MINISTRY OF EDUCATION, YOUTH AND SPORT
NATIONAL UNIVERSITY OF MANAGEMENT
SCHOOL OF GRADUATE STUDIES

FACTORS INFLUENCING QUALITY OF CONSTUCTION PROJECTS IN CAMBODIA

HENG HOK

Dissertation Submitted in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy (PhD)

SPECIALIZATION
MANAGEMENT

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DECLARATION

I declare that this dissertation is my work and has not been submitted for a degree at any university. Information derived from the published or unpublished work of others has been acknowledged in the text and a list of references is given.

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ABSTRACT

Cambodia's annual economy grows rapidly, and construction is one of the engines of growth. It has become one of the important pillars supporting Cambodia's economy and has created a lot of jobs for people. However, it faces many complex issues and also challenges foreign companies mostly on quality in construction projects. The quality of construction projects is affected in different ways by various factors such as stakeholder involvement, project funding, construction material, project management competence, project complexity, and construction conflict. Two important mediators, Cambodian law on construction and Construction quality management system, can define these effects in different ways. The research aims to determine the important factors influencing the quality of construction projects in Cambodia in the case study on local Cambodian construction companies and the relationships of the two mediators between the dependent variable - the quality of construction projects and independent variables such as stakeholder involvement, project funding, construction materials, project management competence, project complexity, and construction conflict. The research used a quantitative methodology with 31 respondents in a pilot study, 385 respondents in a full-scale study, and 10 respondents in confirmation of the final results. In this study by using SPSS and AMOS programs, the confirmation factor analysis and the structural equation modeling methods were used to determine the significant factors and analyze the relation of each variable. The result of this study shows those factors significantly impact the quality of construction projects. Moreover, the study also found the two mediators, Cambodian law on construction and Construction quality management system work as a partial inter-relation between the Quality of construction projects and its factors. The results indicate four important factors for evaluating the quality of construction projects in Cambodia, Avoiding disputes and claims, Motivating and empowering employee training, Enhancing customer/owner satisfaction, and Completing projects on time.

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CHAPTER ONE
INTRODUCTION

1.1. Background of the Study

Over the last few decades, the construction industry has increased in size, technology complexity, interdependencies, and variations in demands from clients (Yong, 2013). Global forecasts for the construction industry account for more than 11% of the global GDP; by 2020 it will account for 13.2% of the world's GDP (Betts et al. 2011). The construction industry globally is one of the largest contributors to the Gross Domestic Product (GDP) and plays an important role in determining a country's economic growth (Debby, W., 2012). Saurav (2020) stated that the construction industry is one of the main contributors to the development of any country, which is the most important in creating jobs when it comes to the country. Cambodia's average annual economic growth has been around 7% for the last 20 years, together with the garment industry, tourism, agriculture, and construction are one of the engines of the growth. China is the largest foreign investor (AsiaNews.it 2019, May). Cambodia is categorized as one of the emerging markets in the Asia Pacific Region. The construction industry in Cambodia is booming due to rising foreign investments. The country's construction sector attracted a total investment of US$3.39 billion, which is an increase of 57.5% over the same period last year (Liyana Hasnan, 2019). The National Bank of Cambodia stated that economic growth will be supported by increasing foreign direct investment inflows, which are expected to continue strongly.

Meanwhile, construction project activity in Cambodia has increased significantly in recent years, the construction sector is also facing many complex issues that cause loss of time and money until the legal dispute, construction materials, and building safety problems accumulate over the entire building process. To satisfy customer satisfaction, the quality of construction projects needs to be defined properly (Rumania, 2011). The definition of quality depends on the people defining it; some view it as conformance to specification, and from performance to standards or value paid for the price. For construction firms, the quality of construction projects is about customer satisfaction and fulfilling their requirements within a specified budget (Vadivel, T.S.; Doddurani, M.; Shoban, K.S.; & Kalidhass, B., 2016). Quality of construction projects is involved in every stage and every aspect of construction.

1.2. Research Problem

As the construction sector plays an important role in the Cambodian economy, local Cambodian construction companies are still unfortunately plagued by low competitiveness. The lack of competitiveness of domestic contractors when competing for contracts with foreign companies is mainly attributed to their poor performance and inability to adapt to change, high execution costs, project delays, low levels of efficiency, low productivity, and conflict among involved parties. As more foreigners move to the country and development continues to pick up the pace, the standards and quality of construction have also risen, but international developers have been bringing their standards for construction practices to projects inside Cambodia (B2B CAMBODiA, 2020). Recent research by the Ministry of Land Management, Urban Planning, and Construction in 2018 found that there were many unauthorized construction projects. These illegal projects affect the environment and lead to poor construction quality (Liyana, H., 03 August, 2019). The World Bank 2016 also stated that construction in Cambodia scored very poorly related to quality construction among 190 countries worldwide (B2B CAMBODiA, 2020).

Quality in construction projects is one of the critical factors in the success of construction projects. The construction industry's success level greatly depends on quality performance (Senthil Vadivel, T., Doddurani, M., Shoban, K.S., & Kalidhass, B., 2016). According to the cause mentioned above Local Cambodian construction companies lack quality in their construction project. From the previous literature review, none of the scholars has evaluated the factors influencing on quality of construction projects in Cambodia for the local Cambodian construction company. Therefore, exploring the factors influencing on quality of construction projects in Cambodia will help local Cambodian construction companies gain better quality improvement in the construction project. The findings of this study will help local Cambodian contractors with important factors that affect the quality of construction projects and also challenge foreign companies in Cambodia. Thus, the researcher is interested in finding out the factors that influence the quality of construction projects in a Cambodian construction company for better quality improvement.

1.3. Research Questions

The research study focuses on the key factors influencing on quality of construction projects that local Cambodian construction companies should improve to achieve customer satisfaction. The research study has three main research questions as follows:

1. What are the factors that influence the quality of construction projects in local Cambodian construction companies?
2. How does Cambodian law on construction relate to construction conflict in local Cambodian construction companies?
3. How does the construction quality management system affect the quality of construction projects in local Cambodian construction companies?

1.4. Research Objectives

The research was undertaken within the context of this research's main aims:

1. To determine the important factors that influence the quality of construction projects in Cambodia for the local Cambodian construction companies.
2. To explore the relationship between Cambodian law on Construction and construction conflict in local Cambodian construction companies.
3. To evaluate the relationship between the construction quality management system and the quality of construction projects in Cambodia in local Cambodian construction companies.

1.5. Significance of the Study

As construction plays an important role in Cambodian economic growth, local Cambodian companies are yet ready to compete with foreign companies. The findings of this study will help local Cambodian companies with factors that affect the quality of construction projects. The research explores a better position to formulate, design, and implement which ensures the quality of construction projects for achieving customer satisfaction. The exploration of the quality of construction is very significant to local Cambodian construction companies for challenging foreign companies and also to meet the customer's satisfaction. The study also provides critical feedback to contractors, and owners on the decision-making process to the various stakeholder involvement in management and better adaptation of improving decisions on the implementation of various projects to help save on time and money.

1.6. Limitation of the Study

The study evaluated factors influencing the quality of construction projects such as stakeholder involvement, project funding, construction materials, project management competence, project complexity, construction conflict, Cambodian law on construction, and construction quality management system, in local Cambodian construction companies in Phnom Penh, Cambodia. The data collection was selected from the top management of construction, contractors, inspectors, site engineers, etc. who were involved in the construction project.

1.7. Definition of Key Term

1.7.1. Dependent Variable

Quality of Construction Projects means a project which is completed within the defined guidelines set out in the scope of work such as time, cost, and scope or the fulfillment of the owner's needs per the defined scope of works within a budget and specified schedule to satisfy the owner's requirements (Chung, H.W., 1999).

1.7.2. Mediator Variables

Construction Quality Management system is formed by a series of coordinated activities that are carried out on a set of elements to achieve the quality of the products or services offered to the customer or user (Verónica, V., & Rocío, A., 2017).

Construction Law is the rule that a government uses to protect the involved parties when something goes wrong in the contract (Gail S, Kelley, 2013). *Cambodian Law on Construction* is a branch of Cambodian law that deals with matters relating to building, construction, engineering, and related fields.

1.7.3. Independent Variables

Stakeholder Involvement means anyone who has an interest in the process or outcome of a project (Deming, W.E., 1986).

Project Funding means the act of providing resources, usually in the form of money or other value such as effort or time (David, K.L., 2015).

Construction Materials are the materials or tools supplied to the construction site by the contractor or subcontractor for constructing the building or work (Aliverdi, R., Naemi, L.M., and Salehipour, A., 2013).

Project Management Competence means the capability of the project manager in project usage that likewise influences the consummation of a project (Olatunji, A.A., 2010).

Project Complexity means the property of a project which makes it difficult to understand, foresee, and keep under control its overall behavior, even when given reasonably complete information about the project system (Mohammed, O., 2021).

Construction Disputes means the disagreements between the parties involved in a project (Jaffar, N., et al., 2011).

1.8. Organization of the Dissertation

This dissertation consists of six chapters. Chapter one is the introduction which contains the background of the study, research problem, research questions, research objectives, the significance of the study, limitations of the study, definition of key terms, and the organization of the dissertation. Chapter two shows the literature review, all constructs measurement with hypotheses, and the theoretical framework. Chapter three is an overview of the construction industry in Cambodia. Chapter four provides the research methodology, research procedure, source of data, data gathering tools and instruments, sampling method, method of data analysis, validity analysis, reliability analysis, and research ethical consideration. Chapter five presents the data analysis and interpretation with discussions of the findings, and Chapter six focuses on the conclusions and recommendations of the study.

CHAPTER TWO

LITERATURE REVIEW

2.1. Introduction

This section consists of the theoretical framework of the study, a review of the literature of different scholars and authors on variables that have been reviewed in the area of construction projects with a special focus on factors influencing the quality of construction projects, the conceptual framework, and empirical review, critical of previous studies on the theories that support the variables under investigation. In this study, there are three main variables: the dependent variable-the quality of the construction projects, two mediating variables-the construction quality management system and Cambodian law on construction; and six independent variables such as stakeholder involvement, project funding, construction materials, project management competence, project complexity, and construction disputes.

2.2. Quality of Construction Projects

Quality refers to specific standards and the ways and means by which those standards are achieved, maintained, and improved upon. Most definitions given to quality refer to 'fitness for use' or 'conformance requirements' (Mohamed, Z. 1991). Quality in construction projects is not only the quality of products and equipment used in the construction of a facility but also the total management approach to completing the facility. The quality of construction projects depends mainly upon the control of construction, which is the primary responsibility of the contractor (Rumane, A. R., 2011). Quality is the fulfillment of project responsibilities in the delivery of products and services in a manner that meets or exceeds the state requirements and expectations of the owner, design professional, and contractor. Responsibilities refer to the tasks that a participant is expected to perform to accomplish the project activities as specified by contractual agreements and applicable laws and licensing requirements, codes, prevailing industry standards, and regulatory guidelines. Requirements are what a team member expects or needs to receive during and after his or her participation in a project (Roberto, P. & Tomi, P.S., 2000). Quality of construction projects is the fulfillment of the owner's needs per the defined scope of works within a budget and specified schedule to satisfy the owner's/user's requirements (Chung, H.W., 1999). An inspection is a specific examination, testing, and formal evaluation exercise and overall appraisal of a process, product, or service to ascertain if it conforms to established requirements. It involves measurements, tests, and gauges applied to characteristics regarding an object or an activity. The results are usually compared to specified requirements and standards for determining whether the item or activity is in line with the target (Rumane, A.R., 2011). Pyzdek, T., (1999) stated that the degree to which inspection can be successfully limited by the established requirements. Inspection accuracy depends on the level of human errors (technique errors, inadvertent, conscious errors, and communication errors), the accuracy of the instruments, and the completeness of the inspection planning. Quality has been variously defined as value, conformance to specifications (Gilmore, H.L., 1974), conformance to requirements, loss avoidance (Crosby, R.B., 1979), and meeting and/or exceeding customers' expectations (Parasuraman, Zeithaml, & Berry, 1985). In short, the quality of construction projects can be measured based on the satisfaction of contract specifications, completion of the project with time, enhancement of customer/owner satisfaction, motivation, and empowerment of employees' training, avoidance of conflicts and claims, and performance-based purpose.

2.3. Stakeholder Involvement

The influence of Stakeholder Involvement on the Quality of Construction Projects.

A stakeholder is anyone who has an interest in the process or outcome of a project. The value of key participants of projects as a source of information to achieve desired levels of quality (Deming, W.E., 1986). Stakeholders can provide tangible value, and supportive feedback information about how they are influenced by the project or service and can assist those delivering the output (Deming, W.E., 1986). Additionally, some studies have extended project success criteria into new aspects, such as stakeholder participation and satisfaction, customer benefit, and upcoming prospective for the organization (Shenhar, A., Dvir, D., Levy, O., & Maltz, A., 2001). Few studies have examined the role of stakeholders in improving project quality within the industry (Tam & Le, 2007). Deming (1986) also declared that the customer's perspective of quality levels is critically important, and therefore the inclusion of the main stakeholders during the important stages of the project lifecycle should be a key feature of any framework aiming to improve quality. In the construction industry, during the different stages of a project from the initial planning through to the final operation and maintenance, specific parties get involved whose expectations of the project (Olander, S. & Landin, A., 2005). These groups include clients or owners, project management teams, consultant and design teams, contractors, employees, local communities, funding bodies, and government authorities. Clients played an important role in the accomplishment of the desired project outcome quality levels (Jha, K.N., & Iyer, K.C., 2006). Evelyn, (2017) also indicated the involved stakeholder in the construction industry such as site engineer involvement, contractor involvement in planning, country inspector's involvement, and quantity surveyor's involvement. From the above literature with many authors' support, this study can propose a hypothesis:

***H1A**: Stakeholder Involvement has a significant influence on the Quality of Construction Projects.*

The relation of Construction Quality Management System to Stakeholder Involvement and the Quality of Construction Projects

Stakeholders such as contractors, sub-contractors, and suppliers are those who might not get engaged in the very early stage of projects but they provide materials, equipment, and on-site labor which greatly impact the final asset quality (Briner et al., 1997). Thus a Management stakeholder can improve the effectiveness and efficiency of its control and management processes-quality management system and as a result, improve project quality (Briner et al., 1997). In recent studies, the stakeholder concept has been applied to several fields of inquiry especially construction quality management projects, while its theory starts from strategic management (Brian, A., & Martin, S., 2008). The importance of stakeholder management in the construction industry and quality management project literature has been emphasized by many scholars (Yang, J., 2010; Achterkamp, M.C., & Vos, J.F.J., 2008). Yang (2010) stated that the management stakeholder can improve the effectiveness and efficiency of construction management quality and as a result, improve project quality. Based on Yang (2010), we can see that better management of stakeholders through a construction quality management system improves project quality. Thus, this study can propose a hypothesis as follows:

***H1B**: Construction Quality Management System mediates between Stakeholder Involvement and the Quality of Construction Projects.*

2.4. Project Funding

The influence of Project Funding on the Quality of Construction Projects

Project Funding refers to the act of providing resources, usually in the form of money or other value such as effort or time (David, K.L., 2015). A project cannot proceed without adequate financing, and the cost of providing adequate financing can be quite large (Dissanayaka, S.M., et al., 2001). The fund is a concern to the other organizations involved in the project such as the general contractor and material supplier (Kerzner, H., 2009). Chan et al (2002) indicated the effect of project funding on the quality of projects. In addition, Chan et al (2002) also indicated the most important cause of delays in the construction sector is financing by the contractor during the project progress, changes in designs by the owner or his agent during the construction, delays in the contractor payment, and non-utilization of professional construction management. Bathurst and Butler (1973) cost and design are closely linked and it is important to ensure that projects are delivered within their approved budgets and that design represents value for money. Evelyn, K. (2017) indicated project funding which effects to the construction project such as cost of funds, source of finance, and adequacy of finances. Poor planning results from badly done project studies especially construction projects which use the biggest budget. Based on the research study by Jean et al., (2015) found that some important factors affecting project quality are the project cost estimation, project technical design, and project implementation time. Bathurst and Butler (1973) a contractor would receive periodic payments from the owner as contraction periods. However, a contractor also may have a negative cash balance due to payment delays and retain the age of profits or cost reimbursements on the part of the owner. Based on the literature above, the study can draw a hypothesis as the following:

***H2A**: Project Funding has a great impact on the Quality of Construction Projects.*

The relation of Construction Quality Management System to Project Funding and the Quality of Construction Projects

Kim et al. (2018) stated that the quality management system in building and construction projects is an essential factor in avoiding defects in the end product, which could lead to the need for replacements, faults, accidents, or any kind of anomalies that will end up a negative impact on the final result and the customer's experience. Kim et al. (2018) stated that construction quality management develops a cost management plan; develops a quality management plan such as project documents, organizational process assets, etc., and brings the processes together. Many authors also witness the beneficial relationship between construction quality management and funding performance (Wruck, K.H., & Jensen, M.C., 1994; Hendricks, K.B., & Singhal, V.R., 1997; Ittner, C.D., & Larcker, D., 1997; Easton, G.S., & Jarrell, S.L., 1998; Kumar et al., 2007). The most recent research emphasized the intermediary role of the different variables between QMS and project funding performance (Ana, K.N., & Andrijana, R., 2017). Herzallah et al., (2104) found that quality management system practice has an indirect, positive, and significant relationship with project funding performance through management strategies. Recently a report by RPPA in 2014 about contract management was blamed. The monitoring of these contracts execution revealed that contract management in Rwanda encounters many problems including inadequate follow-up of the contracts management by the government officials in charge of contract management; technical and financial capability as well as professionalism to execute contracts among local companies, the poor or lack of project studies, lack of clearly defined roles and responsibilities of the officers involved in contract management, etc. The same monitoring exercise also revealed that there are contractors' payment problems due to incomplete documents, poor performance by contractors, untimely and inappropriate follow-up on payment, budget problems, poorly prepared tender documents and contracts that lead to disputes, etc. Based on the literature above, the study can propose a hypothesis as the following:

***H2B**: Construction Quality Management System has a positive interrelation between Project Funding and the Quality of Construction Projects.*

2.5. Construction Materials

The influence of Construction Materials on the Quality of Construction Projects

Construction materials speak to a noteworthy segment of things and project costs, thus it impacts the project quality (Aliverdi, Naeni, and Salehipour, 2013). Recent research investigated the effects of poor quality of construction materials and workmanship on building collapse in Nigeria (Oke, A.E., 2006). The quality of material has been badly affected as a result of poor materials and the reason why many buildings collapse with loss of lives and injuries (Olusola, K.O., Ata, O., & Ayangade, J.A., 2002). Damaged and low-quality material is an important factor that affects the quality of construction projects. Too much water or sand in a concrete mix, lumber cut from undersized trees, and improperly graded steel can all result in widespread construction quality issues. Not only do these materials fail early but, they also create construction safety hazards by reaching unpredictably during the building process. Workers are often hurt when sparks are generated during cutting when they're not expected or as a structure collapses due to a lack of weight-bearing ability. Ordering only from trusted suppliers and assigning a quality control officer to check every shipment of materials is the only way to verify a project is properly supplied (Olusola, K.O., Ata, O., & Ayangade, J.A., 2002). Fisk and Reynolds (2011) indicated that the nature of the materials used will in like manner inside and out affect the way the improvement expands while materials should be procured at the most insignificant cost possible to give hold assets to the association. This is because a wrong examination of material would finally be dangerous to people and the earth since it will lead to the construction of poor-quality structures that may collapse causing danger to both people and the earth. From the evidence above, we can draw a hypothesis:

***H3A**: Construction Materials influence the Quality of Construction Projects.*

The relation of Construction Quality Management System to Construction Materials and the Quality of Construction Projects

The prerequisites for a fruitful administration framework structure are obligatory in any improvement amplification. Several organizations have expanded the productivity of their activities with a particular true objective of remaining engaged and secure future work (Evelyn, 2017). Huge change and cost-save assets would give off an impression of being possible through enhanced quality management materials organization. The perfect openness of materials and structures is vital to produce advancement. Quality management on materials limits is consistently performed on partitioned commerce with immaterial correspondence and no unmistakably settled obligations dole out to the proprietor, master, or legally binding laborer (Enshassi, A., Mohamed, S., & Abushaban, S., 2009). Better management of construction material practices through a management system could consequently extend capability in operations and reduce general costs as a result of improved project quality (Hwang, B.G., & Ng, W.J., 2013). The investigation showed that construction materials management has been an issue of stress in the advancement business. 40% of the time lost adjacent can be credited to a repulsive organization, nonattendance of materials when required, the poor unmistakable confirmation of materials, and lack of stockpiling (Fewings, P., 2013). Fewings (2013) stated that the construction quality management system ensures quality planning of materials purchasing, quality assurance, and quality control of materials to achieve objectives based purpose and compliance of the construction projects. It is to ensure that construction projects are completed and within the constraints given as time, cost, quality, and time. Therefore, we can state a hypothesis as the following:

***H3B**: Construction Quality Management System has a positive mediate between Construction Materials and the Quality of Construction Projects.*

2.6. Project Management Competence

The influence of Project Management Competence on the Quality of Construction Projects

Project management competence is the capability of the project manager in project usage that likewise influences the consummation of a project. For instance, viable observing and criticism by the project head, extend administrators' specialized capacity, initiative nature of the project supervisor, and compelling checking and input by the project partners. Power to take everyday choices by the project group chiefs' group at the site. Besides, the achievement of the project relies on the viability of the project group in dealing with the procedure (Olatunji, A.A., 2010). Wambugu (2013) deduced in a study that a lack of project management competence in supervision and review of work in development prompted improvement in cases of poor workmanship and prompted to postponement of finished projects, as a result of poor project quality. This additionally prompted project costs to overwhelm and may result in project failure. Fapohunda and Stephenson (2010) stated that extended administrations are indispensable for the whole development of extended capacities which incorporate coordination of subcontractors, booking, cost control, work connection, charging, acquiring, exhausting, and different capacities identified with the project. The administrative framework is worried about the basic leadership for arranging and controlling authoritative attempts. A necessary component of the administrative undertaking is authoritative basic leadership (Kast, F.E., & Rosenzweig, J.E., 2011). It is widely believed and studies have shown that the most significant factors affecting construction productivity can be influenced and improved through job-site management efforts (Ailabouni et al., 2009). All builder efforts and resources devoted to the planning phases of construction projects are justified because they will imply a profound study of the project, establishing a base from which to carry out effective control, and the planner must ensure that plans are realistic and prevent excessive exposure to risks such as project running over time or cost or of compromising quality (Johansen, E., & Wilson, B., 2006). Construction material planning and management influence site productivity (Doloi, H.K., 2007) because, as some authors reported, the performance of construction works depends on material quality, adaptation, transportation difficulties within the site, time, and delivery methods (Crawford, P., & Vogl, B., 2006). Evelyn (2017) proposed four important key factors affecting project quality such as conflict management, leadership, team management, and solutions development. From this literature, we can state a hypothesis as the following:

***H4A**: Project Management Competence influences the Quality of Construction Projects.*

The relation of Construction Quality Management System to Project Management Competence and the Quality of Construction Projects

Quality management system in construction is the overall planning, coordination, and control of a project from beginning to completion (Tredle, B., 2008). Construction quality management is aimed at meeting a client's requirement to produce a functionally and financially viable project (Talukhaba, A.A., 2009). Project success depends on key players in the construction. The designers are the important key players during the design stage because any decision made at the inception of the project will affect project success. Defective designs adversely impact projects (Al-Momani, A., 2010). Failure at the conceptual planning and design stages may lead to significant problems in successive stages of the project. Design inefficiencies could lead to redesign and rework or poor quality of products. Thus, a better quality management system in construction through project management competence could improve the project results (Al-Momani, A., 2010). Pongpeng and Liston (2013) problems such as schedule delays, budget overruns, and low-quality work, which affect the project quality as well as a large number of claims and litigation result largely from not selecting the best contractor to construct the facility. Construction quality management during construction concerns the steps taken to ensure that products are by the quality standards and measure the effectiveness/competency of consultants and contractors. Quality management systems help define processes to improve their performance. Supervision during construction is critical to ensure quality products and timely delivery of projects (Kaming et al., 2007). On the part of the consultants, the assessment of the following will determine the speed of construction and ensure the quality of the product a timely inspection procedure; adequate quality management inspection resources; quality management information processing requirements; material or work rejection rate, and clean/dry working environment requirements. On the part of the contractor, the effectiveness of construction quality management will affect the speed of construction. The factors to be considered here are forecasted planning data such as analysis of construction methods; analysis of resource movement to and within the site; analysis of work sequencing to achieve and maintain workflow; monitoring and updating of plans to appropriately reflect work status; responding to, and recovering and updating of plans to appropriately reflect work status; responding to, and recovering from problems taking advantage of opportunities present; effective coordination of resources; and finally, the development of the appropriate organizational structure to maintain workflow (Kaming et al., 2007). The study summarized the previous literature about the role of the construction quality management system. Therefore, the study can propose a hypothesis as the following: ***H4B**: Construction Quality Management System has a positive mediate between Project Management Competence and the Quality of Construction Projects.*

2.7. Project Complexity

The influence of Project Complexity on the Quality of Construction Projects

Complexity is considered an essential factor in the field of project management. Nonetheless, the characteristics and nature of project complexity are a controversial debate. The study by Minh, T.T., & Yingbin, F., (2019) found that project complexity significantly affects the quality of construction projects. The term 'complexity' can be perceived through various connotations not only in different fields but also within the same field. Laurikkala, H., et al., (2001) stated that organization is the main type of complexity of the project that affects the project quality. It includes the allocation of tasks, distribution of the responsibility and authority for decision-making, and designation of the relationship in terms of reporting and communication. Vidal, L.A., & Marle, F., (2008) highlighted the absence of unanimity on the technology conceptual definition has frequently been highlighted in the literature. Technology can be classified into three facets: characteristics of knowledge, characteristics of materials, and the equipment and sequencing of activities i.e. operations (Williams, T., 2002; & Baccarini, D., 1996). Abdou, S.M., Kuan, Y., & Mohammed, O., (2016) also explored the five dimensions of project complexity affecting project quality such as:

1. Environmental Complexity includes weather conditions, number of locations, interference between existing sites, number of different languages, and clarity of project goals.
2. Operational Complexity including project duration, availability of financial sources, strict quality requirements, and a variety of tasks.
3. Organizational Complexity includes uncertainty in methods, size of the project team, involvement of different time zones, and political influence.
4. Technical Complexity includes lack of experience in the country, level of competition, and technical risks.

