.001	-0.025	0.394
Procurement -> Time	0.171	0.174	0.003	-0.083	0.373
Storing -> Cost	0.044	0.051	0.007	-0.181	0.213
Storing -> Quality	0.047	0.054	0.008	-0.157	0.230
Storing -> Time	-0.020	-0.017	0.003	-0.222	0.191
Transportation -> Cost	0.086	0.080	-0.006	-0.110	0.325
Transportation -> Quality	0.035	0.044	0.009	-0.226	0.234
Transportation -> Time	-0.019	-0.028	-0.009	-0.252	0.223

C2: Relationship Between Logistics Services Planning and Logistics Strategy



Path Coefficients

Mean, STDEV, T-Values, P-Values

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
Handling -> Logistics_Strategy	0.248	0.253	0.096	2.593	0.010
Information_Flow -> Logistics_Strategy	0.135	0.151	0.091	1.485	0.138
Procurement -> Logistics_Strategy	0.343	0.333	0.097	3.538	0.000
Storing -> Logistics_Strategy	-0.052	-0.033	0.088	0.597	0.551
Transportation -> Logistics_Strategy	0.043	0.048	0.088	0.496	0.620

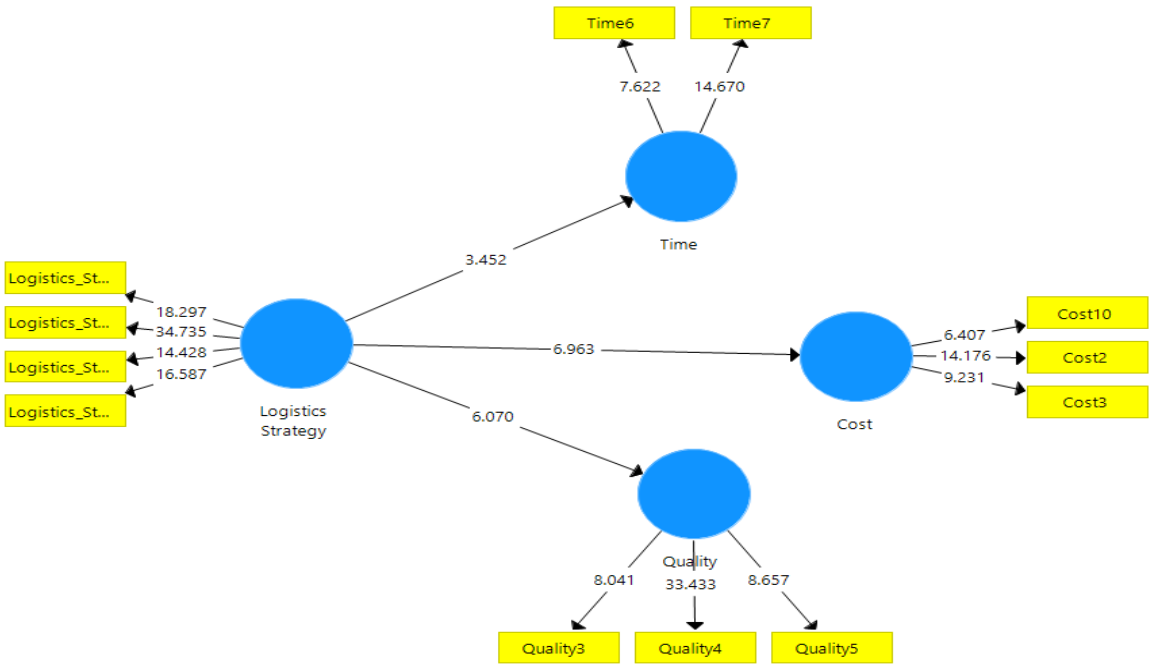
Confidence Intervals

	Original Sample (O)	Sample Mean (M)	2.5%	97.5%
Handling -> Logistics_Strategy	0.248	0.253	0.056	0.440
Information_Flow -> Logistics_Strategy	0.135	0.151	-0.017	0.318
Procurement -> Logistics_Strategy	0.343	0.333	0.149	0.516
Storing -> Logistics_Strategy	-0.052	-0.033	-0.218	0.135
Transportation -> Logistics_Strategy	0.043	0.048	-0.133	0.208

Confidence Intervals Bias Corrected

	Original Sample (O)	Sample Mean (M)	Bias	2.5%	97.5%
Handling -> Logistics_Strategy	0.248	0.253	0.005	0.047	0.431
Information_Flow -> Logistics_Strategy	0.135	0.151	0.016	-0.057	0.294
Procurement -> Logistics_Strategy	0.343	0.333	-0.010	0.162	0.532
Storing -> Logistics_Strategy	-0.052	-0.033	0.019	-0.261	0.100
Transportation -> Logistics_Strategy	0.043	0.048	0.004	-0.148	0.192

C3: Relationship Between Logistics Strategy and Execution of Construction Projects



Path Coefficients

Mean, STDEV, T-Values, P-Values

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
Logistics_Strategy -> Cost	0.479	0.489	0.069	6.963	0.000
Logistics_Strategy -> Quality	0.498	0.516	0.082	6.070	0.000
Logistics_Strategy -> Time	0.284	0.288	0.082	3.452	0.001

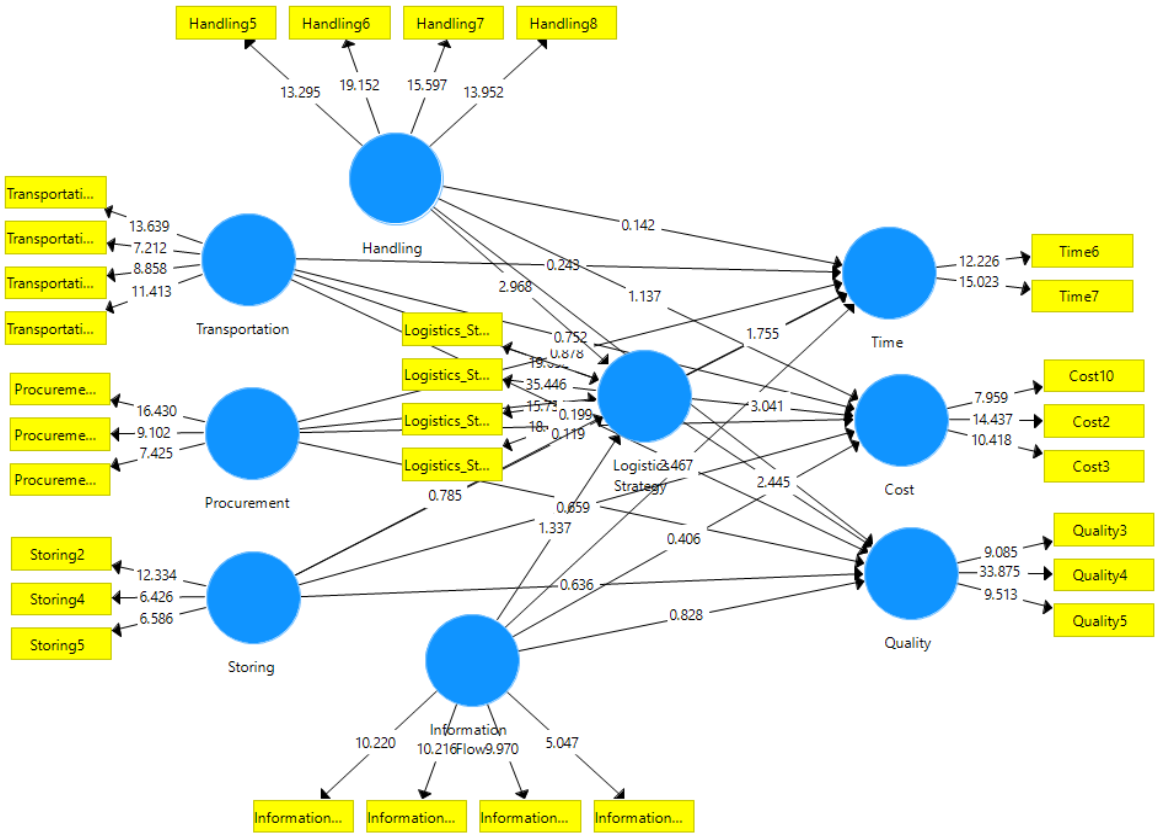
Confidence Intervals

	Original Sample (O)	Sample Mean (M)	2.5%	97.5%
Logistics_Strategy -> Cost	0.479	0.489	0.347	0.609
Logistics_Strategy -> Quality	0.498	0.516	0.348	0.659
Logistics_Strategy -> Time	0.284	0.288	0.135	0.443

Confidence Intervals Bias Corrected

	Original Sample (O)	Sample Mean (M)	Bias	2.5%	97.5%
Logistics_Strategy -> Cost	0.479	0.489	0.010	0.319	0.598
Logistics_Strategy -> Quality	0.498	0.516	0.018	0.301	0.634
Logistics_Strategy -> Time	0.284	0.288	0.003	0.134	0.440