5. Team Complexity includes lack of experience with partners, lack of resources and skills, and several project goals.

Thus, the study can propose a hypothesis as the following:

***H5A**: Project Complexity has a significant influence on the Quality of Construction Projects.*

The relation of Construction Quality Management System to Project Complexity and the Quality of Construction Projects

As construction project becomes more and more complex, there has been an increasing concern about the concept of project complexity. An understanding of project complexity and how it might be managed through a quality management system is of significant importance for project managers because of the differences associated with decision-making and goal attainment related to complexity (José, R., et al., 2018). Sharareh, K., et al., (2016) defined project complexity as the degree of interrelatedness between project attributes and interfaces, and their consequential impact on project quality. Experience suggests that the interrelationships between the project's components are more complex than is suggested by the quality management system rather than the traditional system, working breakdown structure of the project network (Gidado, K., 1993). Vidal and Marle (2008) considered the following factors as necessary but insufficient conditions for project complexity: size, variety, interdependences, and interrelations within the project management system. Project performance is closely related to project complexity; thus, it should be precisely measured to achieve effective management of projects through a quality management system in construction (Abdou, S.M., Kuan, Y., & Mohammed, O., 2016). In short, there is a relationship between the complexity of a project and the management system to project quality; therefore, the study can draw a statement hypothesis as the following:

***H5B**: Construction Quality Management System has an interrelation between Project Complexity and the Quality of Construction Projects.*

2.8. Construction Disputes

The Influence of Construction Disputes on the Quality of Construction Projects

The involvement of multidisciplinary in the construction project also leads to disputes among the parties involved. The disputes seem to be synonymous with the construction project and give the impressions of problems including increasing project cost, project delays, reduced productivity, loss of profit, or damage to business relationships (Jaffar, N., et al., 2011). Kumaraswamy, M.M., (1997) defined 20 common causes of construction disputes affecting project quality, including speed of construction, cost and quality control, technological advances, stringent building regulations, and economic difficulties that become the basis for many studies later regarding disputes in the construction industry. Jaffar, N., et al., (2011); Williamson, O. (1979); Cakmak, E., & Cakmak, P.I., (2014) identified three large root causes of dispute impact the quality project in construction such as behavioral problems, contractual problems, and technical problems due to uncertainty and low experience. *Behavioral Problems* include human interaction, personality, culture, and professional background among the project team. Other issues in human behavior such as an individual's ambition, frustration, dissatisfaction, desire for growth, communication, level of power, fraud, and faith are also causes of disputes (Vorster, M.C., 1993). Words like belonging imitation, loyalty, recognition, superiority, and status are descriptive of the human elements of gregariousness. Try to make the other party feel as if he belongs to the pack. Find out the group the other party feels is important. Show him how the resolution of the dispute will help him achieve or strengthen his membership in the group (Carmicheal, D.G., 2002). All people have an idea of themselves that they feel must be defined (McManamy, R., 1994). Carmicheal (2002) construction disputes and confrontations arise because the people involved have needs. From the contractor's side, the needs are usually money or profit-related. *Contractual Disputes* include the definition, interpretation, and clarification of the contract. The contractual issues cause a significant portion of disputes in many projects (Diekmann, J.E., & Girard, M.J., 1995). Kumaraswamy & Yogeswaran (1998) indicated in their study that the sources of construction disputes are mainly related to contractual matters, including variation, an extension of time, payment, quality of technical specifications, availability of information, administration, and management, unrealistic client expectation and determination. Hohns (1979) in project operation, standard contract documents are guided by an industry organization, codes, and regulations. This concept of a standard contract to a certain degree guides operations toward standard practices. Therefore, a standard contract provides enough common ground for contractual definitions, clarifications in construction operations, and specific project requirements. Hall (2000) stated that contract documents are one major origin of disputes. The other contractual cause of conflicts is plans or drawings (Hellard, 1992). *Technical Disputes* due to uncertainty are considered the most common issues in project operations. Galbraith (1973) uncertainty is the difference between the amount of information required to do the task and the amount of information already processed by the organization. The amount of information needed depends on the task complexity that is the number of different factors that have to be coordinated or performance requirements such as time or budget constraints. Technical disputes also basically include engineering clarification which is a part of engineering decision-making processes. The engineering decision-making process is fairly straightforward and reasonably justifiable for each participant. If technical disputes are unresolved, there are ways of resolving those disputes in project management unlike the resolution of contractual disputes during project operations. From the overview of the literature review, the factors of dispute in the construction industry which is hoped to give a clearer scenario to all project teams. The main dispute factors into three main factors which are dispute factors due to behavioral problems, contractual problems, and technical problems. The dispute would arise due to behavioral problems such as poor communication among the project team, multicultural team problems, and reluctance to check for constructability, clarity, and completeness of the project. Besides that, the dispute also arises due to the factors of the contractual problem which include delaying in term payment from the client, the client's failure to respond promptly, application of extension of time, and improper project schedules. Another factor is the contractor's quality of work, error in pricing or costing, and late instructions from the architect or engineer. In conclusion, the study can state a statement hypothesis as the following:

***H6A**: Construction Dispute has a significant influence on the Quality of Construction Projects.*

The relation of Cambodian Law on Construction to Construction Dispute and the Quality of Construction Projects

When you undertake a construction project, the goal is to ensure that all contingencies are addressed in the contract documents and that all parties have come to a meeting of their minds. However, contract disputes and other construction disagreements do arise. Blaine, A., Damon, M.S., David, V.S., and Roy, B., (2023) in some cases, these disputes arise because a contractor's work is sub-par or because a supplier or contractor tried to use materials of a lower quality than agreed. On the other side, a dispute may arise because the client fails to make a timely payment. However, many construction disputes arise for another reason: the original contract documents were not completely clear. Blaine, et al. (2023) everyone would prefer to avoid the costly delays that come with construction disputes and litigation. The best protection against such disputes is to ensure that the original contract documents are clear and complete and work with construction law to follow an experienced construction lawyer. In some cases, the law is not the best answer for either party. Resolving the disputes can take longer delays and greater expense however, in many cases, construction law is necessary. Gail, S. Kelley (2013) stated that construction law is the rule used to protect the health and welfare of parties, and must be completed when something goes wrong. The construction law is very important when caught up in a construction dispute or situation involving construction defects (Dunlap, 2018). It protects parties involved in a construction project including commercial and residential projects. Though construction disputes can be challenging at times, construction law resources provide options to help parties resolve problems that arise to help create a successful project for everyone involved (Dunlap, 2018; Cyril, C., 2020). To sum up, construction law plays an important role in between construction disputes and the project quality in construction. So, the study can propose a statement hypothesis as the following:

***H6B**: Cambodian Law on Construction roles as mediation between the Quality of Construction Projects and Construction Disputes.*

2.9. Construction Quality Management System

A quality management system is formed by a series of coordinated activities that are carried out on a set of elements to achieve the quality of the products or services offered to the customer or user (Verónica, V., & Rocío, A., 2017). An alternative definition of a Quality management system is through the meaning of each word separately, according to the ISO 9000:2015 quality management system fundamentals and vocabulary: A *System* is a set of interrelated or interacting elements. *Management* coordinates activities to direct and control an organization, and *Quality* is the degree to which a set of inherent characteristics of an object such as product, service, process, person, resource, etc., meet the requirements. Based on Coffey, V., Willar, D., & Trigunarsyah, B., (2011) stated that an effective quality management system can have an impact on meeting the increasing demands of customers in the global market due to the excellent evolution of processes and business performance promoted by ISO 9001-certified companies. Mark & Ali (2019) also provided a clear indication of that the quality management system has a positive effect on construction performance. Most defects in construction projects consist of roof leaks, building structures, foundation movements, drainage deficiencies, plumbing internal leaks, infrastructure, doors, windows, etc., and quality checks will be carried out on the project and reported to the quality manager (Rajendran et al., 2012). Therefore, the construction quality management system aims to prevent construction defects, minimize punch lists and rework during the project, ensure work conforms to the contract documents and functional performance requirements, and preserve warranties (Rajendran et al., 2012). Several studies have examined the effects and benefits of implementing of quality management system in the construction industry, and evidence suggested that it improves communication problems, minimizes material wastage, reworks, and mistakes, and has greater control over suppliers and subcontractors (Leong et al., 2014). The previous model framework by Mark & Ali (2019) showed the factors affecting on quality of construction projects through a construction quality management system. Consequently, the findings advocated a decisive link between construction quality management system and greater construction performance in the new construction industry. Previous research by McCabe (1998) and ISO 9000 Council.org (2009) indicated the general issues related to construction quality

management system on project quality as the following: management attitude and purpose, implementation by consultants, ISO 9001 management representative without power, insufficient resources, lack of improvement, and making it complicated. Mohammad (2004) also showed ten majors affect project quality in construction such as: lack of employee involvement, difficulties in cooperation among middle managers over quality problems, lack of training programs related to quality, insufficiency of project time, lack of cooperation from customers, standard difficult to interpret, lack of communication routes, lack of cooperation from suppliers, lack of top management involvement, and, lack of external advisers properly qualified. Moreover, Abdirad and Nazari (2015) also advocated that the construction quality management system consists of a strategy such as quality planning, quality assurance, quality control, and quality improvement process, which support setting up quality policies, providing, and defining means, resources, and procedures to assess, improve and maintain quality organizations. Based on the above literature review, the study can draw a statement hypothesis as the following:
***H7**: Construction Quality Management System has a great impact on the Quality of Construction Projects.*

2.10. Cambodian Law on Construction

Construction projects often have disputes among involved parties that result in litigation and as a result project quality in the claim (Dunlap, 2018). Construction law is the rule that a government uses to protect the involved parties when something goes wrong in the contract (Gail S. Kelley, 2013). Nate Budde (2019) stated that construction law is an essential library of rulebooks that government defines how a construction project must be completed, who is liable if something goes wrong, and how to define project is qualified. Construction law is very important when caught up in a construction dispute or situation involving construction defects that affect the project quality (Dunlap, 2018). Though construction disputes can be challenging at times, construction law resources provide options to help parties resolve problems that arise to help create a successful project for everyone involved (Dunlap, 2018; Cyril, 2020). The law relating to construction disputes has a significant effect on the final project quality when hand-over projects such as completion with time, and disputes on claims. Examples of legal disputes in England and Wales are incredibly common in construction projects, and construction law touches all aspects of a project, from pre-planning to the months and years after a project is complete (Cyril, 2020). Nate Budde (2019) stated that disputes aren't cheap. In a 2020 report, Arcadis found that the average construction dispute was valued at $18.8 million in 2019 and took 17.6 months to resolve which has a great impact on project quality.

In Cambodia, many factors affect the quality of construction projects related to construction law. In 2018, the MLMUPC found that there were many unauthorized construction projects in Preah Sihanouk Province launched by opportunistic developers. These illegal projects both affect the environment and lead to poor construction quality (Liyana Hasna, August, 2019). The Cambodian government has set up a committee to inspect the quality of all under-construction buildings in southwestern Cambodia's Preah Sihanouk Province after an unfinished building collapsed, leaving at least 25 people dead (Liyana Hasna, 2019). As a result of the inspection of the quality of buildings 23 buildings were ordered to be demolished, 168 to be rehabilitated and 381 construction projects lacked the necessary documents. A new Cambodian law on construction was promulgated in November 2019 and aims to determine the principles of building technical regulations, rules, and procedures for the management of the construction sector in Cambodia. The construction law was re-established to ensure the construction meets quality, security, and safety; the protection of property and well-being of construction owners, construction users, and the public; aesthetics and good environment for sustainable living to promote public well-being; accountability for and efficiency in working and practicing professions in the construction sector; and increase in investors' confidence in the construction sector and the promotion of the economically and socially efficient real estate market (Cambodian Law On Construction, 2019, p. 3). All constructions which are operated in Cambodia, construction stated to be qualified based on Cambodian law on construction, must meet these requirements as follow two main important rules, technical regulations, and management procedures. Cambodian Law on Construction (November 2019) states that all construction work must comply with the building's technical regulations. The building technical regulations must be certified by a certifier who has a license or a permit granted by the Ministry of Land Management Urban Planning and Construction. To get a construction permit, construction must have a structure that can safely carry all loads; and have fire safety regulations and provisions of fire prevention and extinguishment, based on the function of the construction, the classifications, types, and sizes of construction. The technical regulations for construction materials, equipment, and products that are required to adhere to any specific standard shall be followed by the Ministry (Cambodian Law On Construction, 2019, p.4-5). The management of Construction states in Cambodian law on construction (2019) indicates that the construction professional must be registered with the Board of Construction, and every design document used for building or demolished work must be signed by a designer who has a license from the Ministry of Land Management Urban Planning and Construction (Cambodian law on construction, 2019, p.5-8). Cambodian law on construction (2019, p.12) every building work must have a construction permit before construction starts. James K. Wight & James G. MacGregor (2012) stated that the quality of construction depends in part on the workmanship during construction. Inspection is necessary to confirm that the construction is by the project drawings and specifications. It requires that construction be inspected throughout the various work stages by, or under the supervision of a licensed design professional or by a qualified inspector. Cambodian law on construction (November 2019) all builders ensure that the construction achieves public security, safety, order, and environment and the site needs to require a permit license engineer by the Minister of Land Management, Urban Planning, and Construction, to check (Cambodia's Law On Construction, 2019, p.12-13).

In conclusion from the literature review above related to construction law, we can state a statement hypothesis as follows:

***H8**: Cambodian Law on Construction has a significant influence on the Quality of Construction Projects.*

2.11. Summary Construct Measurements

The literature review provides empirical evidence of factors influencing the quality of construction projects. The table below is the summary of the key constructs with references and authors to develop the conceptual framework of the study.

Table 2.1: Quality of Construction Projects

Quality of Construction Projects	References & Authors
Satisfaction of Contract Specifications	Rumane, (2011); Roberto, P. & Tomi, P.S., (2000); Pyzdek, (1999); Gilmore, (1974); Crosby, (1979)
Completion of Project on Time	Rumane, (2011); Roberto, P. & Tomi, P.S., (2000)
Enhancing Customer/Owner Satisfaction	Roberto, P., & Tomi, P.S., (2000); Parasuraman, Zeithaml, & Berry, (1985)
Motivation and Empowering of Employees' Training	Debby, W., (2012)
Avoidance of Disputes and Claims	Rumane, (2011); Crosby, (1979)
Performances-Based Purposes	

Table 2.2: Construction Quality Management System

Construction Quality Management System	References & Authors
Lack of Employee Involvement	McCabe, (1998); ISO 9000-2009; Mohammad, M., (2004); Leong et al., (2014)
Difficulties in Co-operation among Middle Managers over Quality Problems	Leong et al., (2014); McCabe, (1998); ISO 9000-2009; Mohammad, M., (2004)
Lack of Training Programs related to Quality	McCabe, (1998); ISO 9000-2009; Mohammad, (2004); Leong et al., (2014)
Insufficiency of Project Time	
Lack of Co-operation from Customers	
Standard Difficult to Interpret	
Lack of Communication Routes	Leong et al., (2014); Mohammad, (2004)
Lack of Co-operation from Suppliers	
Lack of Top Management Involvement	McCabe, (1998); ISO 9000-2009; Mohammad, (2004)
Lack of External Advisers Properly Qualified	McCabe, (1998); ISO 9000-2009; Mohammad, (2004)

Table 2.3: Cambodian Law on Construction

Cambodian Law on Construction	**References & Authors**
1. Technical Regulations (Law on Construction, 2019)	
Construction Permit	Chapter 8 – Article 26, page 9
Structure is safe by a certified engineer with a license or from MLMUPC	Chapter 4 – Article 7/8, page 4
Having a fire safety	Chapter 4 – Article 9, page 5
Construction Materials, Equipment, and Products follow a Specific Standard	Chapter 7 – Article 23, page 8
2. Management Procedure for Construction (Law on Construction, 2019)	
Construction is registered with the Board of Construction	Chapter 11 – Article 44, page 13
All Design Documents used for the building are signed by the License Designer	Chapter 9 – Article 32, page 11
Construction is Permitted before the Start	Chapter 10 – Article 38, page 12
Construction Site achieved Public Security, Safety, and Environment	Chapter 10 – Article 42, page 13
Operation Site has a License engineer checking Quality Work	Chapter 10 – Article 41, page 13

Table 2.4: Stakeholder Involvement

<table>
<tr><th>Stakeholder Involvement</th><th>References & Authors</th></tr>
<tr><td>Site Engineer Involvement</td><td rowspan="4">Deming, (1986); Olander & Landin, (2005); Evelyn, (2017)</td></tr>
<tr><td>Engineer Involvement</td></tr>
<tr><td>Contractor Involvement in Planning</td></tr>
<tr><td>Sub-Contractor Involvement in the Project</td></tr>
<tr><td>Client Involvement</td><td>Deming, (1986); Olander & Landin, (2005); Jha & Iyer, (2006)</td></tr>
<tr><td>Consultant and Design Team</td><td>Deming, (1986); Olander & Landin, (2005)</td></tr>
<tr><td>Supplier Involvement</td><td>Deming, (1986); Evelyn, (2017)</td></tr>
</table>

Table 2.5: Project Funding

<table>
<tr><th>Project Funding</th><th>References & Authors</th></tr>
<tr><td>Construction schedule due to changes in designs by the owner</td><td rowspan="2">Chan et al., (2002)</td></tr>
<tr><td>Contractor’s Payment</td></tr>
<tr><td>Project Cost Estimation</td><td>Evelyn, (2017); Jean et al., (2015)</td></tr>
<tr><td>Project Technical Design: Defined Project Scope, Insufficient Product Technical Requirement, & Required Quality Standard</td><td>Jean et al., (2015)</td></tr>
<tr><td>Project Implementation Time: The Sequence of Project Activities, Efficient Resource Allocation, & Contractor Performance</td><td>Chan et al., (2002); Jean et al., (2015)</td></tr>
</table>

Table 2.6: Construction Materials

Construction Materials	References & Authors
Source of Materials	Fisk and Reynolds, (2011)
Performance of Quality Tools	Oke, A.E., (2006); Olusola, K.O., Ata, O., & Ayangade, J.A., (2002)
Cost of Materials	Aliverdi, Naeni, and Salehipour, (2013)
Material/Equipment Specification	Oke, A.E., (2006); Olusola, K.O., Ata, O., & Ayangade, J.A., (2002)
Quality of Materials	

Table 2.7: Project Management Competence

Project Management Competence	References & Authors
Conflict Management	Evelyn, (2017)
Leadership	Olatuniji, (2010); Fapohunda & Stephenson, (2010); Kast & Rosenzwieg, (2011); Ailabouni, N., et al., (2009); Johansen & Wilson, (2006); Evelyn, (2017)
Motivation	Olatunji, (2010)
Management Commitment	Wambugu, (2013)
Effective Project Management System	Doloi, (2007); Kaming et al., (2007)
Team Management	Evelyn, (2017); Al-Momani, (2010)
Solutions Development	Wambugu, (2013); Doloi, (2007); Evelyn, (2017)

Table 2.8: Project Complexity

Project Complexity	References & Authors
Environmental Complexity • Weather Condition • Number of Locations • Interference between Existing Sites • Number of Different Languages • Clarity of Project Goals	Williams, T., (2002); Baccarini, D., (1996); Abdou, S.M., Kuan, Y., & Mohammed, O., (2016)
Operational Complexity • Project Duration • Availability of Financial Sources • Strict Quality Requirements • Variety of Tasks	

Table 2.8: Project Complexity (Cont.)

Project Complexity	**References & Authors**
Organizational Complexity • Uncertainty in Methods • Size of the Project Team • Involvement in Different Time Zones • Political Influence	Laurikkala, H., et al., (2001); Williams, T., (2002); Baccarini, D., (1996); Abdou, S.M., Kuan, Y., & Mohammed, O., (2016)
Technical Complexity • Lack of Experience in the Country • Level of Competition • Technical Risks	Vidal, L.A., & Marle, F., (2008); Williams, T., (2002); Baccarini, D., (1996); Abdou, S.M., Kuan, Y., & Mohammed, O., (2016)
Team Complexity • Lack of Experience with Partners • Lack of Resources and skills • Number of Projects Goals	Williams, T., (2002); Baccarini, D., (1996); Abdou, S.M., Kuan, Y., & Mohammed, O., (2016)

Table 2.9: Construction Disputes

Construction Disputes	**References & Authors**
Contractual Disputes • Disputes over Payment • Miscalculations and Over Calculation • Contract Clause, which Unrealistically and Unfairly Shifted • Ambiguous Contract Provision • Overdesign by the Design Team	Jaffar, N., et al., (2011); Williamson, O., (1979); Cakmak, E., & Cakmak, P.I., (2014); Diekmann & Girard, (1995); Kumaraswamy & Yogeswaran, (1998); Hall, (2000); Hellard, (1992)
Technical Disputes • Role Conflict among the Participants • Contract's Low Bid • Late Instruction from Designer • Unrealistic Client Expectation • Error and Incomplete Technical Specification	Jaffar, N., et al., (2011); Williamson, O., (1979); Cakmak, E., & Cakmak, P.I., (2014); Galbraith, J., (1973)
Human Behavior Disputes • The Absence of Team Spirit among the Participants • Poor Communication • Project Participants with an Unexpected Condition • Blaming • Different Profession • Fraud and Faith in Works • Impolite and Lack of Courtesy among each Professional Party • Desire to be Always Right on the Opinion • Anger, Rudeness, & Hatred toward other Parties	Jaffar, N., et al., (2011); Williamson, O., (1979); Cakmak, E., & Cakmak, P.I., (2014); Vorster, M.C., (1993); Carmicheal, D.G., (2002); McManamy, R., (1994)

2.12. Conceptual Framework

This section provides a conceptual framework for the study. From the literature study, the quality of construction projects in this study can be drawn as the model below.

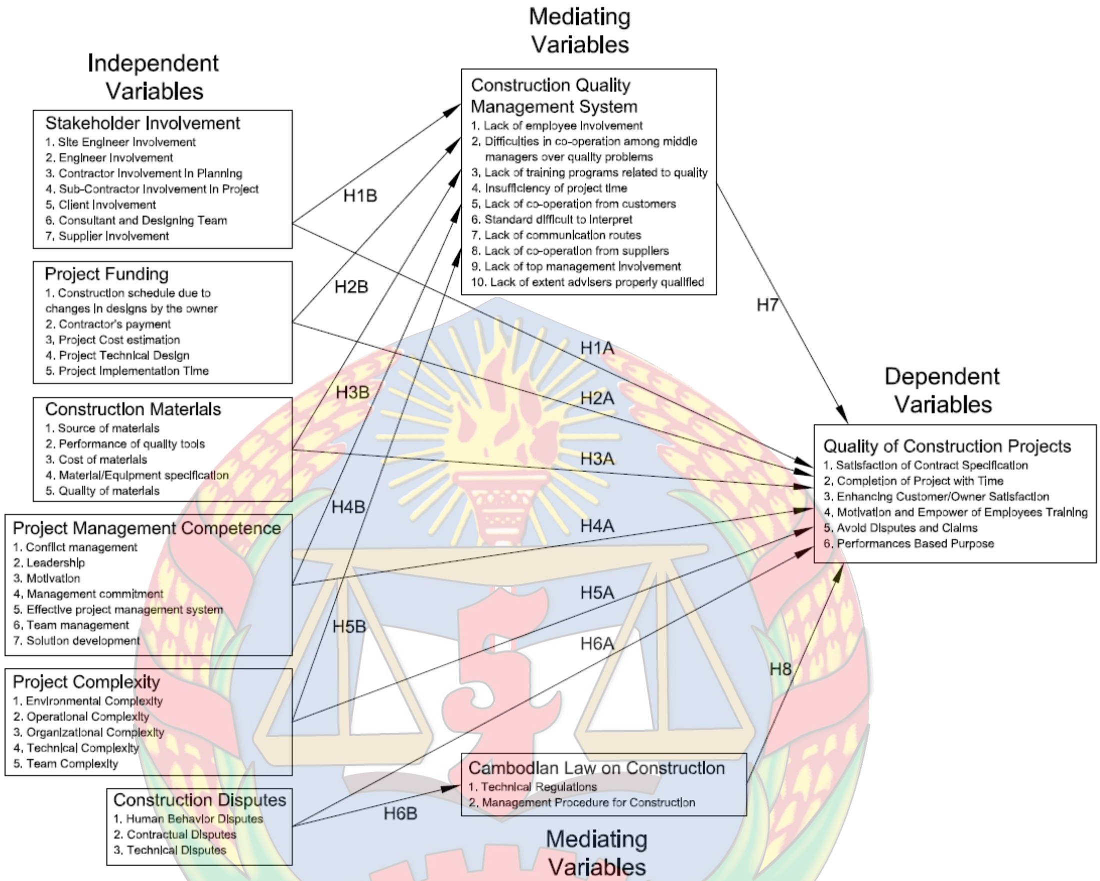


Figure 2.1: Preliminary Model Framework of the Study

CHAPTER THREE
OVERVIEW OF THE CONSTRUCTION INDUSTRY IN CAMBODIA

3.1. Introduction

The construction industry is a driver of growth in another sector due to its heavy reliance on an extended and varied supply chain (UKCG, 2009). All other sectors of the economy like manufacturing, agriculture, entertainment, transportation, education, health, sport, etc. depend on the construction industry as well as the construction industry relying on them for performance (Olufemi Adedamola, O., 2016). Oladinrin, Ogunsemi, and Aje, (2102) expressed that the construction industry plays an important role in the economy. Construction activities affect nearly every aspect of the economy. The construction sector is a key sector for the UK economy. The construction sector is defined as, the construction contracting industry, the provision of construction-related professional services, and the construction-related products and materials. The construction industry can be divided into three major segments. The first construction of a building by building contractors, or general contractors. These contractors build residential, industrial, commercial, and other buildings. The second type is the heavy and civil engineering construction contractors that build sewers, roads, highways, bridges, tunnels, and other projects. The last one is trade contractors who perform specialized activities relating to construction such as carpentry, painting, plumbing, tiling, and mechanical and machinery for construction purposes are also in this category.

3.2. Construction Industry Contribute to Cambodian Economy

The GDP from construction in Cambodia more than tripled in just 7 years; from less than 2000 KHR Billion in 2012 to over 6000 KHR Billion in 2019 (Olga J. Skriabikova, 2022). World Bank in 2020 stated this sector constituted up to 220, 000 jobs and had significant impacts on the Cambodian economy, living standards, and the environment. The construction sectors in Cambodia are predicted to continue to recover by 7.2% in 2023 due to the inflow of foreign investment in construction for tourism and trade activities (NISC, 2022). The low and medium housing price construction is expected to maintain good growth due to the increase in the demand of the people to organize families in line with the trend of increasing domestic investment. The National Institute of Statistics of Cambodia (NISC, 2022) showed the GDP from construction in Cambodia averaged 2462.73 KHR Billion from 1998 until 2021, reaching an all-time high of 6237.50 KHR Billion in 2019 and a record low of 420 KHR Billion in 1998.