C4: The Mediation Role of Logistics Strategy in the Relationship between Logistics Service Planning and Execution of Construction Projects



Path Coefficients

Mean, STDEV, T-Values, P-Values

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
Handling -> Cost	0.124	0.122	0.109	1.137	0.256
Handling -> Logistics_Strategy	0.251	0.252	0.085	2.968	0.003
Handling -> Quality	0.269	0.272	0.116	2.311	0.021
Handling -> Time	0.014	0.021	0.096	0.142	0.887
Information_Flow -> Cost	0.039	0.047	0.097	0.406	0.685
Information_Flow -> Logistics_Strategy	0.132	0.132	0.099	1.337	0.182
Information_Flow -> Quality	0.077	0.078	0.093	0.828	0.408
Information_Flow -> Time	0.243	0.245	0.098	2.467	0.014
Logistics_Strategy -> Cost	0.299	0.297	0.098	3.041	0.002
Logistics_Strategy -> Quality	0.277	0.268	0.113	2.445	0.015
Logistics_Strategy -> Time	0.169	0.169	0.096	1.755	0.080
Procurement -> Cost	0.137	0.148	0.114	1.204	0.229
Procurement -> Logistics_Strategy	0.350	0.342	0.094	3.702	0.000
Procurement -> Quality	0.097	0.102	0.100	0.972	0.331
Procurement -> Time	0.109	0.113	0.124	0.878	0.380
Storing -> Cost	0.067	0.068	0.102	0.659	0.510
Storing -> Logistics_Strategy	-0.068	-0.063	0.087	0.785	0.433
Storing -> Quality	0.064	0.066	0.101	0.636	0.525
Storing -> Time	-0.014	-0.012	0.116	0.119	0.905
Transportation -> Cost	0.076	0.071	0.100	0.752	0.452
Transportation -> Logistics_Strategy	0.041	0.045	0.098	0.419	0.675
Transportation -> Quality	0.024	0.031	0.121	0.199	0.843
Transportation -> Time	-0.030	-0.028	0.122	0.243	0.808

Confidence Intervals

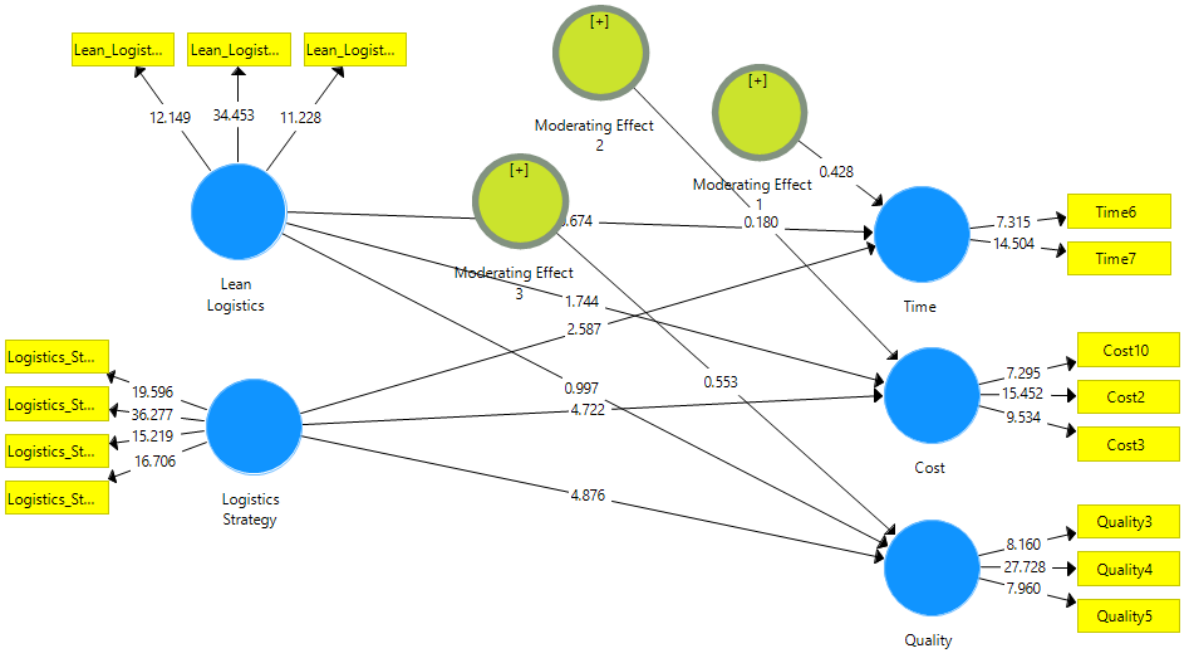
	Original Sample (O)	Sample Mean (M)	2.5%	97.5%
Handling -> Cost	0.124	0.122	-0.088	0.343
Handling -> Logistics_Strategy	0.251	0.252	0.071	0.410
Handling -> Quality	0.269	0.272	0.019	0.459
Handling -> Time	0.014	0.021	-0.177	0.206
Information_Flow -> Cost	0.039	0.047	-0.135	0.228
Information_Flow -> Logistics_Strategy	0.132	0.132	-0.052	0.319
Information_Flow -> Quality	0.077	0.078	-0.110	0.265
Information_Flow -> Time	0.243	0.245	0.025	0.406
Logistics_Strategy -> Cost	0.299	0.297	0.090	0.480
Logistics_Strategy -> Quality	0.277	0.268	0.057	0.497
Logistics_Strategy -> Time	0.169	0.169	-0.029	0.338
Procurement -> Cost	0.137	0.148	-0.074	0.374
Procurement -> Logistics_Strategy	0.350	0.342	0.161	0.522
Procurement -> Quality	0.097	0.102	-0.086	0.310
Procurement -> Time	0.109	0.113	-0.147	0.372
Storing -> Cost	0.067	0.068	-0.123	0.274
Storing -> Logistics_Strategy	-0.068	-0.063	-0.239	0.104
Storing -> Quality	0.064	0.066	-0.130	0.271
Storing -> Time	-0.014	-0.012	-0.231	0.203
Transportation -> Cost	0.076	0.071	-0.122	0.271
Transportation -> Logistics_Strategy	0.041	0.045	-0.144	0.230
Transportation -> Quality	0.024	0.031	-0.207	0.267
Transportation -> Time	-0.030	-0.028	-0.275	0.207

	Original Sample (O)	Sample Mean (M)	2.5%	97.5%
Handling -> Cost	0.124	0.122	-0.088	0.343
Handling -> Logistics_Strategy	0.251	0.252	0.071	0.410
Handling -> Quality	0.269	0.272	0.019	0.459
Handling -> Time	0.014	0.021	-0.177	0.206
Information_Flow -> Cost	0.039	0.047	-0.135	0.228
Information_Flow -> Logistics_Strategy	0.132	0.132	-0.052	0.319
Information_Flow -> Quality	0.077	0.078	-0.110	0.265
Information_Flow -> Time	0.243	0.245	0.025	0.406
Logistics_Strategy -> Cost	0.299	0.297	0.090	0.480
Logistics_Strategy -> Quality	0.277	0.268	0.057	0.497
Logistics_Strategy -> Time	0.169	0.169	-0.029	0.338
Procurement -> Cost	0.137	0.148	-0.074	0.374
Procurement -> Logistics_Strategy	0.350	0.342	0.161	0.522
Procurement -> Quality	0.097	0.102	-0.086	0.310
Procurement -> Time	0.109	0.113	-0.147	0.372
Storing -> Cost	0.067	0.068	-0.123	0.274
Storing -> Logistics_Strategy	-0.068	-0.063	-0.239	0.104
Storing -> Quality	0.064	0.066	-0.130	0.271
Storing -> Time	-0.014	-0.012	-0.231	0.203
Transportation -> Cost	0.076	0.071	-0.122	0.271
Transportation -> Logistics_Strategy	0.041	0.045	-0.144	0.230
Transportation -> Quality	0.024	0.031	-0.207	0.267
Transportation -> Time	-0.030	-0.028	-0.275	0.207