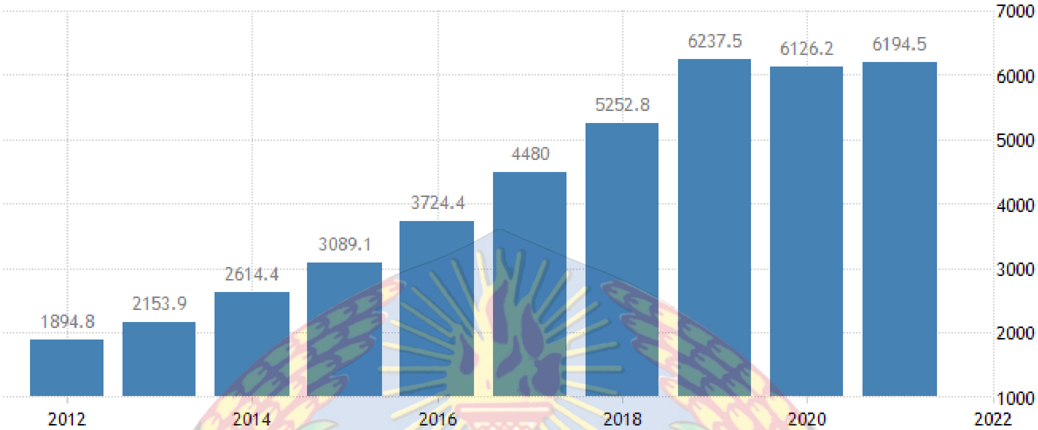


Figure 3.1: Cambodian Construction GDP from 1998 to 2021

Related	Last	Previous	Unit	Reference
GDP Annual Growth Rate	3.00	-3.1	Percent	Dec 2021
GDP	26.96	25.87	USD Billion	Dec 2021
GDP from Utilities	377.8	376.7	KHR Billion	Dec 2021
GDP from Transport	3803.4	3700.2	KHR Billion	Dec 2021
GDP from Services	21078.4	21663.3	KHR Billion	Dec 2021
GDP from Public Administration	752.9	635.1	KHR Billion	Dec 2021
GDP from Mining	1436.9	1199.6	KHR Billion	Dec 2021
GDP from Manufacturing	14194.3	12742.5	KHR Billion	Dec 2021
GDP from Construction	6194.5	6126.2	KHR Billion	Dec 2021
GDP from Agriculture	9641.1	9526.8	KHR Billion	Dec 2021

Table 3.1: Cambodian GDP by December 2021 (NISC, 2021)

The GDP from Construction in Cambodia is expected to reach 6504.00 KHR Billion by the end of 2022, according to Trading Economics Global Macro models and analyses expectations. In the long-term, Cambodia’s GDP from construction is projected to trend around 6829.00 KHR Billion in 2023 and 7273.00 KHR Billion in 2024, according to our economy models (NISC, 2022). The construction sector has significantly contributed to the economic development and has created a lot for our people said Ly Rasmey, secretary of state at the MLMUPC (NISC, 2022). The Ministry of Land Management added that the construction sector in Cambodia has created 170,059 jobs in Phnom Penh (785,000 construction workers in Cambodia) and that unskilled labor earns around $10 to $15 per day whereas skilled labor earns between $15 to $25 per day. In addition, specialized skills like engineers, architects, and experts can earn from $400 to $2,500 per month.

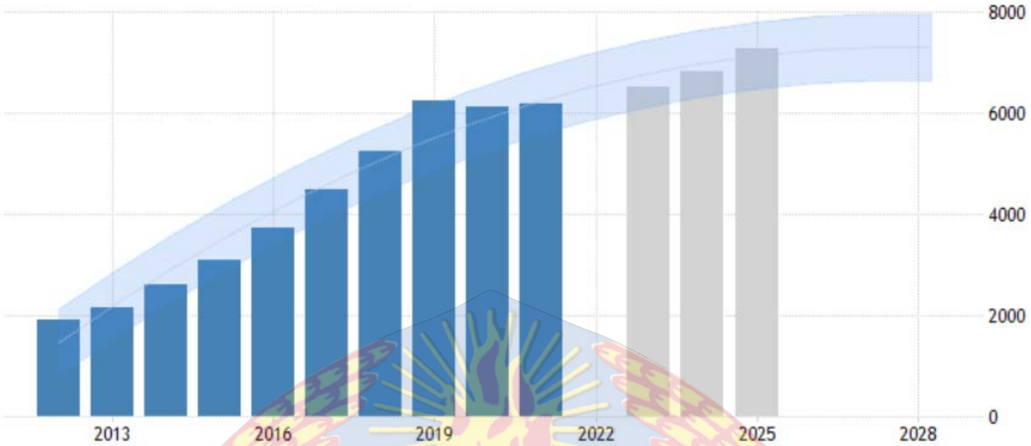


Figure 3.2: Construction GDP Expectations by NISC, 2022)

3.3. Construction Projects in Cambodia

The Ministry of Land Management Urban Planning and Construction has approved 1,679 construction projects nationwide on 2.2 million square meters at about $952 million in the first five months of 2021 (MLMUPC, 2022). Cambodia's construction sector attracted a total investment of US$ 5.33 billion in 2021. The report from MLMUPC showed the nation had provided licenses to 4,303 constructions in 2021. The Ministry of Land Management Urban Planning and Construction (MLMUPC, 2022) has approved in total:

- 19 hotel projects (capital investment of $145.2 million)
- 220 project commercial buildings (capital investment of $1.31 billion)
- 45 factory and warehouse projects (capital investment of more than $306.35 million).
- 45 mixed-building development projects (capital investment of $1.03 billion).

In summary: 2,097 residential projects (capital investment capital of $1.78 billion), and 36 Borey projects (capital investment of more than $648.9 million). In 2019, the construction and real estate sector in Cambodia yielded investments worth approximately $11.43 billion, a 90% rise from 2018. Cambodia's FDI (foreign direct investment) in the real estate sector totaled $437.3 million in 2019 according to the NBC (National Bank of Cambodia, 2022). Below shows a list of the top ten tallest buildings in Cambodia, and other buildings under construction.

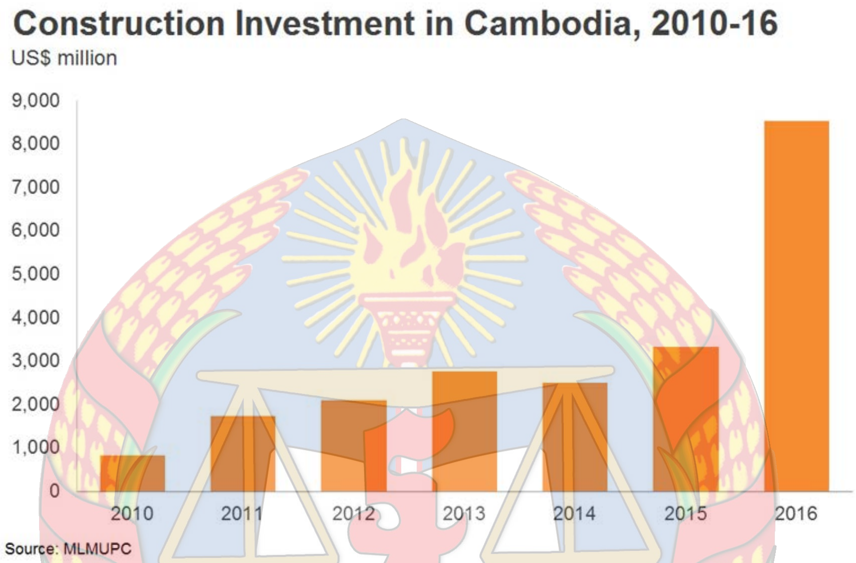


Figure 3.3: Construction Investment by MLMUPC, 2022)

Table 3.2: Finished High-Rise Construction by 2022

Rank	Name of Building	Height (m)	Floors	Year Completion
1	Morgan Enmaison 2	243.8	53	2022
2	The Peak Shangri-la	236	58	2022
3	The Peak Residential 1	224	55	2022
4	The Peak Residential 2	224	55	2022
5	Morgan Tower	218	48	2022
6	Gold Tower Phnom Penh	211	2x47	2021
7	Chpmong Tower	202	45	2022
8	J Tower 2	189	43	2022
9	Vattanac Capital Tower	187.3	39	2014
10	Noble International Center	182.4	48	2020
11	Gia Tower	178	43	2021
12	The Skyline Cambodia	172	2x39	2018
13	Morgan Enmaison 5	171	45	-
14	Prince Huan Yu Center	170	34	-
15	Golden Twoer 322	168	40	2022

(Source: MLMUPC, 2022)

Table 3.3: Under-Construction & Future Building in Sihanouk, 2022

Building	Height (m)	Floors	Notes
Sihanoukville Financial Tower	494	106	Proposal
Le Meridian	261	58	Approved
Xin Hoa Skyline	200+	53	Approved
Lyon D'or Residence Tower	256	58	Approved
Golden Bay Office Building	180	45	Under Construction
Prince Bay Tower	160	40	Approved
The Star Tower	150.5	4x43	Under Construction
The Seagate Suite	146	43	Under Construction
Prince Bay Condominium	140	3x35	Approved
Victory Bay	136.5	39	Approved
Royal Bay View	130/134	36/37	Under Construction
The Scarlet	128	32	Under Construction
Shang Hai Bay	119	34	Under Construction
Sky-Mountain View twin	115	2x33	Under Construction
Morow Capital	112	28	Under Construction
Cloud Coast	108	27	Under Construction
Golden Bay Condominium	105	3x30	Under Construction
Ocean city condominium	108	31	Under Construction
Star Bay	105	6x30	Under Construction
JWM Casino & Hotel	105	20/30	Under Construction
Seaside Resort Apartment	101.5	22/29	Under Construction
La Tree Condominium	100	26	Under Construction
City View Condo	87	2x25	Under Construction

(Source: MLMUPC, 2022)

Table 3.4: Under-Construction & Future Building in Phnom Penh, 2022

Building	Height (m)	Floors	Notes
Phnom Penh Twin World Trade Center	587	2x133	Delayed
Diamond Tower	555	125	Proposal
MGN Tower	485	85	Proposal
Blueprint Tower	425	2x98	Under Construction
Naga World 3 Tower	358	75	Under Construction
Prince Tower	332	72	Proposal
Morgan Enmaison 3	331.2	72	Under Construction
Yutai Twin Tower 1	327.6	72	Approved
Yutai Twin Tower 2	285.6	68	Approved
Mesong Tower 1	269	71	Under Construction
Phnom Penh Harbour Tower	270	60	Approved
Thai Boon rong Trade Building	260	2x65	Delayed
Titan Stone Financial Tower	259.4	58	Under Construction
Naga World 3 Condo Hotel 1 & 2	256	2x61	Under Construction
Morgan Enmaison Tower 3	245	70	Under Construction
Thai Boon rong Comeral Building	236	2x59	Delayed
Naga World 3 Residence	233.2	2x53	Approved
KBX Universal Financial Center	230	60	Under Construction
Sunwah Peal	223.2	2x62	Approved
Olympia Tower	213	53	Under Construction
Prince Royal 1	212	2x60	Approved
R&F Glory	207.5	5x57	Under Construction
Prince Financial Center	203	47	Under Construction
Phnom Penh Harbour	202	45	Approved
Mesong Tower 2	190	50	Under Construction

(Source: MLMUPC, 2022)

In short, Cambodia's annual economy grows rapidly, and construction is the engine of the growth. The construction industry has become one of the important pillars supporting Cambodia's economy and has created a lot of jobs for Cambodian people as MLMUPC (2022) stated Cambodia granted licenses to 57, 590 construction projects across the country with a total investment of $ 66.2 billion.

CHAPTER FOUR
METHODOLOGY

4.1. Introduction

This chapter provides a plan for the investigation to obtain answers to the research questions. It explains how the research is accomplished, what knowledge is required, what information is needed, and how information is collected. This research consists of sample design, sampling technique, sample size, source and instruments of data collection, methods of data analysis, ethical issues, validity and reliability, confirmation factor analysis, structural equation model, and mediator testing.

4.2. Research Design

Saunders, Lewis, and Thornhill (2009) stated that research methodology in a research study is considered an important element, and therefore determining the method of research methodology is a very important section of the study. It must clearly describe the general plan of how the research questions will be answered together with justifying the methods selected and employed for a particular research methodology. A research design according to Zikmund (2003) is the master plan specifying the methods and procedures for collecting and analyzing the needed information. Therefore, it is the framework that plans the action for the research dissertation; and also includes the objectives of the research to ensure the information collected is appropriate for solving the problem. Quantitative research is the process of collecting and analyzing numerical data (Pritha, B., 2021). It can be used to find patterns and averages, make predictions, test causal relationships, and generalize results to wider populations. Qualitative research involves asking participants about their experiences of things that happen in their lives. It enables researchers to obtain insights into what it feels like to be another person and to understand the world as other experiences it (Zubin, A., & Jane, S., 2014).

This study used quantitative methods to collect primary data. Relevant data and information were gathered from top management of construction, contractors, inspectors, government officials, project owners, engineers, designers, and site engineers, etc. who currently work at the site located in Phnom Penh city in

Cambodia. The secondary sources of information are used to provide the conceptual framework of the study and acquire a general picture of the problem. At the end of the result findings, the study conducted an in-depth interview of 10 respondents to gain better insights. The study intends to apply this design to evaluate the relationship between design factors and the quality of construction projects for the selected area. This design is very useful in studying the inter-relations between the variables already mentioned in the conceptual framework. A survey approach is appropriate because the population of the study is in different geographical regions within selected building construction industries in Phnom Penh, Cambodia. The specific respondents collected the required knowledge and experience in the area of monitoring and evaluation and project management considering the independent variables, moderating variables, and dependent variables. The descriptive study allows the researcher to describe the respondent data and helps to know the event that took place while the explanatory study examined the relationship between variables.

4.3. Research Procedure

The following are the research procedures:

Stage 1: Preliminary Literature Review: *Define research questions* ➔ *Establish research objectives* ➔ *Develop a research methodology*

Stage 2: Preliminary Studies: *Pilot Study* ➔ *Extensive literature review* ➔ *Questionnaire full-scale survey* ➔ *Quantitative data analysis*

Stage 3: Dissemination: *Result Findings, Interpretation, and Discussion* ➔ *Conclusions and recommendations*

Stage 4: Thesis Writing and Final Development

4.4. Sources of Data

There are two types of data, secondary data and the other is primary data. Secondary data is any data that has been gathered earlier for some other purpose in the previous study; however, primary data is the data that is collected firsthand by someone specifically to facilitate the study (Bryman and Bell, 2015). The data is required to validate the proposed hypotheses and carry out an empirical examination for this study. This study focuses on factors that influence the quality of construction projects in Cambodia in the case of local Cambodian construction companies. Since there is little existing information and data on factors that influence the quality of construction projects provided by local Cambodian construction companies, primary data collection is used in this research. Bryman and Bell (2015) stated that primary data collection, where original data are obtained directly through various methods such as questionnaires, interviews, and direct observation. Primary data collection is associated with selecting appropriate sampling techniques (Saunders et al., 2009), as it is not possible to collect the required original data from an entire population.

4.5. Data Gathering Tools and Instruments

Zikmund, W.G., (2003) stated that surveys require asking people, called respondents, for information using verbal or written questions, and defines a survey as a method of gathering primary data based on communication with a representative sample of individuals. The respondents in this study were selected and administered to distribute to the top management of construction companies, contractors, country inspectors, national government officials, project owners, and engineers who are involved in the construction project quality. The questionnaires consisted of different parts and mainly focused on the factors that influence the quality of projects which helped the researcher to see how to identify factors affecting the quality of construction projects in the case of local Cambodian construction companies. The survey started with a paragraph explaining the purpose of the study only, and all respondents will be anonymous and confidential.

4.6. Sampling Method

Before starting the full-scale survey, the pilot study represented a fundamental phase of the research process. The purpose of conducting a pilot study is to examine the feasibility of an approach that is intended to be used in a larger-scale study (Andrew, C., et al., 2010, Amy, L.W., Steven, A.J., Cindy, L.C., and Michael, J.C., 2015). The rule of thumb by Browne (1995) recommended at least 30 or greater to estimate a parameter while Julious (2005) suggested a minimum sample size of 12. Teare, M.D., et al. (2014) recommend a pilot sample is about 70 to reduce the imprecision around the estimate of the standard deviation. Based on the above authors, this study selected 31 sample sizes to meet the requirement based on the authors' recommendations.

After the pilot study test is done, the research questions are rearranged, and the inappropriate items that are not significantly related to the research questions, the full-scale survey of the respondent is conducted. The sampling technique in this research is based on probability sampling. Probability sampling means that every item in the population has an equal chance of being included in the sample (Zikmund, W.G., 2003). According to the report from the Ministry of Land Management Urban Planning and Construction, the number of construction and design companies registered is 1205 which 932 are local construction companies, and 273 are foreign companies (MLMUPC, 2012). We focus on local construction companies for this research. Most statisticians agree that 10% of the total population is a good maximum sample size (Conroy, R.M., 2018). Therefore, in this research study, the target site survey for local Cambodian construction companies in Phnom Penh is about **94 construction sites**. According to the Board of Engineers Cambodia (August, 2019), the total number of engineers is about 4014 who registered including civil engineers, mechanical Engineers, rural and geology engineers, electrical engineers, and architects. A sample is a subset of a population selected to participate in the study (Daniel, W.W., 1999) and it is a fraction of the whole selected to participate in the research project. According to Daniel, the sample size in this research was defined as shown:

$$n = \frac{N*X}{X+N-1} \qquad X = \frac{Z_{\alpha/2}^2 * p * (1-p)}{MOE^2}$$

Where:

n = sample size

N = total population (4014)

$Z_{\alpha/2}$ = critical value of the normal distribution at $\alpha/2$

MOE = margin of error

p = the largest possible proportion (0.5)

Table 4.1: Number of sample sizes with a reliability of 95%

		Critical Value of $Z_{\alpha/2}$		
		1%	**5%**	**10%**
		2.576	*1.960*	*1.645*
MOE Margin of Error	**1%**	3232	2831	2519
	5%	570	**351**	254
	10%	159	94	67

The total sample size in this research is at least **351** respondents using a value of reliability of 5% (Z-value, 1.960) and Sampling Error (5%). In this study, we selected 397 respondents, around 20 to 35 respondents-high positions were directly interviewed, around 50 respondents-manager up were asked in place; and the rest respondent-medium positions via telegram. After reviewing the results, we dropped some and we still have 385 samples. The purpose of selecting a bigger sample size than the sample size calculated is to avoid a non-response bias test.

4.7. Methods of Data Analysis

After collecting data through the appropriate method, the task becomes one of ensuring that data will provide meaning and value. Data preparation is the first part of the process of transforming raw data into usable information. The data collected through a questionnaire was presented in table form and descriptive statistics and inferential were employed. After making the necessary coding, Statistical Package for Social Science (SPSS) and AMOS were used to analyze the usage data collected from the respondents. The finding outputs; and the statistical tools are utilized for data analysis by separating them into two shares. First, descriptive statistics describe a set of data in terms of its frequency and percentage for identifying respondents such as age, gender, education, work experience, etc. The Second step is the non-response bias test, normality test, common method bias test, validity, and reliability test, confirmation factor analysis (CFA), structural equation modeling (SEM), and mediator testing. The general equation of the structural equation model is shown:

$$Y = a_0 + a_1X_1 + a_2X_2 + a_3X_3 + a_4X_4 + a_5X_5 + a_6X_6 + a_7X_7 + a_8X_8 + \varepsilon$$

Where: Y: Quality of Construction Project

X_1: Stakeholder Involvement

X_2: Project Funding

X_3: Construction Materials

X_4: Project Management Competence

X_5: Project Complexity

X_6: Construction Disputes

X_7: Cambodian Law on Construction

X_8: Construction Quality Management System

ε: Error Term

4.8. Validity Analysis

The validity of a scale score reflects true differences among objects on the characteristic being measured, rather than a systematic or random error (Malhotra, 2009). Perfect validity requires that there be no measurement error:

$$X_o = X_T, X_R = 0, X_S = 0$$

The requirement for observing scale to meet the validity analysis such as Significant Value < 0.05, Communalities > 0.5, and Component Matrix > 0.7. Based on the requirements and conditions above, the researcher only selects the indicator with value according to the value specified above for the quantitative research.

4.9. Reliability Analysis

Reliability can be defined as the extent to which measures are free from random error, the measure is perfectly reliable when $X_R\ If\ X_R = 0$ (Malhotra, 2009). The coefficient alpha α or Cronbach's alpha is the average of all possible split-half coefficients resulting from different ways of splitting the scale items (Malhotra, 2009). This coefficient varies from 0 to 1. According to Malhotra (2009), a value of alpha α of 0.6 or less generally indicates unsatisfactory internal consistency reliability. Pallant (2005) the reliability values of Cronbach's alpha shall be greater than 0.7 which is considered ideal. Therefore, in this study, all construct items such as independent variables (stakeholder involvement, project funding, construction materials, project management competence, project complexity, construction disputes); Mediating variables (construction quality management system, and Cambodian law on construction), and dependent variable (quality of construction projects) assess with Cronbach's alpha with the value greater than 0.7.

Table 4.2: Cronbach's Alpha Limitation and Interpretation

Close 1.0	High Internal Consistency Reliability
> 0.8	Is Considered Good
> 0.7	Is Considered Acceptable
Less than 0.6	Is Considered Poor

4.10. Mediator Test

A mediator variable explains the how or why of an observed relationship between the independent variables and its dependent variable. In the mediation model, the independent variables cannot influence the dependent variable directly; and instead do so using a third variable. Baron & Kenny (1986) proposed two types of mediation. Once in full mediation is when the entire relationship between the independent variables and the dependent variable is through the mediator variable. If you take away the mediator, the relationship disappears. Partial mediation happens when the mediating variable is only responsible for a part of the relationship between the independent variables and the dependent variable. If the mediating variable is eliminated, there will still be a relationship between the independent variables and the dependent variable. Baron and Kenny (1986), Judd and Kenny (1981), and James and Brett (1984) outlined four steps to identify the mediation hypothesis. If the steps are met, then the variable mediation (M) is said to completely mediate the independent (X) and the dependent (Y) relationship.

Step 1: Show the independents (X) correlate with the mediator (M)

Step 2: Show the dependent (Y) and Mediator (M) are correlated

Step 3: Demonstrate a full mediator on the process. The effect of X on Y, controlling for M. Three regressions need to be met in the result to support mediation:

1. X as the predictor shown to influence the mediator M
2. X as the predictor shown to influence the dependent Y
3. The mediator must significantly influence the dependent variable in the third regression. Here, the independent variable and mediator variable are entered as predictors.

Table 4.3: Correlation coefficient value and its interpretation

Size of Correlation	Interpretations
± 1.00	Perfect Positive/Negative Correlation
± 0.90 to ± 0.99	Very High Positive/Negative Correlation
± 0.70 to ± 0.90	High Positive/Negative Correlation
± 0.50 to ± 0.70	Moderate Positive/Negative Correlation
± 0.30 to ± 0.50	Low Positive/Negative Correlation
± 0.10 to ± 0.30	Very Low Positive/Negative Correlation
± 0.00 to ± 0.10	Markedly Low & Negligible Positive/Negative Correlation

4.11. Factor Analysis

Factor analysis is used to uncover the latent structure of a set of variables. It reduces attribute space from a large number of variables to a smaller number of factors and as such is a non-dependent procedure (Barbara, M., 2010 & Gorsuch, R.L., 1983). Confirmatory Factor Analysis (CFA) is a statistical method used to validate the aspect structure of a fixed of observed variables. In CFA, the loading scale items on factors are tested and removed if the regression weight is lower than 0.5 and ideally 0.7 or higher (Gorsuch, R.L., 1983). Barbara, M., (2010) proposes two steps in CFA.

Step 1: CFA is performed for every factor of the measurement model. The reduction factor in this step can be seen in the full process in Appendix C: Factor Analysis.

Step 2: CFA is performed for entire factors to evaluate the model. After conducting CFA for every variable in the first step of the measurement model, in step 2 in conducting the full scales items were weighted on their fitting factors and every factor was correlated with each other.

To evaluate the criteria for the measurement model, CFA both in step 1 and step 2, uses maximum likelihood (p-value) estimation. To investigate the model's goodness of fit, several statistics were used overall χ^2 (Hooper et al., 2008), root means a square error of approximation (Steiger, 1990; Hooper et al., 2008).

Table 4.4: Value Acceptance and Interpretation (Barbara, M., 2010)

Acronym	Explication	Accepted if	Reference
Likelihood	P-Value	≥ 0.05	Joreskog & Surbon (1996)
CMIN/DF	Chi-Square divided by degree of freedom	≤ 3 = acceptable fit ≤ 5 = reasonable fit	Kline (1998); Marsh & Hocevar (1985)
GFI	The Goodness of Fit Index	1 = Perfect fit ≥ 0.95 = Excellent ≥ 0.90 = Good > 0.80 = Acceptable	Kline (2005); Hu & Bentler (1998); Steiger (1990); Hooper et al. (2008)
CFI	Comparative Fit Index	1 = Perfect fit ≥ 0.95 = Excellent ≥ 0.90 = Good > 0.80 = Acceptable	West et al. (2012); Fan et al. (1995); Steiger (1990); Hooper et al. (2008)
RMSEA	Root Mean Square Error of Approximation	> 0.10 = Poor < 0.10 = borderline fit < 0.08 = acceptable fit ≤ 0.05 = excellent fit	MacCallum et al (1996); Steiger (1990); Hooper et al. (2008)

4.12. In-Depth Interview

After getting the results from the analysis, the confirmation of the results is checked whether the overview from the response is the same as what the study revealed. The In-Depth interview to confirm the results. The In-depth interview is a qualitative research technique that involves conducting intensive individual interviews with a small number of respondents to explore their perspectives on a particular idea, program, or situation (Carolyn, B., & Palena, N., 2006). A large number of articles, book chapters, and books recommended guidance and suggested from 5 to 50 participants as adequate (Shari, L. D., 2012). The general recommendation for In-Depth interviews is a sample size of 30; if the study includes similar segments within the population. A minimum size can be 10 but the population integrity in recruiting. In this study, we selected 10 respondents for an interview with our results. The respondents are the new ones from the previous survey and the responses must be well understood in project quality. Carolyn & Palena (2006) suggest six phases in conducting In-Depth Interviews: Prepare a Plan, Develop Instruments, Train Data Collectors, Collect Data, Analyze Data, and Disseminate Findings. An interview did not take over an hour for each respondent and the taping will be recorded in a voice for not to miss any of the answers. In addition, all responses will be kept confidential. We arranged 10 respondents as shown in the tables below with various roles in the project quality.

Table 4.5: List Respondents for In-depth Interview

Company	Education	Identify	Experiences	Roles in Project
M-Architect	Master	Manager	7	Consultant Technical
M-Architect	Bachelor	Senior Manager	12	Consultant Architect
M-Architect	Bachelor	Supervisor	9	Quantity Surveyor
M-Architect	Bachelor	Engineer	3	Structural Designer
Kim Mex	Master	Senior Supervisor	8	Construction
Kim Mex	Bachelor	Senior Supervisor	7	Construction
Kim Mex	Master	Senior Engineer	3	Designer
Kim Mex	Master	Engineer	3	Structural Engineer
Fasat	Master	Manager	10	Designer
Government	Bachelor	Ass. General Secretary	12	Project Coordinator

4.13. Ethical Consideration

Research ethics is deemed a crucial element in conducting a research project within social science research. It is broadly referred to as the appropriateness of researchers' behavior in connection with the rights of those who are the subjects of the research projects (Saunders et al., 2009). The ethical issues of voluntary participation, informed consent, risk of harm, confidentiality, and anonymity are central and should be considered by researchers when conducting any research project within the social science context (Bryman and Bell, 2015).

CHAPTER FIVE
DATA ANALYSIS AND INTERPRETATION

5.1. Introduction

This chapter presents data preparation and data analysis in tables; data presentation and interpretation, and discusses the study findings. This chapter provides the major findings and results of the study as obtained from the questionnaire.

5.2. Pilot Study

A pilot study represents a fundamental phase of the research process. The purpose of conducting a pilot study is to examine the feasibility of an approach that is intended to be used in a larger-scale study (Andrew, C. et al., 2010). For the pilot study, we conducted 31 sample sizes to validate the scale and items inappropriately. The validity and reliability of the instruments are essential in research data collection. Therefore, the correct data will determine true the results of research quality. Whether true or not the data is highly dependent on true or not the research instrument. Moreover, the research question evaluated the statements of the questionnaire regarding the content's information, layout, and design by a senior well-known professor from the Institute of Technology of Cambodia. In addition, the 31 respondents with direct interviews were selected carefully from only the manager and/or senior staff of the department from each company to improve clarity about readability, content adequacy, etc. After their feedback was considered into account while revising some parts of the questionnaire and the research result from the pilot study are shown validity and reliability accordingly. The full process can find more in Appendix B-Pilot Study, for full detail of the process of doing validity and reliability test. In conclusion, all constructs are accepted as valid and all variables are reliable with Cronbach's Alpha bigger than 0.7 except for Stakeholder which is most likely equal to 0.7. The Stakeholder involvement whose value Cronbach's alpha is less the 0.6. However, we still accept this variable since it is the stage of the preliminary study. In addition, we will observe this variable deeper during the study's full-scale survey.