Confidence Intervals Bias Corrected

	Original Sample (O)	Sample Mean (M)	Bias	2.5%	97.5%
Handling -> Cost	0.124	0.122	-0.002	-0.081	0.352
Handling -> Logistics_Strategy	0.251	0.252	0.001	0.066	0.396
Handling -> Quality	0.269	0.272	0.004	-0.006	0.447
Handling -> Time	0.014	0.021	0.007	-0.192	0.198
Information_Flow -> Cost	0.039	0.047	0.008	-0.169	0.200
Information_Flow -> Logistics_Strategy	0.132	0.132	0.000	-0.052	0.319
Information_Flow -> Quality	0.077	0.078	0.002	-0.112	0.259
Information_Flow -> Time	0.243	0.245	0.003	-0.008	0.382
Logistics_Strategy -> Cost	0.299	0.297	-0.002	0.090	0.480
Logistics_Strategy -> Quality	0.277	0.268	-0.009	0.061	0.506
Logistics_Strategy -> Time	0.169	0.169	0.001	-0.029	0.338
Procurement -> Cost	0.137	0.148	0.011	-0.088	0.358
Procurement -> Logistics_Strategy	0.350	0.342	-0.008	0.171	0.542
Procurement -> Quality	0.097	0.102	0.005	-0.085	0.312
Procurement -> Time	0.109	0.113	0.005	-0.132	0.394
Storing -> Cost	0.067	0.068	0.001	-0.133	0.269
Storing -> Logistics_Strategy	-0.068	-0.063	0.006	-0.239	0.100
Storing -> Quality	0.064	0.066	0.002	-0.135	0.269
Storing -> Time	-0.014	-0.012	0.002	-0.226	0.211
Transportation -> Cost	0.076	0.071	-0.005	-0.115	0.280
Transportation -> Logistics_Strategy	0.041	0.045	0.004	-0.151	0.227
Transportation -> Quality	0.024	0.031	0.007	-0.231	0.257
Transportation -> Time	-0.030	-0.028	0.001	-0.278	0.198

C5: The Moderator Role of Lean Logistics in the Relationship between Logistics Strategy and Execution of Construction Projects



Path Coefficients

Mean, STDEV, T-Values, P-Values

	Original S	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
Lean_Logistics -> Cost	0.178	0.184	0.102	1.744	0.082
Lean_Logistics -> Quality	0.106	0.112	0.106	0.997	0.319
Lean_Logistics -> Time	0.080	0.104	0.119	0.674	0.501
Logistics_Strategy -> Cost	0.403	0.411	0.085	4.722	0.000
Logistics_Strategy -> Quality	0.436	0.445	0.089	4.876	0.000
Logistics_Strategy -> Time	0.234	0.232	0.090	2.587	0.010
Moderating Effect 1 -> Time	-0.040	-0.034	0.093	0.428	0.669
Moderating Effect 2 -> Cost	0.013	0.004	0.070	0.180	0.857
Moderating Effect 3 -> Quality	-0.037	-0.052	0.067	0.553	0.581

Confidence Intervals

	Original Sample (O)	Sample Mean (M)	2.5%	97.5%
Lean_Logistics -> Cost	0.178	0.184	-0.045	0.381
Lean_Logistics -> Quality	0.106	0.112	-0.095	0.302
Lean_Logistics -> Time	0.080	0.104	-0.125	0.323
Logistics_Strategy -> Cost	0.403	0.411	0.238	0.575
Logistics_Strategy -> Quality	0.436	0.445	0.256	0.601
Logistics_Strategy -> Time	0.234	0.232	0.054	0.407
Moderating Effect 1 -> Time	-0.040	-0.034	-0.206	0.159
Moderating Effect 2 -> Cost	0.013	0.004	-0.119	0.158
Moderating Effect 3 -> Quality	-0.037	-0.052	-0.184	0.083

Confidence Intervals Bias Corrected

	Original Sample (O)	Sample Mean (M)	Bias	2.5%	97.5%
Lean_Logistics -> Cost	0.178	0.184	0.006	-0.052	0.372
Lean_Logistics -> Quality	0.106	0.112	0.006	-0.132	0.295
Lean_Logistics -> Time	0.080	0.104	0.024	-0.169	0.303
Logistics_Strategy -> Cost	0.403	0.411	0.008	0.232	0.561
Logistics_Strategy -> Quality	0.436	0.445	0.009	0.240	0.588
Logistics_Strategy -> Time	0.234	0.232	-0.001	0.045	0.392
Moderating Effect 1 -> Time	-0.040	-0.034	0.006	-0.208	0.156
Moderating Effect 2 -> Cost	0.013	0.004	-0.009	-0.087	0.179
Moderating Effect 3 -> Quality	-0.037	-0.052	-0.015	-0.143	0.107

Appendix D: Arbitrators List:

NO.	Name	Occupation
1	Professor Ahmed Hassan El Jack	Professor
2	Dr. Minas Abdulmutallab Elamin Mohamed	Associated Professor
3	Dr. Adam Ismail Adam Khamis	Assistant Professor
4	Dr. Abdalhag Ali Ibrahim	Assistant Professor
5	Eng. Waleed Abuzeid Abusin Albashir	Consultant Engineer