5.3. Demographics of the Respondents

Based on a preliminary analysis of responses obtained which was based on the Five Point Likert Scales and each symbol used represented as the following: Very High (5), High (4), Unsure (3), Low (2), and Very Low (1). The full-scale study sought to find out first the demographics of the respondents with 385 samples.

Table 5.1: Demographics 385 Respondents' Result

Sex					
		Frequency	Percent	Valid Percent	Cumulative Percent
	Female	120	31.2	31.2	31.2
	Male	265	68.8	68.8	100.0
	Total	385	100.0	100.0	
Major					
		Frequency	Percent	Valid Percent	Cumulative Percent
	Civil Engineer	209	54.3	54.3	54.3
	Mechanical Engineer	4	1.0	1.0	55.3
	Electrical Engineer	57	14.8	14.8	70.1
	Architect	115	29.9	29.9	100.0
	Total	385	100.0	100.0	
Level Education					
		Frequency	Percent	Valid Percent	Cumulative Percent
	Master Degree	98	25.5	25.5	25.5
	BA. Degree	286	74.3	74.3	99.7
	Undergraduate	1	.3	.3	100.0
	Total	385	100.0	100.0	
Year Experience					
		Frequency	Percent	Valid Percent	Cumulative Percent
	< 1 Year	11	2.9	2.9	2.9
	1-4 Years	216	56.1	56.1	59.0
	4-9 Years	121	31.4	31.4	90.4
	9-15 Years	36	9.4	9.4	99.7
	15-20 Years	1	.3	.3	100.0
	Total	385	100.0	100.0	

Project Role				
	Frequency	Percent	Valid Percent	Cumulative Percent
Main Contractors	104	27.0	27.0	27.0
Sub-Contractors	1	.3	.3	27.3
Inspector	71	18.4	18.4	45.7
Site Engineer	12	3.1	3.1	48.8
Project Owner or/and Client	1	.3	.3	49.1
Consultant	71	18.4	18.4	67.5
Designing Team	125	32.5	32.5	100.0
Total	385	100.0	100.0	
Company Type				
	Frequency	Percent	Valid Percent	Cumulative Percent
Building Construction	207	53.8	53.8	53.8
Finishing Work	72	18.7	18.7	72.5
MEP Work	64	16.6	16.6	89.1
Management	3	.8	.8	89.9
Design & Consultant	39	10.1	10.1	100.0
Total	385	100.0	100.0	

5.4. Reliability and Validity Analysis

A full test from 385 respondents was used to test the validity and reliability test. The 5% significance level was used with the level of significance for the two-tailed test. So, the df = n – 2 = 383 ➔ Critical values of the Person Product Moment Correlation Coefficient rxy is 0.195 for 5% significance. Below are the summary table results for the validity test with 385 samples

Table 5.2: Validity r-Value with Value Limit

ID	Quality of Construction Projects	rxy	r-table	Status
1	Stakeholder Involvement	.260	0.195	Valid
2	Project Funding	.348	0.195	Valid
3	Construction Materials	.210	0.195	Valid
4	Project Management Competence	.497**	0.195	Valid
5	Project Complexity	.340	0.195	Valid
6	Construction Disputes	.410*	0.195	Valid
7	Cambodian Law on Construction	.482**	0.195	Valid
8	Construction Quality Management System	.309	0.195	Valid

From the result analysis, all items are valid. The critical values of the Person Product Moment Correlation Coefficient rxy are all bigger than the r-table, which is equal to 0.195.

After the research instrument is declared the validity of the test, then the reliability test using method Alpha. The most common measure of reliability is the internal consistency of the scale. Cronbach's alpha was calculated to examine the internal consistency of the scales used in this study. Cronbach's alpha coefficient can range from 0.0 to 1.0 Sekaran (2003). The findings table below indicates the result of the full-scale survey.

Table 5.3: Cronbach's Alpha Value

Variables	Cronbach's Alpha	No. of Items	Comments
Stakeholder Involvement	0.683	7	Acceptable
Project Funding	0.735	9	Acceptable
Construction Materials	0.685	5	Acceptable
Management Competence	0.795	7	Good
Project Complexity	0.902	19	Good
Construction Disputes	0.933	19	High
Construction Law	0.835	9	Good
Construction Quality Management System	0.900	10	High
Quality of Construction Projects	0.791	6	Good
All items	**0.973**		**High**

The findings indicated all Cronbach's alpha for the full-scale survey was found to be 0.973. This means that the variables were reliable.

5.5. Non-Response Bias Test

Any survey has to be concerned with non-response bias. Non-response bias refers to a situation in which people who do not respond to a questionnaire have opinions that are systematically different from the opinions of those who do respond (Sharon, L., Minsun, K., & David, M., 2016). The non-response bias causes the sample to be unrepresentative of the population as a whole. Its error results from a failure to collect complete information on all units in the selected survey and it affects survey results, the decrease in sample size or the amount of information collected in response to a particular question results in larger standard errors (Sharon, L., Minsun, K., & David, M., 2016). We can run an independent Sample t-test in SPSS and compare the mean of both respondents. If the mean difference is not too high then non-response bias does not exist (Brick, J. M., Burke, J., & Lê, T., 2000). The mean difference depends on Sig, (2-tailed) values. If this is over 0.05

then the mean difference won't be too high and we can say that non-response bias does not exist. Tables show the result of the t-statistics and P-value of each construct.

Table 5.4: t-statistics & P-value with N192 early and late

Quality of Construction Projects	Mean	t-value	P-value
Satisfaction of contract specification	4.3177	.901	.369
	4.2604		
Completion of project on time	3.9844	1.095	.275
	3.9167		
Enhancing customer/owner satisfaction	4.1646	.063	.513
	4.1563		
Motivation and empowerment of employees	3.5938	-1.547	.124
	3.7344		
Avoid disputes and claims	3.7917	1.393	.165
	3.6927		
Performance-based purpose	3.8906	1.064	.289
	3.8333		

After analysis, there have 14 constructs with statistically significant differences between the mean response of these two groups of respondents. The 14 constructs are name with the P-value as shown:

- Project Funding: contractor's payment (0.041), defined project scope (0.006), sufficient product technical requirement (0.041), required quality standard (0.043), the sequence of project activities (0.043).
- Construction Materials: performance of quality tools (0.082).
- Project Management Competence: management commitment (0.046).
- Project Complexity: weather condition (0.031), involvement of different time-zones (0.043), lack of experience with partners (0.030).
- Construction Disputes: project participants with an unexpected condition (0.040).
- Cambodian Law on Construction: construction permit (0.027), construction is permitted before the start (0.014).
- Construction Quality Management System: insufficient project time (0.044)

The result shows there have eight constructs that have a sig.2-tailed value close to 0.05 (P-value from 0.40 to 0.46). Three of them have a sig.2-tailed value from 0.14 to 0.31. They are also slightly more likely to agree, and there has only one construct which has a P-value of 0.006 indicating response bias. In short, while these items are statistically different, the differences are quite small and generally would not affect the overall interpretation of the results. The full-scale survey can conclude that non-response bias is not a concern for this sample study. This means that these data should accurately reflect the opinions of respondents as a whole.

5.6. Normality Test

The normality test is very important based on the normality status, the measures of central tendency, dispersion, and selection of parametric/nonparametric test are decided. The assumption of normality needs to be checked for statistical procedures because their validity depends on it (Asghar, G., & Saleh, Z., 2012). For datasets small than 2000 elements, the Shapiro-Wilk test is used, otherwise, the Kolmogorov-Smirnov test is used. The values of asymmetry and kurtosis between -2 and +2 are considered acceptable to prove normal univariate distribution (George & Mallery, 2010). Hair et al. (2019) and Bryne (2010) argue that data is considered to be normal if skewness is between (-2 to +2), and kurtosis is between (-7 to +7).

Skewness & Kurtosis:

- Sample < 50: use the Z-value: -1.96 and +1.96 (For 95% reliability)
- Sample 50 < N < 300: use a more liberal Z-value: -3.29 and +3.29
- Sample N > 300: absolute skewness value between -2 and +2, Absolute kurtosis value between -7 and +7

However, the acceptable values of skewness fall between -3 and +3, and kurtosis is appropriate from a range of -10 to +10 when utilizing SEM (Brown, T.A., 2006). The tables below show the calculation of the value of Skewness and Kurtosis with the status consideration.

Quality of Construction Projects		Skewness			Kurtosis		
		Statistic	Std.Error	Value	Statistic	Std.Error	Value
1	Satisfaction of contract specifications	-.361	.124	(2.90)	-.094	.248	(0.38)
2	Completion of project with time	-.310	.124	(2.49)	1.668	.248	6.73
3	Enhancing customer/owner satisfaction	-.310	.124	(2.49)	-.575	.248	(2.32)
4	Motivation and empowerment of employees	-.312	.124	(2.51)	.820	.248	3.31
5	Avoid disputes and claims	-.320	.124	(2.57)	.649	.248	2.62
6	Performance based purpose	-.072	.124	(0.58)	.072	.248	0.29

Table 5.5: Skewness & Kurtosis Value

The findings show there have 10 constructs that have a value of skewness value out of the value limitation. Those constructs with the skewness value as the following:

- Project Complexity: interference between existing sites (-3.02), lack of experience in the country (-3.01), lack of resources & skills (3.02).
- Construction Disputes: anger, rudeness, and hatred toward other parties (-3.01), contract clause which unrealistically and unfairly shifted (-3.05), ambiguous contract provision (-3.04), over design by the design team (-3.01).
- Construction Quality Management System: insufficiency of project time (-3.01).
- Cambodian Law on Construction: construction is registered at the Board of Construction (-3.01), construction site is achieved the public security safety, and environment (-3.03).

However, these constructions are satisfied in kurtosis limitation. In addition, the values of skewness are just smaller than the limitation from ±0.3% to ±1.7% error. Thus, those constructs are most likely accepted in skewness limitation. In conclusion, the data retain the null hypothesis which means that the data is normally distributed. All the value of skewness is less than -1, which means that the distribution is highly skewed to the right.

5.7. Common Method Bias Test

Common Method Bias (CMB) occurs when the estimates of the relationships between two or more constructs are biased because they are measured with the same method (Podsakoff, P., & Organ, D., 1986). The CMB to assess independent variables and dependent variables is one of the sources of extraneous systematic error variance, distorting the true relationships between the variables and leading to measurement error (Bagozzi, R., & Yi, Y., 1988). Common method bias happens when variations in responses are caused by the instrument rather than the actual predispositions of the respondents that the instrument attempts to uncover. If the total variance extracted by one factor exceeds 50%, CMB is present in the study. In this study extraction sums of squared loadings of variance in a percentage equal to 31.946% which is less than the recommended threshold of 50%. In conclusion, there is no problem with common method bias in this data since the total variance extracted by one factor is less than 50%.

5.8. Mediator Preliminary Test

In this stage, we primarily test the two mediating variables, Cambodian law on construction, and the Construction quality management system. The purpose of doing this test is to ensure whether these two mediating variables can be included in the SEM model or not.

5.8.1. Cambodian Law on Construction

Step 1: Independent (X) Correlation to Mediation (M)

The correlation of height and weight (r = + 0.619), based on n = 385 observations with pairwise height (n = 385). The weight and height have a statistically significant linear relationship (r = + 0.619 > 0.195, p-value < 0.05). The direction of the relationship is a positive effect (i.e., height and weight are positively correlated), meaning that these variables tend to increase together (i.e., greater height is associated with greater weight). The magnitude or strength of the association is approximately *positive moderate* (+0.50 < r = +0.619 < +0.70).

Step 2: Dependent (Y) Correlation to Mediation (M)

The correlation of height and weight (r = + 0.553), based on n = 385 observations with pairwise height (n = 385). The weight and height have a statistically significant linear relationship (r = + 0.553 > 0.195, p-value < 0.05). The direction of the relationship is a positive effect (i.e., height and weight are positively correlated), meaning that these variables tend to increase together (i.e., greater height is associated with greater weight). The magnitude or strength of the association is approximately *positive moderate* (+0.50 < r = +0.553 < +0.70).

Step 3: Three Regression Analysis

- Model 1 (X to M): is significant, p-value 0.00 < 0.05
- Model 2 (X to Y): is significant, p-value 0.00 < 0.05
- Model 3 (X & M to Y): is significant, p-value 0.00 < 0.05

Therefore, we conclude that the variable Cambodian law on construction (M) partially mediates the X-Y relationship.

5.8.2. Construction Quality Management System

Step 1: Independent (X) Correlation to Mediation (M)

The correlation of height and weight (stakeholder involvement, r = + 0.250; project funding, r = + 0.688; construction materials, r = + 0.389; project management competence, r = + 0.638; project complexity, r = + 0.774) based on n = 385 observations with pairwise height (n = 385). The weight and height have a statistically significant linear relationship (r = + 0.619 > 0.195, p-value < 0.05). The direction of the relationship is a positive effect (i.e., height and weight are positively correlated), meaning that these variables tend to increase together (i.e., greater height is associated with greater weight). The magnitude or strength of the association is approximately *positive moderate* (+ 0.50 < r = + 0.619 < + 0.70).

Table 5.6: Correlations Coefficient (X & M)

Independent Variables (X)	**Mediating Variable (M)**	**Correlation Value**	**Status**
Stakeholder Involvement	Construction Quality Management System	+ 0.250	Positive Very Low
Project Funding		+ 0.688	Positive Moderate
Construction Materials		+ 0. 389	Positive Low
Project Management Competence		+ 0.638	Positive Moderate
Project Complexity		+ 0.774	Positive High

Step 2: Dependent (Y) Correlation to Mediation (M)

Table 5.7: Correlations Coefficient (Y & M)

		Cambodian Law on Construction	Quality of Construction Projects
Construction Quality Management System	Pearson Correlation	1	**.612****
	Sig. (2-tailed)		**.000**
	N	385	385
Quality of Construction Projects	Pearson Correlation	**.612****	1
	Sig. (2-tailed)	**.000**	
	N	385	385

**. Correlation is significant at the 0.01 level (2-tailed).

Correlation of height and weight (r = + 0.612), based on n = 385 observations with pairwise height (n = 385). The weight and height have a statistically significant linear relationship (r = + 0.612 > 0.195, p-value < 0.05). The direction of the relationship is a positive effect (i.e., height and weight are positively correlated), meaning that these variables tend to increase together (i.e., greater height is associated with greater weight). The magnitude or strength of the association is approximately *positive moderate* (+ 0.50 < r = + 0.612 < + 0.70).

Step 3: Three Regression Analysis

1. Independent (X) as the Predictor of Mediation (M)

Model Summary (X To M)						
Independent Variables	R	Adjusted R Square	Std. Error of the Estimate	Change Statistics		
				R Square Change	F Change	Sig. F Change
Stakeholder Involvement	.250[a]	.060	5.61575	.063	25.610	.000
Project Funding	.688[a]	.472	4.20858	.474	344.532	.000
Construction Material	.389[a]	.149	5.34264	.152	68.451	.000
Project Management Competence	.638[a]	.406	4.4672	.408	263.451	.000
Project Complexity	.774[a]	.599	3.670500	.600	573.473	.000

2. Independent (X) as the Predictor of Dependent (Y)

Model Summary (X To Y)						
Independent Variables	R	Adjusted R Square	Std. Error of the Estimate	Change Statistics		
				R Square Change	F Change	Sig. F Change
Stakeholder Involvement	.519[a]	.268	2.54718	.270	141.491	.000
Project Funding	.620[a]	.383	2.33826	.385	239.403	.000
Construction Material	.507[a]	.255	2.56863	.257	132.766	.000
Project Management Competence	.593[a]	.350	2.39962	.352	207.977	.000
Project Complexity	.601[a]	.360	2.38137	.362	217.072	.000

3. X and M as Predictors of Dependent (Y)

	Model Summary (X & M To Y)					
	R	Adjusted R Square	Std. Error of the Estimate	Change Statistics		
				R Square Change	F Change	Sig. F Change
Stakeholder Involvement + QMS	.719[a]	.515	2.07313	.518	204.890	.000
Project Funding + QMS	.671[a]	.447	2.21397	.450	156.125	.000
Construction Material + QMS	.678[a]	.457	2.19364	.460	162.588	.000
Project Management Competence + QMS	.666[a]	.441	2.22605	.444	152.366	.000
Project Complexity + QMS	.644[a]	.412	2.28255	.415	135.578	.000

- Model 1 (5Xs to M): is significant, p-value 0.00 < 0.05
- Model 2 (5Xs to Y): is significant, p-value 0.00 < 0.05
- Model 3 (5Xs & M to Y): is significant, p-value 0.00 < 0.05

We can conclude that the variable Construction Quality Management System (M) partially mediates the X-Y relationship.

5.9. Factor Analysis

We have two steps in Confirmation Factor Analysis (CFA). For the first step, we can see the full process detail on each factor in Appendix C: Factor Analysis; and the following table is the summary of CFA result individual in step 1.

Table 5.8: Summary of CFA Individual

Variables	**Construct Measurement before Analysis**	**Construction Measurement after Analysis**	**CFI**	**GFI**	**RMSEA**	**Status**
Stakeholder Involvement	7	3	1.00	1.00	--	perfect
Project Funding	9	3	1.00	1.00	0.462	poor
Construction Materials	5	4	0.965	0.988	0.097	excellent
Project Management Competence	7	6	0.913	0.950	0.126	good
Project Complexity	19	11	0.903	0.900	0.114	good
Construction Disputes	19	17	0.872	0.837	0.101	acceptable
Cambodian law on construction	9	7	0.820	0.877	0.173	acceptable
Construction Quality Management System	10	9	0.937	0.921	0.105	good
Quality of Construction Projects	6	6	0.913	0.950	0.123	good
	91	**66**				

CFA is performed for entire factors to evaluate the model after conducting CFA for every variable in the first step of the measurement model. In step 2 in conducting the full scales, items were weighted on their fitting factors and every factor was correlated with each other. The table below is the CFA result for the overall measurement model.

Table 5.9: CFA Model 1, Construction Quality Management System

Model 1	Constructs	CMIN/DF	GFI	CFI	RMSEA	Model Status
Initial Model Results	42	4.472 ≤ 5 OK	0.687 < 0.8 NO	0.730 < 0.8 NO	0.095 < 0.10 OK	unacceptable
2nd Model Results	41	4.520 ≤ 5 OK	0.691 < 0.8 NO	0.735 < 0.8 NO	0.096 < 0.10 OK	unacceptable
2nd Model Refined	41	3.994 ≤ 5 OK	0.746 < 0.8 NO	0.788 < 0.8 NO	0.088 < 0.10 OK	unacceptable
Final Refined Model Results	38	3.847 ≤ 5 OK	0.803 > 0.8 OK	0.814 > 0.8 OK	0.086 < 0.10 OK	acceptable

1. From the initial model test, 42 constructs, we see the values of GFI (0.687), and CFI (0.730) show an unacceptable fit of the measurement model. Therefore, the measurement model needs to improve. To improve the model, some items weighted below 0.50 is decided to be eliminated. There have items that need to be eliminated for this step such as QCP1 (0.490).
2. In the second model test, we see the value of GFI (0.691), and CFI (0.735) still show an unacceptable fit of the measurement model. Therefore, we need to refine the model even if the regression weight is higher than 0.5. In this issue, we need to do covariance modification indices to refine the model fit.
3. After refining the 2nd model, we need to eliminate some items CM1 (0.490), PMC4 (0.460), and QCP6 (0.490) for the final model fit.

In final model 1, we obtain Chi-Square (CMIN/DF) = 3.847 ≤ 5, Goodness of Fit Index (CFI) = 0.803 > 0.8, Comparative Fit Index (CFI) = 0.814 > 0.8, and Root Mean Square Error of Approximation (RMSEA) = 0.086 < 0.10. Thus, we can conclude that model 1 is fit.

Table 5.10: CFA Model 2, Cambodian Law on Construction

Model 2	Constructs	CMIN/DF	GFI	CFI	RMSEA	Model Status
Initial Model Results	30	5.418 > 5 NO	0.719 < 0.8 NO	0.732 < 0.8 NO	0.107 > 0.10 NO	unacceptable
2nd Model Results	27	5.348 > 5 NO	0.748 < 0.8 NO	0.769 < 0.8 NO	0.106 > 0.10 NO	unacceptable
Final Refined Model Results	27	4.420 ≤ 5 OK	0.811 > 0.8 OK	0.831 > 0.8 OK	0.094 < 0.10 OK	acceptable

1. From the initial model test, we see the values of CMIN/DF (5.418), GFI (0.719), CFI (0.732), and RMSEA (0.107) show an unacceptable fit of the measurement model. Therefore, the measurement model needs to be improved. To improve the model, some items that regression weighted below 0.50 is decided to be eliminated. There have items that need to be eliminated for this step such as CI1 (0.488), CI2 (0.430), and QCP1 (0.470).
2. In the second model test, we see the model is still an unacceptable fit for the measurement model. Therefore, we need to refine the model since the regression weight is higher than 0.5. In this issue, we need to do covariance modification indices to refine the model.

After refining the 2nd model, we obtain Chi-Square (CMIN/DF) = 4.420 ≤ 5, Goodness of Fit Index (CFI) = 0.811 > 0.8, Comparative Fit Index (CFI) = 0.831 > 0.8, and Root Mean Square Error of Approximation (RMSEA) = 0.094 < 0.10. Thus, we can state that model 2 is fit.

5.10. Reliability and Validity of Model Measurement

Structural Equation Modeling (SEM) is a set of statistical techniques used to measure and analyze the relationships between observed and latent variables. Similar but more powerful than regression analyses (Tanya, N., & Claudio, V., 2010); and it's specifically to test the structural model for the hypothesis framework in the research study. Xia, B., et al., (2015) have three steps to do as the following. Step 1 - Assess the reliability and validity of the model measurement, Step 2 - Structural model fit, and Step 3 - refined model measurement into SEM.

Appendix D – Full detail process of Reliability and Validity of Model Measurement

Reliability of Model Measurement

The following table shows the compound reliability (C.R) which has a value higher than the value of Cronbach's Alpha 0.7 and the meaning is that the measurement of internal consistency is closely related to a set of items as a group. In short, the measurements are reliable.

Table 5.11: Compound Reliability Value

Factors	$\Sigma(Load)^2$ (A)	Σ(Error) (B)	C.R A/(A+B)	Status
Stakeholder Involvement	3.54	0.84	0.81	OK
Project Funding	5.51	0.77	0.88	OK
Construction Materials	3.08	0.79	0.80	OK
Project Management Competence	9.73	1.74	0.85	OK
Project Complexity	60.76	3.83	0.94	OK
Construction Disputes	132.83	6.08	0.96	OK
Cambodian Law on Construction	10.73	1.77	0.86	OK
Construction Quality Management System	41.87	2.68	0.94	OK
Quality of Construction Projects	10.13	1.41	0.88	OK

Validity of Model Measurement

Karakaya-Ozyer, K., & Aksu-Dunya, B., (2018) Validity is defined as the accuracy of the outcome of a test. SEM analysis, it can be categorized into two major types.

Convergent Validity refers to the correlation between responses of different variables in assessing the same construct. It assures that variables are associated with the latent construct. The validity must be greater than or equal to 0.5 for its average value (Hamid, et al., 2017; Engellant et al., 2016; and Sujati, H., et al., 2020). The table below is the summary result for convergent validity. The AVE of the 9 factors can be accepted for the ultimate refined measurement model.

Table 5.12: Convergent Validity

Factors	AVE	Status
Stakeholder Involvement	0.501	OK
Project Funding	0.638	OK
Construction Materials	0.564	OK
Project Management Competence	0.530	OK
Project Complexity	0.502	OK
Construction Disputes	0.520	OK
Cambodian Law on Construction	0.550	OK
Construction Quality Management System	0.523	OK
Quality of Construction Projects	0.560	OK

Discriminant Validity or divergent validity refers to the degree to which the measures that should not be very highly correlated with each other are distinct. Correlating one construct to another could be used to show discriminant validity

(Sujati, H., et al., 2020). If the correlation value between the two constructs is less than the square root of the AVE value, discriminant validity exists (Engellant, et al., 2016). During the first analysis, even the convergent validity of the model measurement is satisfying yet the discriminant for some items is not satisfied. Some correlation coefficient value is bigger than correlation factors. Then we eliminate some constructs having square loading weight in lower values as indicated below.

Table 5.13: Square Root Loading of Convergent Validity

Factors	AVE	SqrtRoot.(AVE)
Stakeholder Involvement	0.501	0.708
Project Funding	0.638	0.799
Construction Materials	0.564	0.751
Project Management Competence	0.530	0.728
Project Complexity	0.502	0.709
Construction Disputes	0.520	0.721
Cambodian Law on Construction	0.550	0.742
Construction Quality Management System	0.523	0.723
Quality of Construction Projects	0.560	0.748

Some items need to eliminate to validate the discriminant validity.

1. Project Funding: *PRF5*
2. Project Management Competence: *PMC2*, *PMC4*
3. Project Complexity: *PRC15, PRC16, PRC17, PRC18*, and *PRC19*.
4. Construction Disputes: *CC3*, *CC4*, *CC5*, *CC12*, *CC13*, *CC15*, *CC16*, and *CC19*
5. Cambodian law on construction: *CL3*, and *CL8*
6. Construction Quality Management System: *QMS3*, *QMS4*, and *QMS6*
7. Quality Construction Projects: *QCP1*, and *QCP6*

After we reduced and re-analyzed the model to fit the two models.

Model 1: After eliminating those constructs, we observed that Model 1 still fit. CMIN/DF (4.124 < 5, OK), GFI (0.807 > 0.8, OK), CFI (0.841 > 0.8), and RMSEA (0.090 < 0.10), and the convergent validity of the 7 factors are still acceptable which value is bigger than 0.50.

Model 2: After eliminating those constructs, we observed that Model 2 still fit. CMIN/DF (4.493 < 5, OK), GFI (0.909 > 0.8, OK), CFI (0.921 > 0.8), and RMSEA (0.095 < 0.10), and the convergent validity of the 3 factors are still acceptable which value is bigger than 0.50.

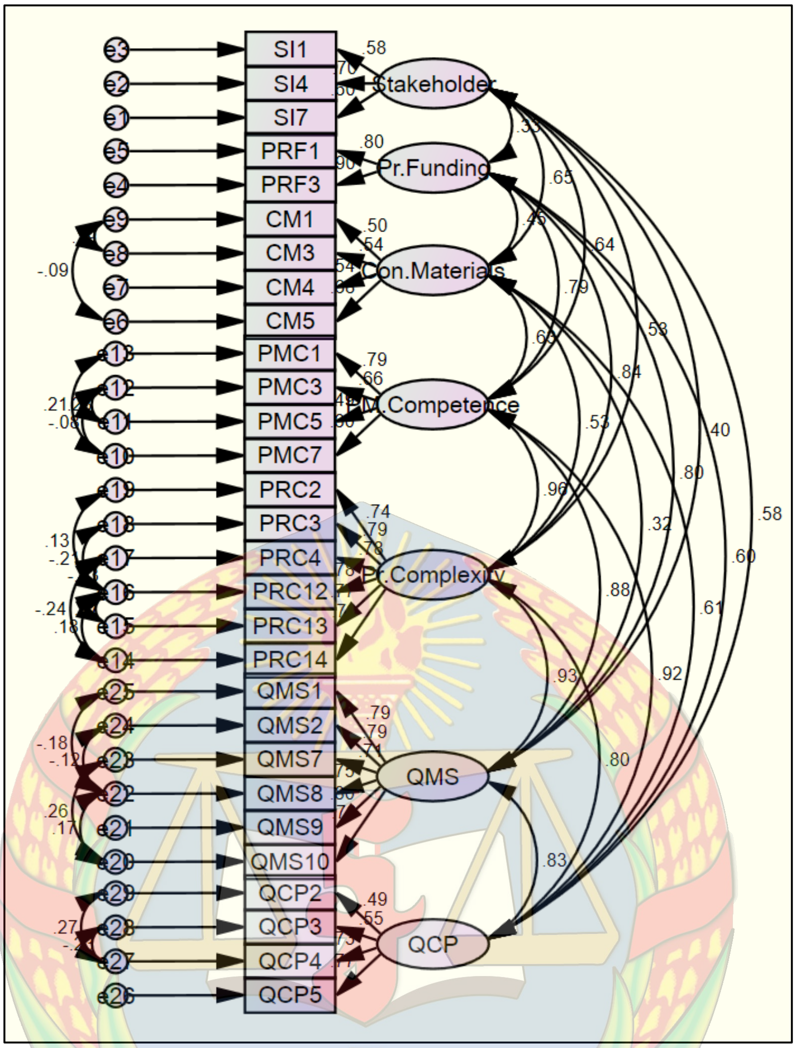
Table 5.14: New Square Root Loading of Convergent Validity

Factors	AVE	AVE (new)	Sqrt Root (AVE-new)
Stakeholder Involvement	0.501	0.501	0.708
Project Funding	0.638	0.670	0.820
Construction Materials	0.564	0.564	0.751
Project Management Competence	0.530	0.600	0.771
Project Complexity	0.502	0.590	0.771
Construction Disputes	0.520	0.570	0.757
Cambodian Law on Construction	0.550	0.640	0.802
Construction Quality Management System	0.523	0.600	0.773
Quality of Construction Projects	0.560	0.600	0.774

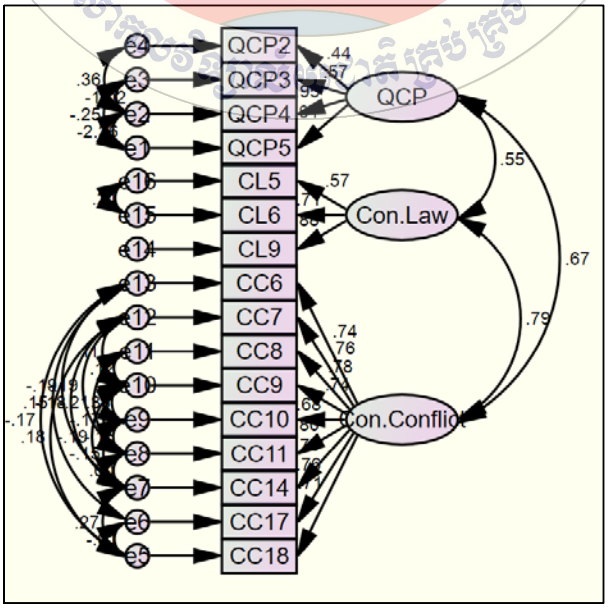
The value of correlation is better and can accept. From the table below, we can see that all correlation factor value is bigger than the corresponding correlation coefficient of the factor. We conclude that the study model is fit and satisfies validity both convergent and discriminant. Hence, the model is ok to measure in Structural Equation Model Analysis.

Table 5.15: Value Correlation Factor and Corresponding Correlation

	Stakeholder Involvement	Project Funding	Construction Materials	Project Management Competence	Project Complexity	Constructio n Disputes	Cambodian Law on Construction	Construction Quality Management System	Quality of Construction Project
Stakeholder Involvement	***0.708***								
Project Funding	0.330	***0.820***							
Construction Materials	0.645	0.447	***0.751***						
Project Management Competence	0.645	0.789	0.631	***0.771***					
Project Complexity	0.532	*0.819*	0.533	*0.760*	***0.771***				
Construction Disputes						***0.757***			
Cambodian Law on Construction						0.666	***0.802***		
Construction Quality Management System	0.402	0.800	0.321	*0.770*	*0.730*			***0.773***	
Quality of Construction Project	0.584	0.600	0.606	*0.718*	*0.703*	0.551	0.792	*0.731*	***0.774***



CFA Final Model 1-Construction Quality Management System



CFA Final Model 2-Cambodian Law on Construction

5.11. Structural Equation Model Observation and Evaluation

The predicting capability of the model can be done by the sum of the variance of independent variables in the dependent variables (Xia, B., et al., 2015). The superior value is assumed by most potential. In SEM analysis, the value of variances is calculated by squared multiple correlations associated with dependent variables. Squared multiple correlations (R) are called the coefficient of determination which is defined as the proportion of the total variation explained by the model. In the AMOS model, symbol representations following: F1-Stakeholder Involvement, F2-Project Funding, F3-Construction Materials, F4-Project Management Competence, F5-Project Complexity, F6-Construction Quality Management System, F7-Quality of Construction Projects, F8- Construction Disputes, and F9-Cambodian Law on Construction

Table 5.16: Table of Squared Multiple Correlations

Constructs	Estimate
F9	.606
F6	.859
F7	.835
Registered Construction at the Board of Construction	.385
Design Document Signed By License Designer	.555
Operations Site Have the License Engineer Check Quality	.727
Fraud and Faith in Works	.534
Impolite and Lack of Courtesy Among Each Professional Parties	.596
Desire to be Always Rights on the Option Given	.616
Anger Rudeness and Hatred Toward Other Parties	.595
Disputes Over Payment	.489
Miscalculations and Over Calculations	.552
Over Design by Design Team	.522
Late Instruction from the Designer	.581
Unrealistic Clients Expectation	.550
Completion Project Time	.210
Enhancing Customer Satisfaction	.190
Motivation Empowerment Employees	.453

Constructs	Estimate
Avoid Disputes and Claims	.484
Lack of Employee Involvement	.536
Difficulties Cooperation Middle Manager Quality	.539
Lack Communication Routes	.458
Lack of Cooperation from Suppliers	.472
Lack of Top Management Involvement	.582
Lack of External Advisers Properly Qualified	.534
Number of Locations	.549
Interference between Existing Sites	.597
Number of Different Languages	.572
Involvement of Different Time Zones	.629
Political Influences	.631
Lack of Experience in the Country	.590
Conflict Management	.631
Motivation	.425
Effective Project Management System	.288
Solution Development	.456
Source of Materials	.233
Cost of Materials	.320
Material or Equipment Specification	.279
Quality of Materials	.479
Construction Schedule Due to Owner	.763
Project Cost Estimation	.676
Engineer Involvement	.373
Sub-Contractor Involvement in Project	.403
Supplier	.415

Hair et al., (2019) suggest that loadings of the items should be at least 0.50 and ideally 0.70. Higher loadings indicate that items are strongly related to latent variables. In more extension, the value which is lower than 0.25 shall remove. The squared multiple correlations of dependent variables of the study are shown in the table given below. It shows a good relationship between IVs and DV.

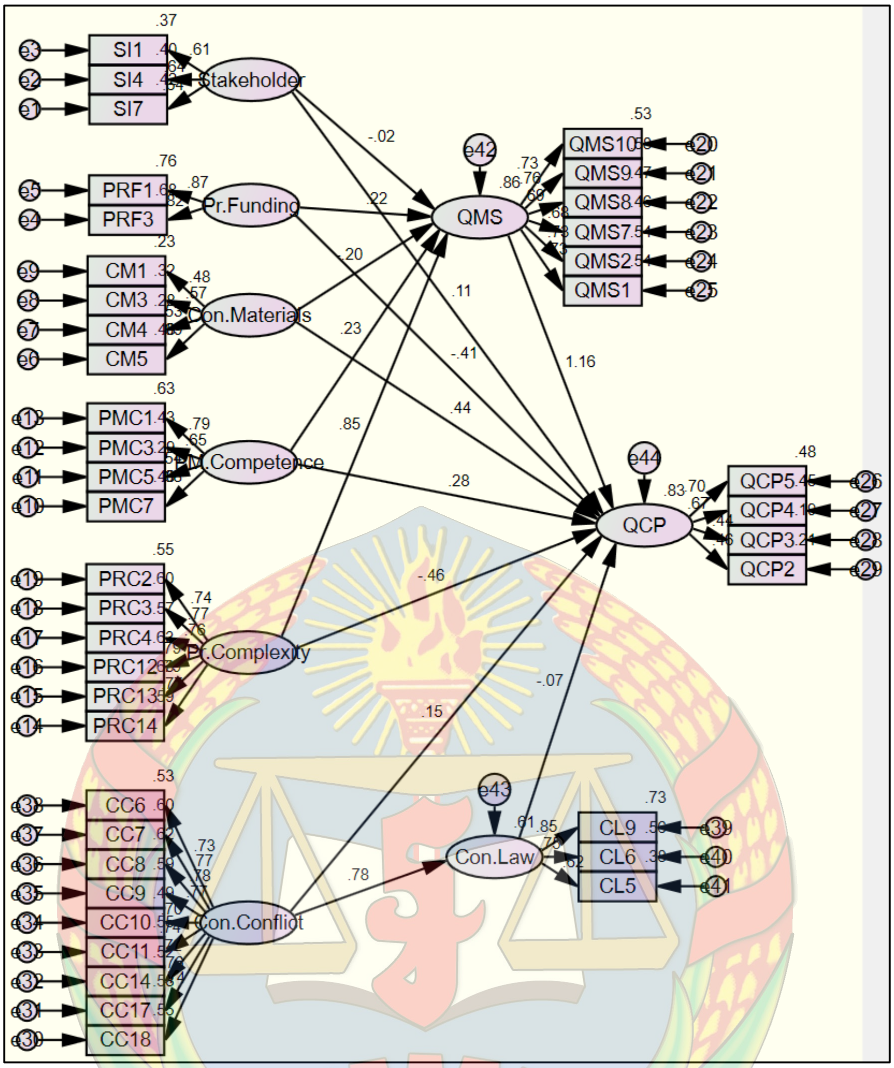


Figure: Structural Equation Model after CFA

Table 5.17: Squared Multiple Correlation

Dependent Variables	Independent Variables	Squared Multiple Correlation (R)
Construction Quality Management System	Stakeholder Involvement Project Funding Construction Materials Project Management Competence Project Complexity	0.859
Cambodian Law on Construction	Construction Disputes	0.606
Quality of Construction Projects	Stakeholder Involvement Project Funding Construction Materials Project Management Competence Project Complexity Construction Disputes	0.835

5.12. Hypothesis Testing and Results

In this section, to test the hypotheses of the study, the P-value of the SEM result needs to be considered. Each hypothesis statement of the study was tested. The hypothesis statement is considered significant unless the P-value is less than 0.05, and partially significant when the P-value is between 0.05 to 0.10 (Barbara, M., 2010).

Table 5.18: The Summary Result of the P-value from the SEM

			Estimate	S.E.	C.R.	**P-value**	Status
F6	*<---*	*F1*	*-.021*	*.051*	***-.420***	***.675***	*Insignificant*
F6	<---	F2	.168	.029	**5.731**	*******	*Significant*
F6	<---	F3	-.259	.055	**-4.682**	*******	*Significant*
F6	<---	F4	.257	.045	**5.658**	*******	*Significant*
F6	<---	F5	.654	.048	**13.500**	*******	*Significant*
F9	<---	F8	.887	.068	**13.069**	*******	*Significant*
F7	*<---*	*F1*	*.126*	*.071*	***1.776***	***.076***	*Partial Sig*.
F7	<---	F2	-.284	.058	**-4.855**	*******	*Significant*
F7	<---	F3	.495	.109	**4.534**	*******	*Significant*
F7	<---	F4	.276	.086	**3.223**	**.001**	*Significant*
F7	<---	F5	-.318	.159	**-1.998**	**.046**	*Significant*
F7	*<---*	*F8*	*.116*	*.071*	***1.639***	***.011***	*Significant*
F7	<---	F6	1.029	.237	**4.338**	*******	*Significant*
F7	*<---*	*F9*	*-.050*	*.065*	***-.777***	***.086***	*Partial Sig.*

Stakeholder Involvement

In the result of SEM, the P-value of F6 (Construction Quality Management System) and F1 (Stakeholder Involvement) is 0.675 > 0.05 (Insignificant). So hypothesis H1B is rejected. The P-value of F7 (Quality of Construction Projects) and F1 (Stakeholder Involvement) is 0.076 > 0.05, but 0.076 < 0.10 (Partially significant or we can say P-value 0.065 < 0.10 significant in the level of reliability of 90%). So hypothesis H1A is accepted in the level of reliability of 90%.

H1A: *Stakeholder Involvement has a partially significant influence on the Quality of Construction Projects.*

H1B: *Construction Quality Management System doesn't play a role as a mediation between Stakeholder Involvement and the Quality of Construction Projects.*

Project Funding

In the result of SEM, the P-value of F6 (Construction Quality Management System) and F2 (Project Funding) is *** (Significant representative). So hypothesis H2B is rejected null. The P-value of F7 (Quality of Construction Projects) and F2 (Project Funding) is *** (Significant representative) the hypothesis H2A also rejects null.

H2A: *Project Funding has a great impact on the Quality of Construction Projects.*

H2B: *Construction Quality Management System roles as a full mediation between Project Funding and the Quality of Construction Projects.*

Construction Materials

In the result of SEM, the P-value of F6 (Construction Quality Management System) and F3 (Construction Materials) is *** (Significant representative). So hypothesis H3B accepts an alternative. The P-value of F7 (Quality of construction projects) and F3 (Construction Materials) is *** (Significant representative) that we accept alternative hypothesis H3A.

H3A: *Construction Materials influence the Quality of Construction Projects.*

H3B: *Construction Quality Management System functions as a partial mediation between Construction Materials and the Quality of Construction Projects.*

Project Management Competence

In the result of SEM, the P-value of F6 (Construction Quality Management System) and F4 (Project Management Competence) is *** (Significant representative). So hypothesis H4B is rejected the null hypothesis. The P-value of F7 (Quality of Construction Projects) and F4 (Project Management Competence), is $0.001 < 0.05$ (Significant). So hypothesis H4A also rejects null.

H4A: *Project Management Competence influences the Quality of Construction Projects.*

H4B: *Construction Quality Management System functions as a partial mediation between Project Management Competence and the Quality of Construction Projects.*

Project Complexity

In the result of SEM, the P-value of F6 (Construction Quality Management System) and F5 (Project complexity) is *** (Significant representative). So hypothesis H5B is rejected null. The P-value of F7 (Quality of Construction Projects) and F5 (Project Complexity), is 0.046 < 0.05 (Significant). So hypothesis H5A is an acceptable alternative.

H5A: *Project Complexity has a significant influence on the Quality of Construction Projects.*

H5B: *Construction Quality Management System functions as a partial mediation between Project Complexity and the Quality of Construction Projects.*

Construction Disputes

In the result of SEM, the P-value of F9 (Cambodian Law on Construction) and F8 (Construction Disputes) is *** (Significant representative). So hypothesis H6B is an acceptable alternative, and the P-value of F7 (Quality of Construction Projects) and F8 (Construction Disputes) is 0.011 ≅ 0.010 < 0.05 (Significant).

H6A: *Construction Disputes has a significance influence on the Quality of Construction Projects.*

H6B: *Cambodian Law on Construction roles as a partial mediation between Construction Disputes and the Quality of Construction Projects.*

Construction Quality Management System

In the result of SEM, the P-value of F6 (Construction Quality Management System) and F7 (Quality of Construction Projects) is *** (Significant). So hypothesis H7 is an acceptable alternative.

H7: *Construction Quality Management System has a great significant impact on the Quality of Construction Projects.*

Cambodian Law on Construction

In the result of SEM, the P-value of F9 (Cambodian Law on Construction) and F7 (Quality of Construction Projects) is 0.086 > 0.05 but lower than 0.10. It is significant in the level of reliability of 90%. So hypothesis H8 accepts an alternative with a level of reliability of 90%.

H8: *Cambodian Law on Construction has a partial significant influence on the Quality of Construction Projects.*

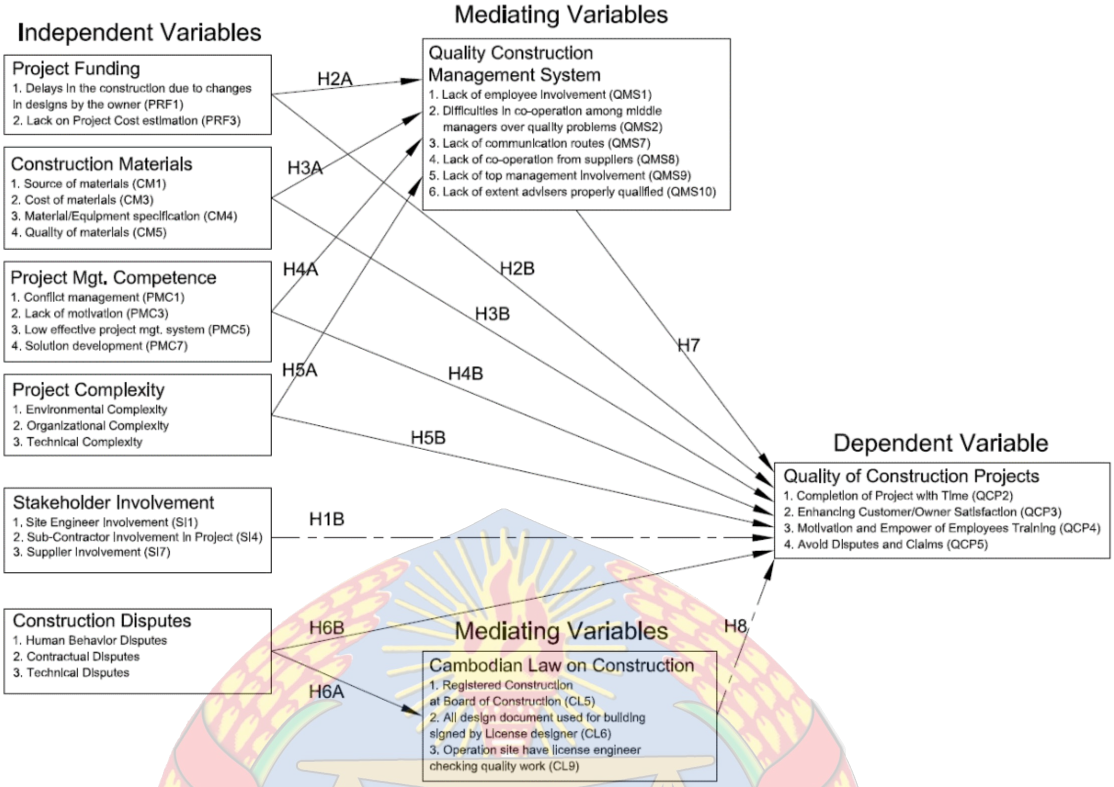


Figure: Final Model Framework of the Study

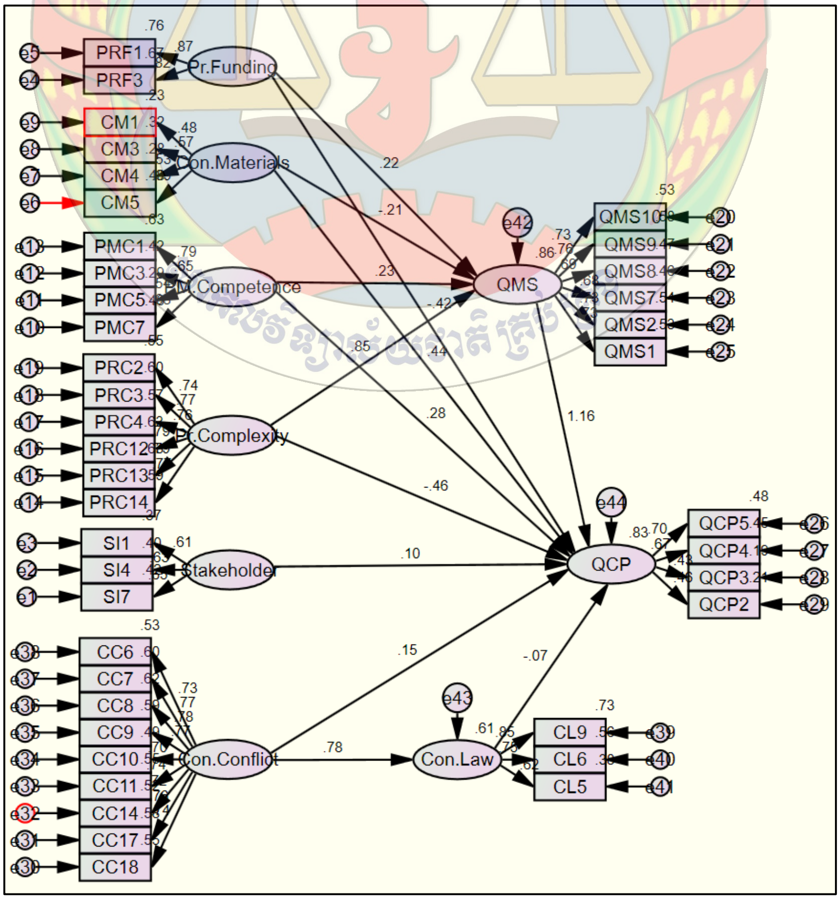


Figure: Final Model after Hypothesis Testing

5.13. Mediator Final Check

The study used to check the mediator of variable Construction Quality Management System and Cambodian Law on Construction. Through the CFA, Reliability & Validity of the model measurement, and structural equation model, the researcher dropped many constructs to fit the model, and also hypotheses confirmation on the independent variable (Stakeholder Involvement) shown insignificant on Construction Quality Management System, and partially significant to the dependent variable; therefore, the study need to recheck whether the two mediators still partially mediate to the X-Y relationship. Once again, the process of checking the mediator is the same as in section 5.8.

Cambodian Law on Construction

Step 1: Independent (X) Correlation to Mediation (M)

Table 5.19: Correlation Coefficient (X & M)

		Construction Disputes	Cambodian Law on Construction
Construction Disputes	Pearson Correlation	1	.644**
	Sig. (2-tailed)		.000
	N	385	385
Cambodian Law on Construction	Pearson Correlation	.644**	1
	Sig. (2-tailed)	.000	
	N	385	385

**. Correlation is significant at the 0.01 level (2-tailed).

The correlation between height and weight is still moderate (r = + 0.644), and the weight and height have a statistically significant linear relationship (r = + 0.644 > 0.195, p-value, 0.000 < 0.05). The direction of the relationship is still a positive effect (i.e., height and weight are positively correlated), meaning that these variables tend to increase together (i.e., greater height is associated with greater weight), and the magnitude or strength of the association is approximately *positive moderate* (+ 0.50 < r = + 0.644 < + 0.70).

Step 2: Dependent (Y) Correlation to Mediation (M)

The correlation between height and weight is still moderate (r = + 0.504). The weight and height have a statistically significant linear relationship (r = + 0.504 > 0.195, p-value, 0.000 < 0.05). The direction of the relationship is a positive effect (i.e., height and weight are positively correlated), meaning that these variables tend to increase together (i.e., greater height is associated with greater weight), and the magnitude or strength of the association is approximately positive moderate (+ 0.50 < r = + 0.504 < + 0.70).

Table 5.20: Correlation Coefficient (Y & M)

		Cambodian Law on Construction	Quality of Construction Projects
Cambodian Law on Construction	Pearson Correlation	1	.504**
	Sig. (2-tailed)		.000
	N	385	385
Quality of Construction Projects	Pearson Correlation	.504**	1
	Sig. (2-tailed)	.000	
	N	385	385

**. Correlation is significant at the 0.01 level (2-tailed).

Step 3: Three Regressions Analysis

Independent (X) as the Predictor of Mediation (M)						
				Change Statistics		
	R	**Adjusted R Square**	**Std. Error of the Estimate**	**R Square Change**	**F Change**	**Sig. F Change**
Construction Disputes	.644[a]	.414	1.64596	.415	272.029	**.000**

Independent (X) as the Predictor of Dependent (Y)						
				Change Statistics		
	R	**Adjusted R Square**	**Std. Error of the Estimate**	**R Square Change**	**F Change**	**Sig. F Change**
Construction Disputes	.614[a]	.376	1.78580	.377	231.945	**.000**

X and M as Predictors of Dependent (Y)						
				Change Statistics		
	R	**Adjusted R Square**	**Std. Error of the Estimate**	**R Square Change**	**F Change**	**Sig. F Change**
Construction Disputes + Cambodian Law on Construction	.630[a]	.394	1.75933	.397	125.794	**.000**

- Model 1 (X to M): is significant, p-value 0.000 < 0.05
- Model 2 (X to Y): is significant, p-value 0.000 < 0.05
- Model 3 (X & M to Y): is significant, p-value 0.000 < 0.05, and the X to Y still significant relation.

We can conclude that the variable Cambodian Law on Construction (M) partially mediates the X-Y relationship.

Construction Quality Management System

Step 1: Independent (X) Correlation to Mediation (M)

Table 5.21: Correlation Coefficient (X & M)

Independent Variables (X)	Mediating Variable (M)	Correlation Value	Status
Project Funding	Construction Quality Management System	+ 0.588	Positive Moderate
Construction Materials		+ 0.265	Positive Very Low
Project Management Competence		+ 0. 695	Positive Moderate
Project Complexity		+ 0.838	Positive High

Step 2: Dependent (Y) Correlation to Mediation (M)

Table 5.22: Correlation Coefficient (Y & M)

		Cambodian Law on Construction	Quality of Construction Projects
Construction Quality Management System	Pearson Correlation	1	**.654****
	Sig. (2-tailed)		**.000**
	N	385	385
Quality of Construction Projects	Pearson Correlation	**.654****	1
	Sig. (2-tailed)	**.000**	
	N	385	385

**. Correlation is significant at the 0.01 level (2-tailed).

The correlation between height and weight is still high (r = + 0.654). The weight and height have a statistically significant linear relationship (r = + 0.654 > 0.195, p-value < 0.05). The direction of the relationship is a positive effect (i.e., height and weight are positively correlated), meaning that these variables tend to increase together (i.e., greater height is associated with greater weight), and the magnitude or strength of the association is approximately positive moderate (+ 0.50 < r = + 0.654 < + 0.70).

Step 3: Three Regression Analysis

Independent (X) as the Predictor of Mediation (M)						
Independent Variables	**R**	**Adjusted R Square**	**Std. Error of the Estimate**	**Change Statistics**		
				R Square Change	**F Change**	**Sig. F Change**
Project Funding	.588[a]	.344	3.18625	.346	202.638	**.000**
Construction Material	.265[a]	.068	3.79917	.070	28.918	**.000**
Project Management Competence	.695[a]	.482	2.83216	.483	358.229	**.000**
Project Complexity	.838[a]	.701	2.15294	.701	899.702	**.000**

Independent (X) as the Predictor of Dependent (Y)						
Independent Variables	**R**	**Adjusted R Square**	**Std. Error of the Estimate**	**Change Statistics**		
				R Square Change	**F Change**	**Sig. F Change**
Project Funding	.465[a]	.131	2.10691	.133	58.785	**.000**
Construction Material	.432[a]	.185	2.04038	.187	88.064	**.000**
Project Management Competence	.653[a]	.425	1.71330	.427	285.085	**.000**
Project Complexity	.625[a]	.388	1.76721	.390	244.949	**.000**

X and M as Predictions of Department (Y)						
	R	**Adjusted R Square**	**Std. Error of the Estimate**	**Change Statistics**		
				R Square Change	**F Change**	**Sig. F Change**
Project Funding + QMS	.655[a]	.426	1.71243	.429	143.385	**.520/ .000**
Construction Material + QMS	.707[a]	.498	1.60157	.500	191.279	**.000/ .000**
Project Management Competence + QMS	.710[a]	.502	1.59519	.504	191.343	**.000**
Project Complexity + QMS	.669[a]	.445	1.68366	.448	154.908	**.000**

We can conclude that the variable Construction Quality Management System (M) completely mediates the X (Project Funding) and Y (Quality of Construction Projects) relationship. In contrast, partially mediates the X-Y relation on independent variables such as Construction Materials, Project Management Competence, and Project Complexity.

5.14. Summary of Hypothesis

After getting results from the analysis with the P-value in SEM, we can conclude the hypothesis of the study as shown in table below.

Table 5.23: Summary of Hypothesis

	Hypothesis	P-Value	Status
H1A	Stakeholder Involvement has a significant influence on the Quality of Construction Projects.	0.076	Partial Significant
H1B	Construction Quality Management System mediates between Stakeholder Involvement and the Quality of Construction Projects.	0.675	Insignificant
H2A	Project Funding has a great impact on the Quality of Construction Projects.	***	Significant
H2B	Construction Quality Management System has a positive interrelation between Project Funding and the Quality of Construction Projects.	***	Significant
H3A	Construction Materials influence the Quality of Construction Projects.	***	Significant
H3B	Construction Quality Management System has a positive mediate between Construction Materials and the Quality of Construction Projects.	***	Significant
H4A	Project Management Competence influence the Quality of Construction Projects.	0.001	Significant
H4B	Construction Quality Management System has a positive mediate between Project Management Competence and the Quality of Construction Projects.	***	Significant
H5A	Project Complexity has a significant influence on the Quality of Construction Projects.	0.046	Significant
H5B	Construction Quality Management System has an interrelation between Project Complexity and the Quality of Construction Projects.	***	Significant
H6A	Construction Disputes has a significant influence on the Quality of Construction Projects.	0.011	Significant
H6B	Cambodian Law on Construction roles as mediation between the Quality of Construction Projects and Construction Disputes.	***	Significant
H7	Construction Quality Management System has a great impact on the Quality of Construction Projects.	***	Significant
H8	Cambodian Law on Construction has a significant influence on the Quality of Construction Projects.	0.086	Partial Significant

5.15. Results Confirmation by In-Depth Interview

After getting results from the analysis, results confirmation needs to be conducted. In this stage, the researcher uses an In-Depth Interview with 10 respondents to check the result whether the overview from the response is the same as the study findings or not. An interview takes not over an hour for each respondent and the taping was recorded in voice for do not miss any of the answers, some did not allow to record the voice. The table below lists some questions related to the results of this study. Most questions are closed-ended questions rather than open-ended questions.

Table 5.24: Yes/No Question for Confirmation Analysis

No	Constructs effect on the Quality of Construction Projects
1	**Stakeholder Involvement** a. Site engineer involvement (0.610) b. Sub-contractor involvement (0.635) c. Supplier involvement (0.646)
2	**Project Funding** a. Project cost estimate (0.822) b. Construction Schedule due to change in designs by owner (0.874)
3	**Construction Materials** a. Source of materials (0.483) b. Materials/Equipment specification (0.529) c. Cost of materials (0.566) d. Quality of materials (0.692)
4	**Project Management Competence** a. Effective project management system (0.536) b. Motivation (0.652) c. Solution development (0.676) d. Conflict management (0.795)
5	**Project Complexity** *Environmental Complexity* a. Number of locations (0.741) b. Number of different languages (0.756) c. Interferences between sites (0.773) *Organizational Complexity* d. Involvement of different time zones (0.793) e. Political influences (0.794) *Technical Complexity* f. Lack of experience in the country (0.768)
6	**Construction Disputes** *Human Behavior* a. Fraud and faith in work (0.730) b. Hatred toward other parties (0.771) c. Impolite and lack of courtesy among each professional party (0.772)

	d. Desire to be always right on the opinion given (0.785) *Contractual Conflict* e. Dispute over payment (0.699) f. Overdesign by the design team (0.723) g. Miscalculation and over-calculations (0.743) *Technical Conflict* h. Unrealistic client expectations (0.741) i. Late instruction from the designer (0.762)
7	**Construction Quality Management System** a. Lack of communication routes (0.676) b. Lack of cooperation from the supplier (0.686) c. Lack of extent advisers properly qualified (0.730) d. Lack of employee involvement (0.731) e. Difficulties in cooperation among middle managers over quality problems (0.733) f. Lack of top management involvement (0.763)
8	**Cambodian Law on Construction** a. Construction is registered at the Board of Construction (0.620) b. All design documents used for the buildings are signed by the licensed designer (0.745) c. Operation site has a licensed engineer checking quality work (0.825)
9	**Quality of Construction Projects** a. Enhancing customer/owners satisfaction (0.435) b. Complete the project on time (0.458) c. Motivation and empowering employees training (0.672) d. Avoid disputes and claims (0.695)
A	*Please tick if you agree that those constructs/factors influence the Quality of construction projects, and cross if you don't agree. Have you any idea else?*
B	*Do you agree on the important order weight score on each construct? If not, could you re-order in base on your opinion?*
C	*For Item (7), Construction Quality Management System. We found this factor plays a role as a mediator between (Project Funding, Construction Materials, Project Management Competence, and Project Complexity) and the Quality of construction projects. Do you agree or not?*
D	*For Item (8) Cambodian Law on Construction. We also found this factor plays a role as a mediator between Construction Conflict and the Quality of construction projects.*
E	*Do you agree that, when we overcome the barrier of difficulties in the Construction Quality Management System, the Quality of Construction Projects will be better?*
F	*Do you agree that, when we manage the Construction Law, the Quality of Construction Projects will be better by reducing conflict and avoidance of claims and disputes?*

In the result of the in-depth interview, all participants agreed with the constructs that the study found, all influence the quality of construction projects. Most respondents agree with the order of influence weight on each factor, few respondents have no idea on this point. Moreover, they all strongly support the Construction quality management system and Cambodian law on construction work as the mediation between the independent variables and dependent variables. In conclusion, the result of the in-depth interview strongly supports the result of the study.

5.16. Discussion

The discussion of the results is divided into nine parts: (1) Stakeholder Involvement, (2) Project Funding, (3) Construction Materials, (4) Project Management Competence, (5) Project Complexity, (6) Construction Disputes, (7) Construction Quality Management System, (8) Cambodian Law on Construction, and (9) Quality of Construction Projects. The research is discussed in the context of the literature reviewed in Chapter Two, to further explain the findings in the case of local Cambodian construction companies.

Stakeholder Involvement

The research results show that stakeholder involvement does not affect the construction quality management system, but it has a partial effect on the quality of construction projects. The results show most likely support for Deming (1986) that declares the value of key participants of projects as a source of information to achieve desired levels of quality; and also Tam & Le (2007) indicate the roles of stakeholders in improving project quality. In addition, the P-value (0.065 < 0.10) shows significance in the level of reliability of 90% with the t-value (C.R. = Estimate/S.E. = 1.776 > 0) means that there is a little significant difference with the values to the right of the mean. This means that when improving stakeholders in construction projects can achieve the desired level of quality in construction projects too. Moreover, the results find the three most important factors as the key participants in stakeholder which contribute to the quality of construction projects from less to high influence respectively: site engineer involvement (0.610), sub-contractor involvement (0.635), and supplier involvement (0.646).

Project Funding

Based on the research findings show that project funding significantly influences the construction quality management system and the quality of construction projects. The results strongly support previous authors as Chan et al (2002) indicate the effect of project funding on the quality of projects, is mostly the cause of delays in the construction, and also Evelyn (2017) and Jean et al., (2015) also show the effect to the quality of construction projects due to the cost estimation. In addition, the results find two most important factors: construction schedule due to changes in designs by the owner (0.874) and project cost estimate (0.822). Moreover, construction quality management systems with P-value (*** < 0.05) and t-value (5.731) mean that there is a great significant difference with the values to the right of the mean. For the quality of construction projects, the P-value (*** < 0.05) with the negative t-value (-4.855) also means that there is a great significant difference with the value to the right of the mean. Since the constructs in project funding are negative meaning. This means when improving the project funding by minimizing design changes due to owner and more accuracy in an estimate of the project cost, the quality of construction projects would meet the customer's needs.

Construction Materials

The research studies show that construction materials significantly influence both the construction quality management system and the quality of construction projects. The studies show positive support for previous studies as Aliverdi, Naeni, and Salehipour (2013) that indicate construction materials impact the project quality. In addition, another study by Oke, A.E., (2006) also shows the impact of poor quality of construction materials and workmanship on the quality of construction projects. Olusola et al., (2002) also indicate the source of material from suppliers impact the quality of construction project. The studies find the four most important parts of construction materials that affect the quality of construction projects with the less to high influence respectively, source of materials (0.483), cost of materials (0.566), material/equipment specification (0.529), and quality of materials (0.692). Moreover, the studies also show a positive relation between construction to construction quality management system with P-value (*** < 0.05) and t-value (-4.682). The t-value shows a negative sign since the meaning of construction quality management systems is negative meaning while the construction materials are positive meaning. However, the construction materials and the quality of construction projects show positive significant relation with the P-value (*** < 0.05) and t-value (4.534). This means that there is a great significant difference with the value to the right of the mean. In short, when improving construction materials and managing them well, the quality of construction projects also improves.

Project Management Competence

The studies show that project management competence is significant in both construction quality management system and the quality of construction projects. Much support from previous authors as Wambugu (2013) that indicate lack of project management competence in supervision and review work would improve poor workmanship and prompt to postponed finish construction projects as a result of poor quality of projects. Evelyn (2017) also proposes four key important factors affecting project quality which are as the study findings as conflict management (0.795), motivation (0.652), effective project management system (0.536), and solution development (0.676). In addition, the studies show a positive relation between project management competence and construction quality management system with a P-value (*** < 0.05) and t-value (5.658), and also positive relation to the quality of construction projects with a P-value (0.001 < 0.05) and t-value (3.223). This means that there is a great significant difference with the value to the right of the mean. In conclusion, when improving project management competence, the quality of construction projects also improves too.

Project Complexity

The studies show that project complexity is significant in both the construction quality management system and the quality of construction projects. The studies show positive support for previous authors as Minh & Yingbin (2019) that indicate project complexity significantly influences the quality of construction projects. Further study by Laurikkala, H., et al., (2001) also indicate that organization, which is a part of project complexity, affects the quality of construction that strongly support the research finding. In addition, many authors Vidal & Marle (2008), and Williams, T., (2002), Baccarini, D., (1996), Abdou, Kuan, S.M., Kuan, Y., & Mohammed, O., (2016) also determine the effect of project complexity on the quality of construction projects. The studies find there have three major factors affecting the quality of construction projects such as environmental complexity, organizational complexity, and technical complexity. In addition, the studies also find key constructs in each of those factors with the less influence to the high influence respectively as the following:

- Environmental complexity: number of locations (0.741), interference between existing sites (0.773), and number of different languages (0.756).
- Organizational complexity: involvement of different time zone (0.793), and political influences (0.794).
- Technical complexity: lack of experience in the country (0.768).

The studies show a great positive relation between project complexity and construction quality management system with a P-value (*** < 0.05) and t-value (13.500). In addition, it also shows a positive relation between project complexity and the quality of construction projects with a P-value (0.046 < 0.05) with a t-value (-1.998). The t-value show in negative sign since the project complexity meaning is negative meaning. This means that there is a significant difference with the value to the right of the mean. Thus, improving project complexity by minimizing the complexity not only organizational and technical but also environmental in the project would increase the quality desire level in construction projects.

Construction Disputes

The studies show construction disputes have a positive significant influence on Cambodian law on construction and also significant to the Quality of construction projects. Many previous studies support these findings such as Jaffa, N., et al., (2011) indicate that disputes affect the Quality of construction projects on project cost, project delay, reduce productivity, loss of profit, and damage to business relationship. Three major points finding in this research such as human behavior disputes, contractual disputes, and technical disputes, support Jaffar, N., et al., (2011), Williamson, O., (1979), Cakmak, E., & Cakmak, P.I., (2014) that define these three points as the key largest root cause of disputes impact the quality of construction projects. In addition, the studies also find many constructs that affect these three factors.

- Human behavior disputes: fraud and faith in work (0.730), impolite and lack of courtesy among each professional party (0.772), desire to be always right on the opinion given (0.785), and anger, rudeness, and hatred toward other parties (0.771).
- Contractual dispute: dispute over payment (0.699), miscalculation and over calculations (0.743), and over design by the design team (0.723).
- Technical disputes: late instruction from the designer (0.762), and unrealistic client expectations (0.741).

The studies show a great positive relation between construction disputes and Cambodian law on construction with a P-value (*** < 0.05) and t-value (13.069). In addition, also show a positive relation between construction disputes and the quality of construction projects with a P-value (0.011 < 0.05) and t-value (1.639). This means there is a significant difference with the value to the right of the mean. Thus, to improve the quality of construction projects, we have to minimize the disputes in construction.

Construction Quality Management System

The studies show construction quality management system positive influence on the quality of construction projects. Its roles fully mediate between the quality of construction projects and project funding whiles partially mediating between construction material, project management competence, and project complexity. The studies also find many factors that impact the quality of construction projects such as: Lack of employee involvement (0.731), Difficulty in cooperation among middle managers over quality problems (0.733), Lack of communication routes (0.676), Lack of cooperation from the supplier (0.686), Lack of top management involvement (0.763), and Lack of extent advisers properly qualified (0.730).

Based on the results, many authors strongly support these findings. Coffey, V., Willar, D., & Trigunarsyah, B., (2011) indicate the effectiveness of construction quality management system impact on the demands of customer satisfaction meanwhile Mark, K., & Ali, R., (2019) also support that the construction quality management system has a positive effect on construction performance. In addition, McCabe, S., (1998), ISO 9000, (2009), and Mohammad, M., (2004) indicate ten factors that impact the quality of construction projects which is right to the findings.

On the other hand, the P-value (*** < 0.05) shows great significance, and the t-value (4.338) showed positive while this variable meaning is negative. This means that there is a significant difference with the value to the left of the mean. In this case, when improving the construction quality management system, it does not improve the quality of construction projects. Many authors also find this argument is right. Landin, A., (2000) argues the effectiveness of the Quality management system in construction for improving the quality of construction projects since this QMS is difficult to apply by construction companies because the processes are too general. Turk, A.M., (2006) also argues the effectiveness of QMS takes a long time to integrate into the construction management system and the operation costs would be high which affects the quality of construction projects.

Cambodian Law on Construction

The studies show construction law has a partial effect on the quality of construction projects in Cambodia. Its roles partially mediate between construction disputes and the quality of construction projects. The three most important finding in these studies such as: registered construction at the Board of Construction (0.620), All designed document used for the building is signed by the licensed designer (0.745), and the operation site has a licensed engineer checking quality work (0.825). The P-value (0.086 < 0.10) with t-value (-0.777). This means that construction law in Cambodia has a partially negative effect on the quality of construction projects. Registered construction at the Board of Construction and getting the construction permit, take time (45 days of working days) with many documents (all documents are not complete at once) that extend the starting time of construction which would affect to customer’s business. In addition, having a licensed designer both signed on documents and check operations at the site would spend costly that affect the construction profit.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

This section mentioned the inferences from the result analysis. The conclusion and recommendations are from the results of the study. The research study is focused on local Cambodian construction companies, mostly located in Phnom Penh, Cambodia. The following conclusion and recommendations are based on the research study findings.

6.1. Conclusions

After testing the model, the researcher can give the final model framework of the study as shown in section 5.12. *Hypothesis Testing and Results on page 78*. In addition, the qualitative of the In-depth interview strongly supports the quantitative of the study findings. Thus, the researcher can conclude the answers to the three main research questions and the objectives of the study as the following.

To measure the Quality of Construction Projects in Cambodia, four factors need to be defined properly with less to high impact values respectively, Completion of a project on time, Enhancing customer/owner satisfaction, Motivation and empowering employees training, and Avoidance of disputes and claims. In addition, the six impact variables must be the key ingredient to improve the Quality of construction projects such as Stakeholder Involvement, Project Funding, Construction Materials, Project Management Competence, Project Complexity, and Construction Disputes. Moreover, these six variables impact the Quality of Construction Projects in different ways by influencing the effectiveness of the Construction Quality Management System and the barrier from Cambodian Law on Construction.

The findings also conclude the role of Cambodian Law on Construction works as the partial mediation between the Quality of Construction Projects and Construction Disputes. Three important factors in Construction Disputes that affect the Quality of Construction Projects such as Human Behavior Disputes, Contractual Disputes, and Technical Disputes. To improve the Quality of Construction Projects, minimize the disputes in the construction mostly in claims. And to minimize the disputes in claims in construction, Cambodian Law on Construction is the only way to avoid it.

Finally, the study can conclude also the role of the Construction Quality Management System works as the partial mediation between the Quality of Construction Projects and its variables such as: Project Funding, Construction Materials, Project Management Competence, and Project Complexity. To improve the Quality of Construction Projects, Project Funding, Construction Materials, Project Management Competence, and Project Complexity. However, developing Project Funding, Construction Materials, Project Management Competence, and Project Complexity through the Construction Quality Management System would negatively affect the Quality of Construction Projects in Completion of a project on time and loss of satisfaction from customers/owners in profit.

6.2. Recommendations

According to the research findings, the researcher would like to give some recommendations as the following:

For Local Construction Companies

To achieve the desired level of quality of the construction projects, the local Cambodian construction companies should do the following five important parts.

Firstly, *Avoidance of disputes and claims*: The organization should avoid disputes and claims during and after construction. To avoid disputes and claims, local construction companies should do as following: Avoid fraud and faith in works due to dishonestly. Honest working on documents and human behavior can avoid conflict. Impoliteness and lack of courtesy among each professional party can happen from different levels of knowledge and professionalism. However, being well-behaved gains respect from parties' involvement and avoid dispute. The desire to be always right on the opinion given can lead to inferiority and other parties not being satisfied with his decision. Forcing without consultation can lead to disputes among parties. Anger, rudeness, and hatred toward other parties can also lead to disputes. Good behavior toward another party is very effective in avoiding disputes. Disputes over payment, Miscalculation and over calculations, and over-design by the design engineer or team design caused by not having an expert on being preparing and checking over the contractual document before construction starts. So having a license/or an expert designer/engineer can minimize this dispute. The lateness of instruction from the designer also can lead to a dispute in construction and can cause many defects and cost high on construction. Having an expert or a licensed engineer checking on quality work can minimize defects and claims. Unrealistic client expectations can also cause sub-contractor or site engineer disputes due to the client making instructions. This can also be adjusted if having an expert or a licensed engineer during the operation site.

Secondly, *Motivation and empowering employees' training*: to achieve the quality of construction projects, local Cambodian construction companies should motivate employees, give power, and employee training. The employee is the most important part of the organization to be succeeded, Training can lead employees to be stronger. Some recommendations to gain good motivation and empowering employees training such as: Lack of motivation from top management can cause employees' quality of work to worse. The organization should prepare the management system related to quality. A good management system can minimize conflict in management among involved parties. Employee motivation can be contributed by stakeholders, especially site engineers and sub-contractors who are involved in the project. Political or company policies will cause employee motivation also. Good on well preparing for the company organization through the quality management system can motivate employee retention. Empowering employee training also contribute to the quality of construction project. Having an external adviser can motivate employees on work products, experience, etc. Lack of project cost estimate due to lack of employee training and due to lack of co-operation from suppliers on material specification and cost of the material. Enough on employee training, employee involvement will clearly understand communication routes from team design to the site, and from site to suppliers, etc. So, being well in the quality management system can motivate and empower employee training.

Thirdly, *Completion of the project with time*: To achieve the quality of the construction project, local Cambodian construction companies should complete the project with the contract schedule. Some recommendations to avoid being an incomplete project within time such as: Changing the design by the owner during construction can cause construction delays on schedule. Good preparation for the quality construction management system can lead to changes from involvement parties know, understanding clearly the changes which minimizes the construction late. Solution development is also a factor that can delay in construction schedule due to being late on a solution from an expert engineer will cause rework and delay in the construction schedule. The source of materials due to changes in design can lead to delays in material shipping which on delays in the construction schedule. Having a quality construction management system with cooperation from suppliers makes it easier to make a material change due to the client's design change.

Fourthly, *Enhancing customer/owner satisfaction*: To achieve the quality of construction projects, local Cambodian construction should enhance customer satisfaction or owner satisfaction. Some recommendations to gain customer/owner satisfaction such as: Material used in the project should have good specifications and the right to design which has expert/licensed engineer approval before use at the site. A good quality construction management system can reduce the difficulties in cooperation among middle managers over the quality problem on time. Late instruction from designers and solution development can ruin construction quality. Having qualified/licensed engineers can solve defects on time and can enhance customer satisfaction. Contractual conflict over payment, miscalculation, etc. can lead to less customer satisfaction. The construction law which has enough document support before construction, and has experts in checking will minimize those conflicts and can enhance owner satisfaction.

Lastly, the effectiveness of the construction quality management system should be applied to the appropriate construction site to get their effectiveness. Using the construction quality management system depends on the range planning of the construction at the site (short-range, intermediate-range, and long-range).

For Policymakers

To achieve the desired level of quality of the construction projects in Cambodia mostly on the avoidance of disputes and claims, the policymaker should strengthen three important points as the following.

First, *all construction projects should register with the Board of Construction*: to ensure that all projects have been approved before starting construction to avoidance on the loss of life in some cases, and the right to the government's rule. However, the process for asking construction permit should reduce the time and minimize some documents unnecessarily to achieve completion of the project on time.

Second, *all design document used for the building should be signed by a licensed designer*: to ensure that the documents used is good both in design and calculation. The licensed designer can inspect the payment contract and somewhere miscalculations or waste somewhere on the design team. On the other hand, requesting a licensed designer to sign in every document would cost much. Policymakers should reconsider the type of construction (small, medium, and big) with the construction function (no effect on loss of life, small hazard, medium hazard, and very hazard).

Last, *all operation sites should have a licensed engineer checking the quality of work*: disputes can occur most of the time during the construction period, especially between technical conflicts among the site and design teams, and involvement parties on technical work. The licensed engineer can independent decisions on technical instructions for site operation and can define the unrealistic something unexpected. On the other hand, having a licensed engineer check the quality of work would be costly. Policymakers should reconsider the ability of residential engineers who meet the qualification in quality construction based on the site construction (small, medium, or big) and the function of construction (less important, medium important, or highly important).

6.3. Limitation and Future Research

The result of the study evaluated only the local Cambodian construction companies mostly in Phnom Penh city. During COVID-19 and time constraints, the accessibility of the respondents was a problem, therefore the survey was conducted mostly via telegram and the sample size was limited and focused only on local construction companies. We hope future research will continue to study this field more and enlarge the sample size to international companies in all areas of Cambodia. Future research should study more on the construct measurements that this research dropped.

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APPENDIX A – SAMPLE OF QUESTIONNAIRE

Dear Respondents,

I am a doctoral candidate pursuing in Ph.D., in the department of management at the National University of Management, and now conducting a partial study regarding research on “Factors Influencing Quality of Construction Project in Cambodia, case study on local Cambodian company”

I would appreciate it if you could spare some time and think about completing the survey questionnaires. I hope that you would cooperate in completing the questionnaire to the best of your ability.

This questionnaire consists of two main purposes; one is the investigation on the current status of quality construction implemented in a local Cambodian construction company, and the other part is focused on the barrier to implementation of the quality construction management system which affects the quality of construction projects. Your response will be treated as confidential and used for research purposes only. There is no right or wrong answer.

Thank you for your willingness to participate in this study.

Yours sincerely,

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Factors Influencing Quality of Construction Projects in Cambodia

Case Study on Local Cambodian Company

Questionnaire

AIM

The aims of this survey are:

1. To investigate the current status of quality construction which is implemented by a local Cambodian construction company.
2. To identify the barrier to implementation of the quality construction management system which affects the quality of the construction project.

CONFIDENTIALITY

All information provided in this survey will be treated as strictly confidential, no companies or individuals will be identified in any subsequent research report, and all information collected will be used purely for the purpose of academic research.

FEEDBACK OF RESULTS

After all, surveys are collected and analyzed, feedback on the overall research results will be provided upon request to interested respondents in this study.

CONTACT DETAILS

If you have any questions regarding this survey, please do not hesitate to contact:
HENG Hok on (+588) 12 368 107 or e-mail: henghok.itc001@gmail.com

Questionnaires

Please kindly respond to the following questions by ticking (√) the appropriate box, circling the appropriate figure, or writing your answer in the space provided.

Part A: Background Information

1. What is your major?
   - Civil Engineer ☐
   - Mechanical Engineer ☐
   - Rural and Geology Engineer ☐
   - Electrical Engineer ☐
   - Architect ☐
   - Other (*please specify*): ……………………
2. Sex
   - Female ☐
   - Male ☐
3. What is your highest level of education?
   - Master Degree ☐
   - Bachelor Degree ☐
   - Undergraduate ☐
   - Diploma ☐
   - Other (*please specify*): ……………………
4. How long have you been in this skill?

   ☐ < 1 year ☐ 1 – 4 years ☐ 4 – 9 years ☐ 9 – 15 years

   ☐ 15 – 20 years ☐ > 20 years
5. What is your role in this project?
   - Main Contractors ☐
   - Sub-Contractors ☐
   - Inspector ☐
   - Site Engineer ☐
   - Project Owner or/and Client ☐
   - Consultant ☐
   - Safety Engineer ☐
   - Designing Team ☐

- Quantity Surveyor ☐
- Supplier ☐
- Other *(please specify)*: ....

6. Type of your company
   - Building Construction ☐
   - Finishing Work ☐
   - MEP Work ☐
   - Management ☐
   - Design and Consultant ☐
   - Supplier ☐
   - Other (Please specify): ………………………………….

Part B: Factors Affecting the Quality of Construction Projects

Please tick (√) the appropriate box which indicates whether your construction has also experienced these problems (*5 = Very High, 4 = High, 3 = Unsure, 2 = Low, 1 = Very Low)*

1. Stakeholder Involvement

To what extent do the following stakeholder involvement factors influence the quality of construction projects in your project? (តើកត្តាចូលរួមរបស់ភាគីពាក់ពន្ធ័ខាងក្រោមនេះមានឥទ្ធិពលដល់គុណភាពនៃការសាងសង់គម្រោងរបស់អ្នកកម្រិតណា?)

	Stakeholder Involvement	**5**	**4**	**3**	**2**	**1**
1	Site Engineer Involvement					
2	Engineer Involvement					
3	Contractor Involvement in Planning					
4	Sub-Contractor Involvement in Project					
5	Client Involvement					
6	Consultant and Design Team					
7	Supplier Involvement					

2. Project Funding

To what extent do the following project funding factors influence on the quality of construction projects in your project? (តើកត្តាថវិកាគម្រោងខាងក្រោមនេះមានឥទ្ធិពលដល់គុណភាពនៃការសាងសង់គម្រោងរបស់អ្នកកម្រិតណា?)

	Project Funding	**5**	**4**	**3**	**2**	**1**
1	Construction schedule due to changes in designs by the owner					
2	Contractor’s Payment					
3	Project Cost Estimation					
4	Project Technical Design					
4.1	*Defined Project Scope*					
4.2	*Sufficient Product Technical Requirement*					
4.3	*Required Quality Standard*					
5	Project Implementation Time					
5.1	*The Sequence of Project Activities*					
5.2	*Efficient Resources Allocation*					
5.3	*Contractors Performance*					

3. Construction Materials

To what extent do the following construction materials factors influence the quality of construction projects in your project? (តើកត្តាសម្ភារៈសំណង់ខាងក្រោមនេះមានឥទ្ធិពលដល់គុណភាពនៃការសាងសង់គម្រោងរបស់អ្នកកម្រិតណា?)

	Construction Materials	**5**	**4**	**3**	**2**	**1**
1	Source of Materials					
2	Performance of Quality Tools					
3	Cost of Materials					
4	Material/Equipment Specification					
5	Quality of Materials					

4. Project Management Competence

To what extent do the following project management competence factors influence quality construction project in your project? (តើកត្តាសមត្ថភាពគ្រប់គ្រងគម្រោងខាងក្រោមនេះមានឥទ្ធិពលដល់គុណភាពនៃការសាងសង់គម្រោងរបស់អ្នកកម្រិតណា?)

	Project Management Competence	**5**	**4**	**3**	**2**	**1**
1	Conflict Management (ការគ្រង់គ្រងជម្លោះ)					
2	Leadership (ភាពជាអ្នកដឹកនាំ)					
3	Motivation (ការលើកទឹកចិត្ត)					
4	Management Commitment (ការប្តេជ្ញាចិត្តក្នុងការគ្រប់គ្រង)					
5	Effective Project Management System (ប្រព័ន្ធគ្រប់គ្រងគម្រោងមានប្រសិទ្ធភាព)					
6	Team Management (ការគ្រប់គ្រងក្រុម)					
7	Solution Development (ការអភិវឌ្ឍដំណោះស្រាយ)					

5. Project Complexity

To what extent do the following project complexity factors influence the quality of construction projects in your project? (តើកត្តាស្មុគស្មាញនៃគម្រោងខាងក្រោមនេះមានឥទ្ធិពលដល់គុណភាពនៃការសាងសង់គម្រោងរបស់អ្នកកម្រិតណា?)

A	**Environmental Complexity**	**5**	**4**	**3**	**2**	**1**
1	Weather Condition					
2	Number of Locations (ចំនួនទីតាំងការដ្ឋាន)					
3	Interference between Existing Sites (ការជ្រៀតជ្រែករវាងការដ្ឋានមានស្រាប់)					
4	Number of Different Languages					
5	Clarity of Project Goals (ភាពច្បាស់លាស់នៃគោលដៅគម្រោង)					

B	**Operational Complexity**	**5**	**4**	**3**	**2**	**1**
1	Project Duration					
2	Availability of Financial Sources					
3	Strict Quality Requirements					
4	Variety of Tasks (ភាពខុសគ្នានៃភារកិច្ចដៅនិងជំនាញ)					

C	**Organizational Complexity**	**5**	**4**	**3**	**2**	**1**
1	Uncertainty in Methods (ភាពមិនច្បាស់លាស់នៃវិធីសាស្ត្រសាងសង់គម្រោង)					
2	Size of Project Team (ទំហំក្រុមការងារមិនសមស្របនិងទំហំគម្រោង)					
3	Involvement of Different Time-Zones (ការចូលរួមនៃភាគីពាក់ព័ន្ធខុសពេលវេលា)					
4	Political Influences (ឥទ្ធិពលនយោបាយ)					

D	**Technical Complexity**	**5**	**4**	**3**	**2**	**1**
1	Lack of Experience in the Country (កង្វះបទពិសោធន៍ក្នុងតំបន់)					
2	Level of Competition (កម្រិតនៃការប្រកួតប្រជែង)					
3	Technical Risks (ហានិភ័យលើបច្ចេកទេស)					

E	**Team Complexity**	**5**	**4**	**3**	**2**	**1**
1	Lack of Experience with Partners (កង្វះបទពិសោធន៍ជាមួយដៃគូសាងសង់)					
2	Lack of Resources and Skills (កង្វះធនធាននិងជំនាញ)					
3	Number of Project Goals (ចំនួនគោលដៅគម្រោង)					

6. Construction Disputes

To what extent do the following construction conflict factors influence on a quality construction project in your project? (តើកត្តាទំនាស់និតសំណង់ខាងក្រោមនេះមានឥទ្ធិពលដល់គុណភាពនៃការសាងសង់គម្រោងរបស់អ្នកកម្រិតណា?)

1	**Human Behavior Disputes**	**5**	**4**	**3**	**2**	**1**
1.1	The Absence of Team Spirit among the Participants (កង្វះការធ្វើការងារជាក្រុម)					
1.2	Poor Communication (ទំនាក់ទំនងមិនល្អ)					
1.3	Project Participants with Unexpected Condition (អ្នកចូលរួមក្នុងគម្រោងមិនដូចការរំពឹងទុក)					
1.4	Blaming (ការស្តីបន្ទោស)					
1.5	Different Profession (វិជ្ជាជីវៈខុសគ្នា)					
1.6	Fraud and Faith on Works (ការក្លែងបន្លំនិងជំនឿលើការងារ)					
1.7	Impolite and Lack of Courtesy among each Professional parties (មិនសមរម្យនិងខ្វះសុជីវធម៌លើផ្នែកដែរមានជំនាញផ្សេងពីគ្នា)					
1.8	Desire to be Always Rights on the Opinion Given (ចង់តែឈ្នះ)					
1.9	Anger, Rudeness and Hatred toward other Parties (ខឹង ឈ្លើយ និងស្អប់ខ្ពើមភាគីផ្សេងៗទៀត)					
2	**Contractual Disputes**	**5**	**4**	**3**	**2**	**1**
2.1	Disputes over Payment (ជម្លោះការទូទាត់ប្រាក់)					
2.2	Miscalculations and Over Calculations (ការគណនាខ្វះ និងលើស)					
2.3	Contract Clause, which Unrealistically and Unfairly Shifted (កិច្ចសន្យាមិនច្បាស់លាស់ និងខ្សែលើ)					
2.4	Ambiguous Contract Provision (កិច្ចសន្យាមិនច្បាស់លាស់)					
2.5	Over Design by Design Team (ការគណនាលើសដោយក្រុមរចនា)					
3	**Technical Disputes**	**5**	**4**	**3**	**2**	**1**
3.1	Roles Conflict among the Participants (ជម្លោះអ្នកចូលរួមលើតួនាទី)					
3.2	Contract's Low Bid submitted by Contractor (ការដេញថ្លៃទាបពេករបស់អ្នកម៉ៅការសាងសង់)					
3.3	Late Instruction from Designer (ការណែនាំយឺតយ៉ាវពីអ្នករចនា)					
3.4	Unrealistic Client Expectation (ការរំពឹងទុករបស់អតិថិជនមានភាពមិនប្រាកដនិយម)					
3.5	Error and Incomplete Technical Specification (កំហុស និងបទដ្ឋានបច្ចេកទេសមិនពេញលេញ)					

7. Cambodian Law on Construction

To what extent do the following construction law factors influence the quality of construction projects in your projects? (តើកត្តាច្បាប់សំណង់ខាងក្រោមនេះមានឥទ្ធិពលដល់គុណភាពនៃការសាងសង់គម្រោងរបស់អ្នកកម្រិតណា?)

1	**Technical Regulations**	**5**	**4**	**3**	**2**	**1**
1.1	Construction Permit (លិខិតអនុញ្ញាតិសាងសង់)					
1.2	Structure is safe by certified engineer with license from Ministry of Land Management and Urban, Planning and Construction (MLMUPC) (សំណង់មានសុវត្ថិភាពបញ្ជាក់ដោយវិស្វករទទួលស្គាល់ដោយក្រសួងរៀបចំដែនដី នគរូបនីយកម្ម និងសំណង់)					
1.3	Having a Fire Safety (មានប្រព័ន្ធសុវត្ថិភាពអគ្គីភ័យ)					
1.4	Construction Materials, Equipment and Product are follow Specific Standard (សំភារៈសំណង់ ឧបករណ៍និងផលិតផលត្រូវតាមបទដ្ឋានជាក់លាក់)					
2	**Management Procedure for Construction**	**5**	**4**	**3**	**2**	**1**
2.1	Construction is registered at Board of Construction (សំណង់បានចុះបញ្ជីនៅក្រុមប្រឹក្សាសំណង់)					
2.2	All Design Document used for building signed by License Designer (ឯកសាគណនាទាំងអស់បានចុះហត្ថលេខាដោយអ្នករចនាមានអាជ្ញាប័ណ្ណត្រឹមត្រូវ)					
2.3	Construction is Permit before Start (ការសាងសង់ត្រូវបានអនុញ្ញាតមុនពេលចាប់ផ្តើម)					
2.4	Construction Site is achieved the Public Security, Safety, and Environment (ការដ្ឋានសាងសង់ត្រូវបានសម្រេចនូវសុវត្ថិភាពជាសាធារណៈ សុវត្ថិភាពនិងបរិស្ថាន)					
2.5	Operation Site have License Engineer checking Quality Work (ការដ្ឋានសាងសង់មានវិស្វករមានអាជ្ញាប័ណ្ណត្រឹមត្រូវ ត្រួតពិនិត្យគុណភាពការងារ)					

Part C: Quality Construction Management System

Question to the problems of QMSs implementation. The following statement is related to problems and the motives for developing QMSs that the project mostly faces regarding the effective ISO 9001 implementation. Please tick (√) the appropriate box which indicates whether your construction has also experienced these problems. (*5 = Always, 4 = Usually, 3 = Sometimes, 2 = Rarely, 1 = Never)*

	Difficulties in the Process of Attaining QMS	**5**	**4**	**3**	**2**	**1**
1	Lack of Employee Involvement (កង្វះការចូលរួមរបស់និយោជិក)					
2	Difficulties in Co-operation among Middle Managers over Quality Problems (ភាពលំបាកក្នុងកិច្ចសហការរវាងអ្នកគ្រប់គ្រងថ្នាក់កណ្ដាលលើបញ្ហាគុណភាព)					
3	Lack of Training Programs related to Quality (កង្វះកាកម្មវិធីបណ្ដុះបណ្ដាលទាក់ទងនឹងគុណភាព)					
4	Insufficiency of Project Time (ពេលវេលាមិនគ្រប់គ្រាន់សម្រាប់គម្រោង)					
5	Lack of Co-operation from Customers (កង្វះកិច្ចសងការពីអតិថិជន)					
6	Standard Difficult to Interpret (បទដ្ឋានពិបាកយល់)					
7	Lack of Communication Routes (កង្វះទំនាក់ទំនង)					
8	Lack of Co-operation from Suppliers (កង្វះកិច្ចសហការពីអ្នកផ្គត់ផ្គង់)					
9	Lack of Top Management Involvement (កង្វះការចូលរួមពីថ្នាក់ដឹកនាំកំពូល)					
10	Lack of External Advisers Properly Qualified (កង្វះទីប្រឹក្សាខាងក្រៅដែលមានសម្បត្តិភាពគ្រប់គ្រាន់)					

Part D: Quality of Construction Projects

Please tick (√) the appropriate box which indicates whether your construction has also experienced these problems (*5 = Very High, 4 = High, 3 = Unsure, 2 = Low, 1 = Very Low)*

8. To what extent in your industry rate the quality of construction projects in the following aspect?

	Quality of Construction Projects	**5**	**4**	**3**	**2**	**1**
1	Satisfaction of Contract Specifications (ការពេញចិត្តលើកិច្ចសន្យា)					
2	Completion of Project with Time (ការបញ្ចប់គម្រោងតាមពេលវេលា)					
3	Enhancing Customer/Owner Satisfaction (ការលើកកម្ពស់ការពេញចិត្តរបស់អតិថិជនរឺម្ចាស់គម្រោង)					
4	Motivation and Empowerment of Employees' Training (ការលើកទឹកចិត្ត និងការផ្ដល់អំណាចដល់បុគ្គលិក)					
5	Avoidance Disputes and Claims (ជៀសវាងជម្លោះនិងការទាមទារសំណង)					
6	Performance Based Purpose (គោលបំណងដែលមានមូលដ្ឋានគ្រឹះ)					

****** Thank you very much for your participation in this survey *******

APPENDIX B – PILOT STUDY

The results of 31 samples as shown in the tables.

Table B.1: Demographics 31 Respondents

Major					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Civil Engineer	25	80.6	80.6	80.6
	Architect	6	19.4	19.4	100.0
	Total	31	100.0	100.0	
Sex					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	31	100.0	100.0	100.0
Level					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Master Degree	19	61.3	61.3	61.3
	Bachelor Degree	12	38.7	38.7	100.0
	Total	31	100.0	100.0	
Year					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1-4 Years	18	58.1	58.1	58.1
	4-9 Years	5	16.1	16.1	74.2
	9-15 Years	8	25.8	25.8	100.0
	Total	31	100.0	100.0	
Project					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Main Contractors	6	19.4	19.4	19.4
	Inspector	1	3.2	3.2	22.6
	Consultant	6	19.4	19.4	41.9
	Designing Team	18	58.1	58.1	100.0
	Total	31	100.0	100.0	

A. Validity Test

Validity is a measure of the degree of validity or the validity of a research instrument. An instrument is said to be valid if it can measure what is to be measured or desired. An instrument is said to be valid if can reveal the data of the variables studied. In quantitative research, an instrument is often used in the form of a questionnaire. To determine true, the questionnaire complied it valid or not it is necessary to test validity. A Test of the validity of the questionnaire was conducted using Pearson Product Moment Correlations using SPSS. The validity test Product Moment Pearson Correlation is done by correlating each item's questionnaire score with the total score. Item-item questionnaire that significantly correlated with the total score indicates that the item is valid. Basic making decision in validity test if the significance value < 0.05 table product moment then the instrument is declared valid, but if the value > 0.05 then the instrument is declared invalid. When comparing the value of rxy-table with r product moment. If the value of rxy > r-table product moment, then the instrument is declared valid but if the value of rxy < r-table product moment then the instrument is declared invalid (Del Siegle, 2015). Below is the r Critical value table. Below are the results based on the output above in mind some values like Pearson correlation or correlation value between of the item or the item with a total score also known as rxy. Sig. (2-tailed) was significant at a level of 5%, while N is the total of pilot survey respondents is 31 people. df = n-2 = 31-2 = 29; so, the rxy value is 0.355 for 5% and 0.301 for 10%.

For interpretation, the Site Engineer Involvement is a significant value obtained by the sig. (2-tailed) of 0.000 < 0.05, so it can be concluded to this item is valid. Based on the count value obtained rxy = 0.731 > 0.355, so it can be concluded that this item was valid, and the Contractor Involvement significant value obtained by the sig. (2-tailed) of 0.054 > 0.05 but < 0.10, so it can be concluded to this item is partially valid at level 5% and significant at level 10%. Based on the count value obtained rxy = 0.349 < 0.355 but > 301, it can be concluded that this item was partially valid at a level of 5% and significant at a level of 10%.

Summary table for validity test of item Stakeholder Involvement and other variables.

Table B.2: Stakeholder Involvement Validity Value

1	**Stakeholder Involvement**	**rxy**	**r-table**	**Status**
1	Site Engineer Involvement	0.731	0.355	Valid
2	Engineer Involvement	0.689	0.355	Valid
3	Contractor Involvement	0.349	0.355	Partially Valid
4	Sub-Contractor Involvement	0.602	0.355	Valid
5	Client Involvement	0.406	0.355	Valid
6	Consultant and Design Team Involvement	0.237	0.355	Invalid
7	Supplier Involvement	0.611	0.355	Valid

Stakeholder Involvement Correlations Results

Table B.3: Stakeholder Involvement Correlation Results

Correlations

		Site_Engineer_Involvement	Engineer_Involvement	Contractor_Involvement_in_Planing	Sub_Contractor_Involvement_in_Project	Client	Consultant_and_Designing_Team	Supplier	Stakeholder_Involvement
Site_Engineer_Involvement	Pearson Correlation	1	.507**	-.038	.278	.357*	-.303	.555**	.731**
	Sig. (2-tailed)		.004	.838	.131	.049	.098	.001	.000
	N	31	31	31	31	31	31	31	31
Engineer_Involvement	Pearson Correlation	.507**	1	.372*	.395*	.349	.077	.158	.689**
	Sig. (2-tailed)	.004		.039	.028	.054	.681	.397	.000
	N	31	31	31	31	31	31	31	31
Contractor_Involvement_in_Planing	Pearson Correlation	-.038	.372*	1	.549**	-.301	.610**	.025	.349
	Sig. (2-tailed)	.838	.039		.001	.100	.000	.893	.054
	N	31	31	31	31	31	31	31	31
Sub_Contractor_Involvement_in_Project	Pearson Correlation	.278	.395*	.549**	1	-.159	.314	.168	.602**
	Sig. (2-tailed)	.131	.028	.001		.393	.086	.367	.000
	N	31	31	31	31	31	31	31	31
Client	Pearson Correlation	.357*	.349	-.301	-.159	1	-.211	.039	.406*
	Sig. (2-tailed)	.049	.054	.100	.393		.254	.837	.023
	N	31	31	31	31	31	31	31	31
Consultant_and_Designing_Team	Pearson Correlation	-.303	.077	.610**	.314	-.211	1	.001	.273
	Sig. (2-tailed)	.098	.681	.000	.086	.254		.994	.137
	N	31	31	31	31	31	31	31	31
Supplier	Pearson Correlation	.555**	.158	.025	.168	.039	.001	1	.611**
	Sig. (2-tailed)	.001	.397	.893	.367	.837	.994		.000
	N	31	31	31	31	31	31	31	31
Stakeholder_Involvement	Pearson Correlation	.731**	.689**	.349	.602**	.406*	.273	.611**	1
	Sig. (2-tailed)	.000	.000	.054	.000	.023	.137	.000	
	N	31	31	31	31	31	31	31	31

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Correlations-Stakeholder Involvment

Table B.4: *Validity Value & Value Limit*

2	**Project Funding**	**rxy**	**r-table**	**Status**
2.1	Construction Schedule due to Changes in Designs by the Owner	0.866	0.355	Valid
2.2	Contractor's Payment	0.859	0.355	Valid
2.3	Project Cost Estimation	0.937	0.355	Valid
2.4	Defined Project Scope	0.528	0.355	Valid
2.5	Sufficient Product Technical Requirement	0.837	0.355	Valid
2.6	Required Quality Standard	0.225	0.355	Invalid
2.7	Sequence of Project Activities	0.262	0.355	Invalid
2.8	Efficient Resources Allocation	0.634	0.355	Valid
2.9	Contractors Performance	0.062	0.355	Invalid
3	**Construction Materials**	**rxy**	**r-table**	**Status**
3.1	Source of Materials	0.816	0.355	Valid
3.2	Performance of Quality Tools	0.398	0.355	Valid
3.3	Cost of Materials	0.815	0.355	Valid
3.4	Material/Equipment Specification	0.856	0.355	Valid
3.5	Quality of Materials	0.758	0.355	Valid

4	**Project Management Competence**	**rxy**	**r-table**	**Status**
4.1	Conflict Management	0.773	0.355	Valid
4.2	Leadership	0.816	0.355	Valid
4.3	Motivation	0.766	0.355	Valid
4.4	Management Commitment	0.768	0.355	Valid
4.5	Effective Project Management System	0.602	0.355	Valid
4.6	Team Management	0.687	0.355	Valid
4.7	Solution Development	0.883	0.355	Valid
5	**Project Complexity**	**rxy**	**r-table**	**Status**
5.1	Weather Condition	0.589	0.355	Valid
5.2	Number of Locations	0.704	0.355	Valid
5.3	Interference between Existing Sites	0.825	0.355	Valid
5.4	Number of Different Languages	0.887	0.355	Valid
5.5	Clarity of Project Goals	0.456	0.355	Valid
5.6	Project Duration	0.232	0.355	Invalid
5.7	Availability of Financial Sources	0.651	0.355	Invalid
5.8	Strict Quality Requirements	0.362	0.355	Valid
5.9	Variety of Tasks	0.718	0.355	Valid
5.10	Uncertainty in Methods	0.298	0.355	P.Valid
5.11	Size of the Project Team	0.364	0.355	Valid
5.12	Involvement of Different Time-Zones	0.847	0.355	Valid
5.13	Political Influences	0.712	0.355	Valid
5.14	Lack of Experience in the Country	0.914	0.355	Valid
5.15	Level of Competition	0.289	0.355	P.Valid
5.16	Technical Skills	0.489	0.355	Valid
5.17	Lack of Experience with Partners	0.816	0.355	Valid
5.18	Lack of Resources & Skills	0.758	0.355	Valid
5.19	Number of Project Goals	0.711	0.355	Valid

6	**Construction Disputes**	**rxy**	**r-table**	**Status**
6.1	The Absence of Team Spirit among the Participants	0.519	0.355	Valid
6.2	Poor Communication	0.675	0.355	Valid
6.3	Project Participants with an Unexpected Condition	0.719	0.355	Valid
6.4	Blaming	0.799	0.355	Valid
6.5	Different Profession	0.597	0.355	Valid
6.6	Fraud and Faith in Works	0.897	0.355	Valid
6.7	Impolite and Lack of Courtesy among each Professional Party	0.886	0.355	Valid
6.8	Desire to be Always Right on the Opinion Given	0.923	0.355	Valid
6.9	Anger, Rudeness, and Hatred toward other Parties	0.894	0.355	Valid
6.10	Disputes over Payment	0.838	0.355	Valid

	Construction Disputes (Cont.)	rxy	r-table	Status
6.11	Miscalculations and over Calculations	0.931	0.355	Valid
6.12	Contract Clause, which Unrealistically and Unfairly	0.920	0.355	Valid
6.13	Ambiguous Contract Provision	0.937	0.355	Valid
6.14	Overdesign by the Design Team	0.843	0.355	Valid
6.15	Roles of Conflict among the Participants	0.740	0.355	Valid
6.16	Contract's Low Bid submitted by the Contractor	0.777	0.355	Valid
6.17	Late Instruction from Designer	0.891	0.355	Valid
6.18	Unrealistic Client Expectation	0.934	0.355	Valid
6.19	Error and Incomplete Technical Specification	0.642	0.355	Valid
7	**Cambodian Law on Construction**	**rxy**	**r-table**	**Status**
7.1	Construction Permit	0.848	0.355	Valid
7.2	The Structure is safe by a certified engineer with a license from the Ministry of Land Management and Urban, Planning, and Construction (MLMUPC)	0.736	0.355	Valid
7.3	Having Fire Safety	0.757	0.355	Valid
7.4	Construction Materials, Equipment, and Product are followed a Specific Standard	0.337	0.355	Valid
7.5	Construction is Registered with the Board of Construction	0.906	0.355	Valid
7.6	All Design Documents used for buildings are signed by the License Designer	0.718	0.355	Valid
7.7	Construction is Permitted before Starting	0.692	0.355	Valid
7.8	Construction Site is achieved Public Security, Safety, and Environment	0.866	0.355	Valid
7.9	Operation Site has a Licensed Engineer checking Quality Work	0.730	0.355	Valid

8	Construction Quality Management System	rxy	r-table	Status
8.1	Lack of Employee Involvement	0.872	0.355	Valid
8.2	Difficulties in Co-operation among Middle Managers over Quality Problems	0.936	0.355	Valid
8.3	Lack of Training Programs related to Quality	0.564	0.355	Valid
8.4	Insufficiency of Project Time	0.888	0.355	Valid
8.5	Lack of Co-operation from Customers	0.747	0.355	Valid
8.6	Standard Difficult to Interpret	0.846	0.355	Valid
8.7	Lack of Communication Routes	0.871	0.355	Valid
8.8	Lack of Co-operation from Suppliers	0.933	0.355	Valid
8.9	Lack of Top Management Involvement	0.939	0.355	Valid
8.10	Lack of External Advisers Properly Qualified	0.905	0.355	Valid

9	**Quality of Construction Projects**	**rxy**	**r-table**	**Status**
9.1	Satisfaction of Contract Specification	0.488	0.355	Valid
9.2	Completion of Project on Time	0.732	0.355	Valid
9.3	Enhancing Customer/Owner Satisfaction	0.805	0.355	Valid
9.4	Motivation and Empowerment of Employees' Training	0.794	0.355	Valid
9.5	Avoidance Disputes and Claims	0.640	0.355	Valid
9.6	Performance-Based Purpose	0.479	0.355	Valid

Table B.5: Values of Pearson Product-Moment Correlation Coefficient

df = n -2				
Level of Significance (p) for Two-Tailed Test	.10	.05	.02	.01
df				
1	.988	.997	.9995	.9999
2	.900	.950	.980	.990
3	.805	.878	.934	.959
4	.729	.811	.882	.917
5	.669	.754	.833	.874
6	.622	.707	.789	.834
7	.582	.666	.750	.798
8	.549	.632	.716	.765
9	.521	.602	.685	.735
10	.497	.576	.658	.708
11	.476	.553	.634	.684
12	.458	.532	.612	.661
13	.441	.514	.592	.641
14	.426	.497	.574	.623
15	.412	.482	.558	.606
16	.400	.468	.542	.590
17	.389	.456	.528	.575
18	.378	.444	.516	.561
19	.369	.433	.503	.549
20	.360	.423	.492	.537
21	.352	.413	.482	.526
22	.344	.404	.472	.515
23	.337	.396	.462	.505
24	.330	.388	.453	.496
25	.323	.381	.445	.487
26	.317	.374	.437	.479
27	.311	.367	.430	.471
28	.306	.361	.423	.463
29	.301	.355	.416	.456
30	.296	.349	.409	.449
35	.275	.325	.381	.418
40	.257	.304	.358	.393
45	.243	.288	.338	.372
50	.231	.273	.322	.354
60	.211	.250	.295	.325
70	.195	.232	.274	.303
80	.183	.217	.256	.283
90	.173	.205	.242	.267
100	.164	.195	.230	.254

From the pilot result, a few sub-dimensions are invalid and partially valid. We will consider dropping those items during the full-scale survey. In conclusion, the validity test of the study assumes that all constructs are valid.

B. Reliability Test

After the research instrument is declared the validity of the test, then the next step is the reliability test using method Alpha method. Reliability is a measure to indicate that a reliable instrument to be used as a means of collecting data for the instrument is considered good. A good instrument will not be tendentious directing the respondents to select certain answers. Reliable means trustworthy also reliable. Several times repeated whatever the outcome will remain the same or consistent. The reliability test is the test of whether a group of items (i.e. items measuring a construct generated from factor analysis consistently reflected the construct it is measuring. The most common measure of reliability is the internal consistency of the scale. Cronbach's alpha was calculated to examine the internal consistency of the scales used in this study. Cronbach's alpha coefficient can range from 0.0 to 1.0. Sekaran, U., (2003), indicated the following table

Table B.6: Cronbach's Alpha Limitation and Interpretation

Close 1.0	High Internal Consistency Reliability
> 0.8	Is Considered Good
> 0.7	Is Considered Acceptable
Less than 0.6	Is Considered Poor

The findings table below indicated the result of the pilot study

Table B.7: Cronbach's Alpha Value from Analysis and Acceptance

Variables	Cronbach's Alpha	No. of Items	Comments
Stakeholder Involvement	0.562	7	Poor
Project Funding	0.805	9	Good
Construction Materials	0.735	5	Acceptable
Management Competence	0.864	7	Good
Project Complexity	0.897	19	Good
Construction Disputes	0.971	19	High
Cambodian Law on Construction	0.894	9	Good
Construction Quality Management System	0.957	10	High
Quality of Construction Projects	0.746	6	Acceptable
All items	**0.855**		**Good**

The findings indicated that Construction Quality Management System and Construction Conflict were more reliable with coefficients close to 1.0, while Project Funding, Management Competence, Project Complexity, and Construction Law with a coefficient greater than 0.8 were considered good consistency reliable, and

Construction Materials and Quality of Construction Project are in Acceptable. The result of the pilot test shows only one variable; Stakeholder Involvement which Cronbach's Alpha coefficient is smaller than 0.6. A low value of this item could be due to a low number of questions, poor inter-relations between items, or heterogeneous constructs. Previous research by Evelyn, K., (2017) shows a strong value coefficient of Cronbach's Alpha 0.743 is a little bit different. However, these values (0.562) are also accepted at a minimum acceptable level of reliability, 0.6-0.7. From the output of Reliability Statistics obtained Cronbach's Alpha values of 0.855 > 0.6, based on decision-making in the reliability test can be concluded that this research instrument is reliable, whereas a high level of reliability is.

****** This is the End of the Pilot Study *******

APPENDIX C – FACTOR ANALYSIS

The individual model fit results in AMOS comprised the following indexes. The following shows each CFA individually.

1. Stakeholder Involvement

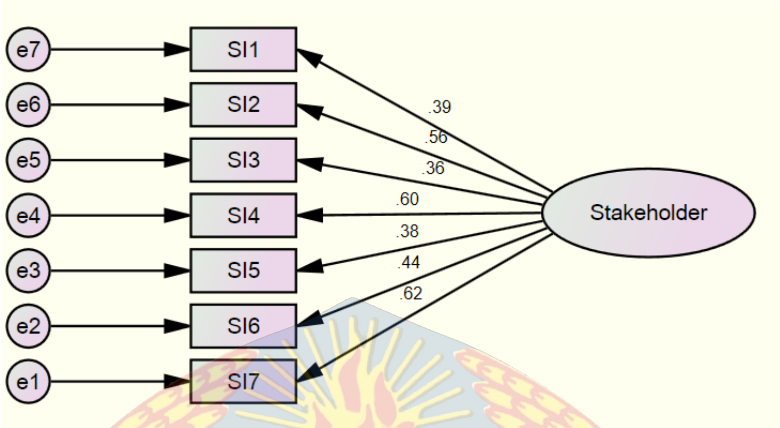

Figure: CFA Stakeholder Involvement Individual Model

ID	Weight	Status	CFI	Status	GFI	Status	RMSEA	Status
SI1	*0.39*	*NO*	0.800	acceptable	0.938	good	0.116	poor
SI2	0.56	OK						
SI3	*0.36*	*NO*						
SI4	0.60	OK						
SI5	*0.38*	*NO*						
SI6	*0.44*	*NO*						
SI7	0.62	OK						

From the result above, we observe the construct measurement weight is below 0.50. So, we omit items SI1, SI3, SI5, and SI6 to model fit.

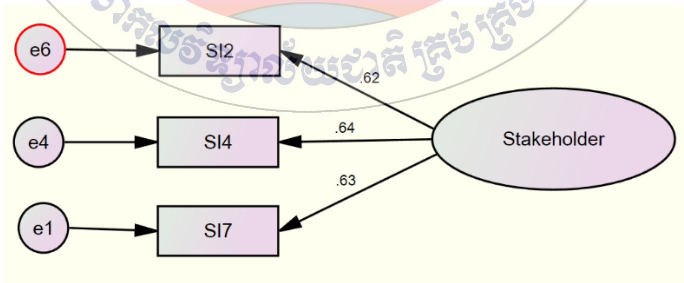

Figure: CFA Stakeholder Involvement after drop Constructs

ID	Weight	Status	CFI	Status	GFI	Status	RMSEA	Status
SI2	0.62	OK	1.00	perfect fit	1.00	perfect fit		perfect
SI4	0.64	OK						
SI7	0.63	OK						

After removing the four items, we got the model Stakeholder Involvement fit as expressed in a table.

2. Project Funding

ID	Weight	Status	CFI	Status	GFI	Status	RMSEA	Status
PRF1	0.58	OK	0.685	unacceptable	0.856	acceptable	0.146	poor
PRF2	*0.43*	*NO*						
PRF3	0.65	OK						
PRF4	*0.21*	*NO*						
PRF5	0.72	OK						
PRF6	*0.42*	*NO*						
PRF7	*0.48*	*NO*						
PRF8	*0.38*	*NO*						
PRF9	*0.47*	*NO*						

From the result above, we observe the construct measurement weight is below 0.50. So, we omit items PRF2, PRF4, PRF6, PRF7, PRF8, and PRF9 to model fit.

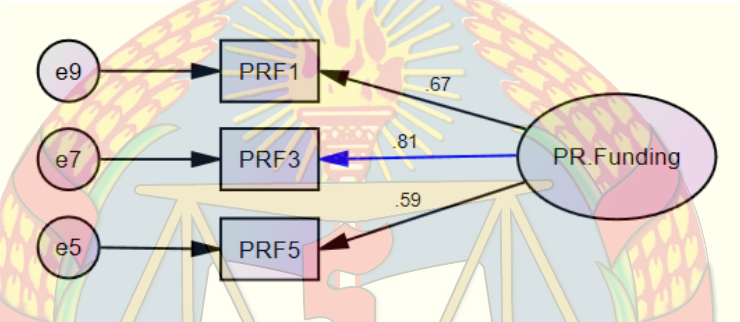

Figure: CFA Project Funding after drop Constructs

ID	Weight	Status	CFI	Status	GFI	Status	RMSEA	Status
PRF1	0.67	OK	1.000	excellent	1.000	excellent	0.462	poor
PRF3	0.81	OK						
PRF5	0.59	OK						

We got the model project funding fit as expressed in the table after removing those items.

3. Construction Materials

ID	Weight	Status	CFI	Status	GFI	Status	RMSEA	Status
CM1	0.58	OK	0.942	good	0.980	excellent	0.089	acceptable
CM2	*0.45*	*NO*						
CM3	0.59	OK						
CM4	0.53	OK						
CM5	0.60	OK						

From the result above, we observe the construct measurement weight is below 0.50. So, we omit items CM2 to model fit.

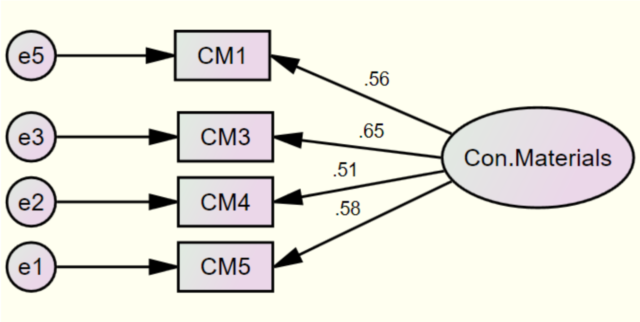

Figure: Construction Materials after drop Constructs

ID	Weight	Status	CFI	Status	GFI	Status	RMSEA	Status
CM1	0.56	OK	0.965	excellent	0.988	excellent	0.097	borderline
CM3	0.65	OK						
CM4	0.51	OK						
CM5	0.58	OK						

We obtain the model construction materials fit as expressed in the table.

4. Project Management Competence

ID	Weight	Status	CFI	Status	GFI	Status	RMSEA	Status
PMC1	0.69	OK	0.876	acceptable	0.925	acceptable	0.132	poor
PMC2	0.60	OK						
PMC3	0.60	OK						
PMC4	0.62	OK						
PMC5	0.57	OK						
PMC6	*0.49*	*NO*						
PMC7	0.72	OK						

From the result above, we observe the construct measurement weight is below 0.50. So, we omit items PMC6 to model fit.

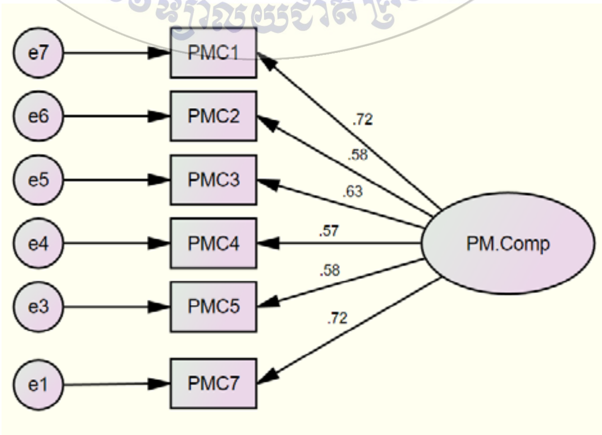

Figure: CFA Project Management Competence after drop Constructs

ID	Weight	Status	CFI	Status	GFI	Status	RMSEA	Status
PMC1	0.72	OK	0.913	good	0.950	excellent	0.126	poor
PMC2	0.58	OK						
PMC3	0.63	OK						
PMC4	0.57	OK						
PMC5	0.58	OK						
PMC7	0.72	OK						

We got the model project management competence fit as expressed in the table.

5. Project Complexity

ID	Weight	Status	CFI	Status	GFI	Status	RMSEA	Status
PRC1	*0.47*	*NO*	0.741	unacceptable	0.767	acceptable	0.121	poor
PRC2	0.77	OK						
PRC3	0.74	OK						
PRC4	0.74	OK						
PRC5	*0.43*	*NO*						
PRC6	*0.26*	*NO*						
PRC7	*0.34*	*NO*						
PRC8	*0.32*	*NO*						
PRC9	*0.45*	*NO*						
PRC10	*0.31*	*NO*						
PRC11	*0.38*	*NO*						
PRC12	0.80	OK						
PRC13	0.76	OK						
PRC14	0.77	OK						
PRC15	0.64	OK						
PRC16	0.55	OK						
PRC17	0.74	OK						
PRC18	0.61	OK						
PRC19	0.62	OK						

From the result above, we observe the construct measurement weight is below 0.50. So, we omit items PRC1, PRC5, PRC6, PRC7, PRC8, PRC9, PRC10, and PRC11 to model fit. After removing these items, we got the model project complexity fit as expressed in the table.

ID	Weight	Status	CFI	Status	GFI	Status	RMSEA	Status
PRC2	0.77	OK	0.903	good	0.900	good	0.114	poor
PRC3	0.74	OK						
PRC4	0.74	OK						
PRC12	0.80	OK						
PRC13	0.76	OK						
PRC14	0.77	OK						
PRC15	0.64	OK						
PRC16	0.55	OK						
PRC17	0.74	OK						
PRC18	0.61	OK						
PRC19	0.62	OK						

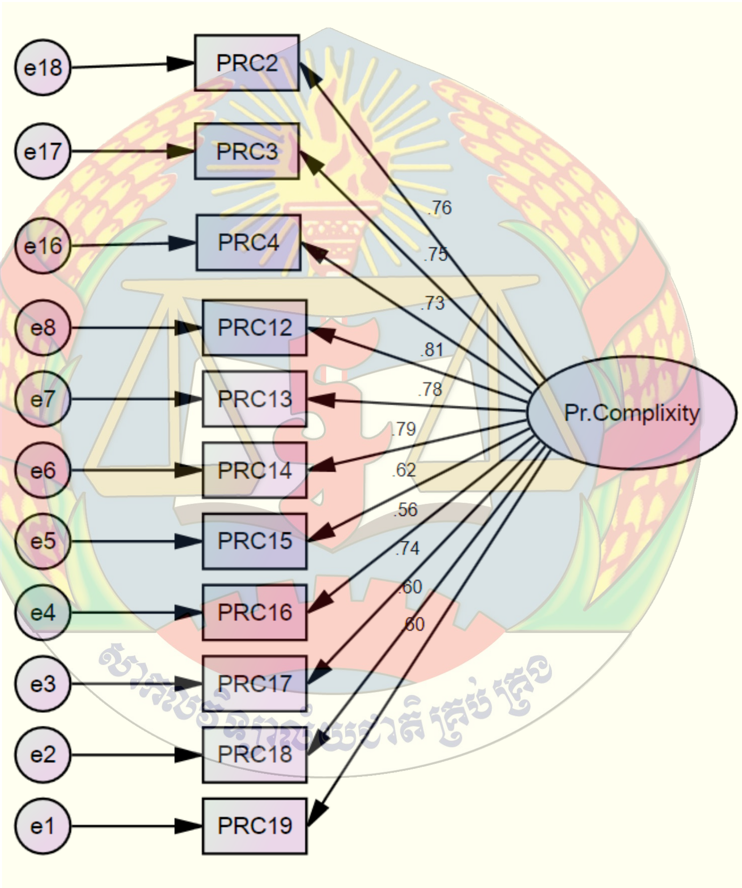

Figure: CFA Project Complexity after drop Constructs

6. Construction Disputes

ID	Weight	Status	CFI	Status	GFI	Status	RMSEA	Status
CC1	*0.39*	*NO*	0.841	acceptable	0.813	acceptable	0.103	borderline
CC2	*0.42*	*NO*						
CC3	0.61	OK						
CC4	0.56	OK						
CC5	0.51	OK						
CC6	0.73	OK						
CC7	0.77	OK						
CC8	0.78	OK						
CC9	0.76	OK						
CC10	0.71	OK						
CC11	0.74	OK						
CC12	0.74	OK						
CC13	0.72	OK						
CC14	0.72	OK						
CC15	0.54	OK						
CC16	0.58	OK						
CC17	0.76	OK						
CC18	0.76	OK						
CC19	0.52	OK						

From the result above, we observe the construct measurement weight is below 0.50.

So, we omit items CC1 and CC2 to model fit.

ID	Weight	Status	CFI	Status	GFI	Status	RMSEA	Status
CC3	0.61	OK	0.872	acceptable	0.837	acceptable	0.101	borderline
CC4	0.55	OK						
CC5	0.51	OK						
CC6	0.73	OK						
CC7	0.77	OK						
CC8	0.78	OK						
CC9	0.77	OK						
CC10	0.72	OK						
CC11	0.74	OK						
CC12	0.74	OK						
CC13	0.73	OK						
CC14	0.72	OK						
CC15	0.53	OK						
CC16	0.58	OK						
CC17	0.76	OK						
CC18	0.75	OK						
CC19	0.52	OK						

After removing those items, we got the model construction conflict fit as in the table.

7. Cambodian Law on Construction

ID	Weight	Status	CFI	Status	GFI	Status	RMSEA	Status
CI1	0.62	OK	0.772	unacceptable	0.844	acceptable	0.158	poor
CI2	0.55	OK						
CI3	0.67	OK						
CI4	*0.46*	*NO*						
CI5	0.69	OK						
CI6	0.59	OK						
CI7	0.51	OK						
CI8	0.68	OK						
CI9	0.63	OK						

From the result above, we observe the construct measurement weight is below 0.5. So, we omit items CI4 to model fit.

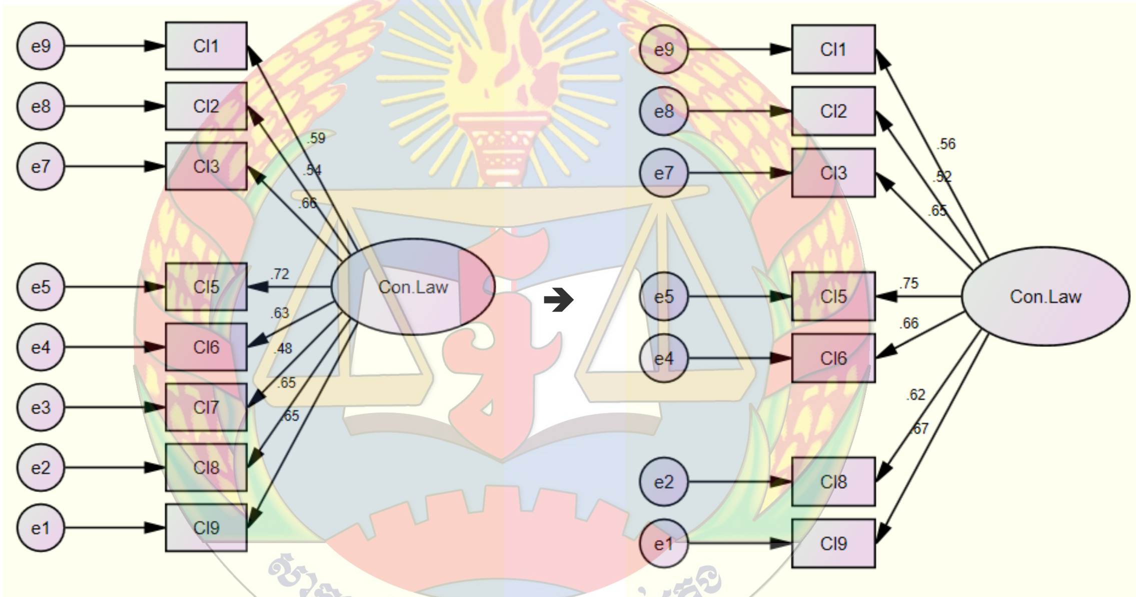

Figure: CFA Cambodian Law on Construction after drop Constructs

ID	Weight	Status	CFI	Status	GFI	Status	RMSEA	Status
CI1	0.59	OK	0.814	acceptable	0.870	acceptable	0.155	poor
CI2	0.54	OK						
CI3	0.66	OK						
CI5	0.72	OK						
CI6	0.63	OK						
CI7	*0.48*	*NO*						
CI8	0.65	OK						
CI9	0.65	OK						

ID	Weight	Status	CFI	Status	GFI	Status	RMSEA	Status
CI1	0.56	OK	0.820	acceptable	0.877	acceptable	0.173	poor
CI2	0.52	OK						
CI3	0.65	OK						
CI5	0.75	OK						
CI6	0.66	OK						
CI8	0.62	OK						
CI9	0.67	OK						

After removing those items, we got the model construction law fit as expressed in the table.

8. Construction Quality Management System

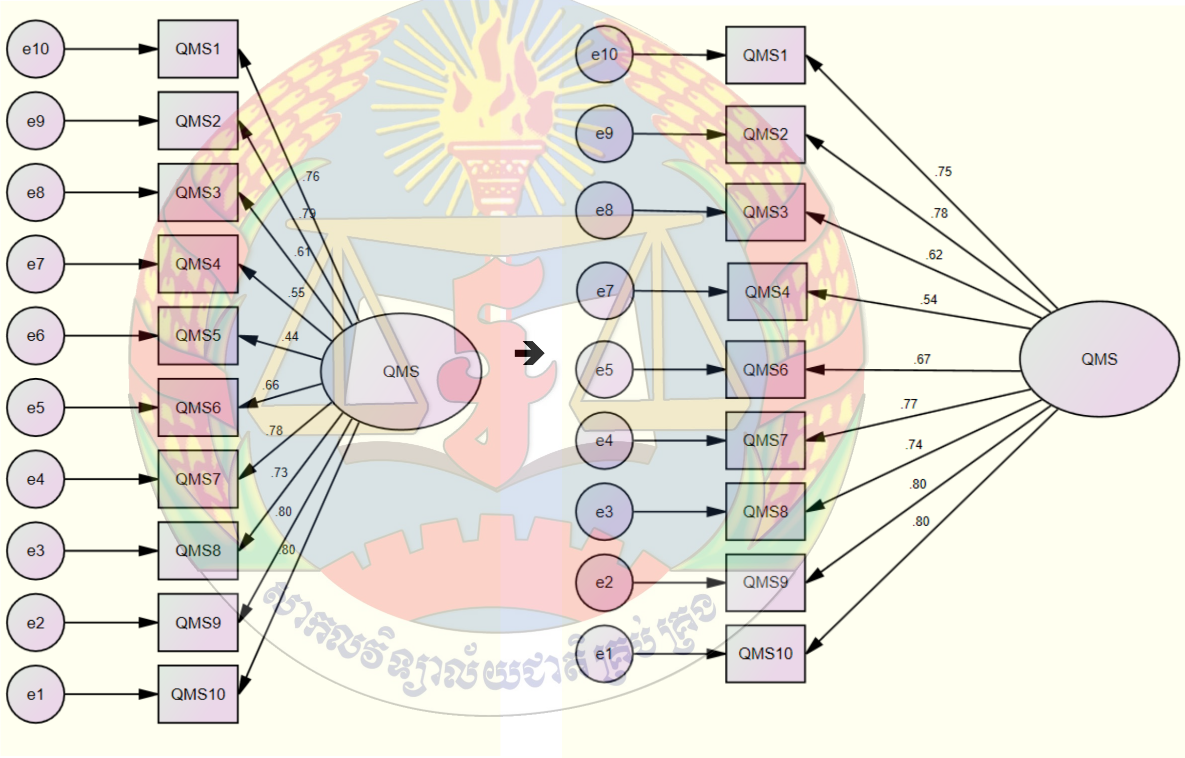

Figure: CFA Construction Quality Management System after drop Constructs

ID	Weight	Status	CFI	Status	GFI	Status	RMSEA	Status
QMS1	0.76	OK	0.918	good	0.905	good	0.109	poor
QMS2	0.79	OK						
QMS3	0.61	OK						
QMS4	0.55	OK						
QMS5	*0.44*	*NO*						
QMS6	0.66	OK						
QMS7	0.78	OK						
QMS8	0.73	OK						
QMS9	0.80	OK						
QMS10	0.80	OK						

From the result above, we observe the construct measurement weight is below 0.50. So, we omit items QMS5 to model fit. After removing these items, we got the model construction quality management system fit as expressed in the table.

ID	Weight	Status	CFI	Status	GFI	Status	RMSEA	Status
QMS1	0.75	OK	0.937	good	0.921	good	0.105	borderline
QMS2	0.78	OK						
QMS3	0.62	OK						
QMS4	0.54	OK						
QMS6	0.67	OK						
QMS7	0.77	OK						
QMS8	0.74	OK						
QMS9	0.80	OK						
QMS10	0.80	OK						

9. Quality of Construction Projects

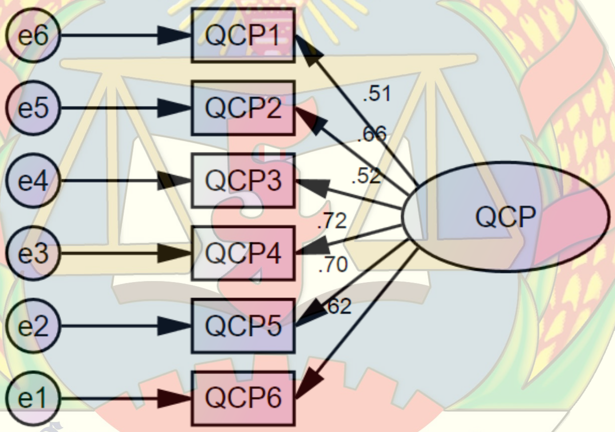

Figure: CFA Quality of Construction Projects after drop Constructs

ID	Weight	Status	CFI	Status	GFI	Status	RMSEA	Status
QCP1	0.51	OK	0.913	good	0.950	excellent	0.123	poor
QCP2	0.66	OK						
QCP3	0.52	OK						
QCP4	0.72	OK						
QCP5	0.70	OK						
QCP6	0.62	OK						

For the model quality of construction projects, the model fit and all constructs are all ok.

****** This is the End of Factor Analysis *******

APPENDIX D – RELIABILITY AND VALIDITY OF MODEL MEASUREMENT

Reliability of Model Measurement

Model 1: Independent (X)-Mediation CQMS (M)-Dependent (Y)

Summary table of standardized regression weight, error variances, and value calculation of compound reliability (C.R) for model 1.

Table D.1: Compound Reliability of Model 1

Factors	Construct Measurements		Standardized Regression Weights	Error Variances	$S(Load)^2$	S(Error)	CR
Stakeholder Involvement	Supplier	F1	0.587	0.292	3.54	0.84	0.81
	Sub Contractor Involvement in Project	F1	0.706	0.308			
	Engineer Involvement	F1	0.588	0.243			
Project Funding	Sufficient Product Technical Requirement	F2	0.777	0.261	5.51	0.77	0.88
	Project Cost Estimation	F2	0.829	0.237			
	Construction Sechedule due to Owner	F2	0.742	0.276			
Construction Materials	Quality of Materials	F3	0.68	0.211	3.08	0.79	0.80
	Material or Equipment Specification	F3	0.547	0.311			
	Cost of Materials	F3	0.528	0.272			
Project Management Competence	Solution Development	F4	0.61	0.332	9.73	1.74	0.85
	Effective Project Management System	F4	0.504	0.388			
	Motivation	F4	0.665	0.326			
	Leadership	F4	0.544	0.374			
	Conflict Managment	F4	0.797	0.321			
Project Complexity	Number of Project Goals	F5	0.606	0.317	60.76	3.83	0.94
	Lack of Resources and Skills	F5	0.605	0.45			
	Lack of Experience with Partners	F5	0.733	0.356			
	Technical Risks	F5	0.587	0.377			
	Level of Competition	F5	0.59	0.464			
	Lack of Experience in the Country	F5	0.808	0.302			
	Political Influences	F5	0.753	0.308			
	Involvement of Different Time Zones	F5	0.8	0.326			
	Number of Different Languages	F5	0.789	0.321			
	Interference between Existing Sites	F5	0.771	0.302			
	Number of Locations	F5	0.753	0.304			

Factors	Construct Measurements		Standardized Regression Weights	Error Variances	$S(Load)^2$	S(Error)	CR
Construction Quality Management System	Lack External Advisers Propoerly Qualified	F6	0.746	0.301	41.87	2.68	0.94
	Lack Top Management Involvement	F6	0.8	0.262			
	Lack Cooperation from Suppliers	F6	0.75	0.262			
	Lack Communication Routes	F6	0.714	0.247			
	Standard Difficult to Interpret	F6	0.678	0.325			
	Insufficiency Project Time	F6	0.559	0.413			
	Lack Training Program Quality	F6	0.633	0.36			
	Difficulties Cooperation Middle Manager Quality	F6	0.798	0.225			
	Lack of Employee Involvement	F6	0.793	0.283			
Quality of Construction Project	Avoid Disputes and Claims	F7	0.759	0.261	3.23	1.27	0.72
	Motivation Empowerment Employees	F7	0.74	0.346			
	Enhancing Customer Satisfaction	F7	0.531	0.362			
	Completion Project Time	F7	0.527	0.297			

Model 2: Independent (X)-Mediation CL (M)-Dependent (Y)

Summary table of standardized regression weight, error variances, and value calculation of compound reliability (C.R) for model 2.

Table D.2: Compound Reliability of Model 2

Factors	Construct Measurements		Standardized Regression Weights	Error Variances	S(Load)^2	S(Error)	CR
Construction Disputes	Project Participants with Unexpected Condition	F1	0.612	0.301	132.83	6.08	0.96
	Blaming	F1	0.582	0.47			
	Different Profession	F1	0.513	0.388			
	Fraud and Faith on Works	F1	0.742	0.368			
	Impolite and Lack of Courtesy Among each Professional Parties	F1	0.764	0.289			
	Desire to be Always Rights on the Option Given	F1	0.767	0.311			
	Anger Rudeness and Hatred Toward Other Parties	F1	0.752	0.335			
	Disputes Over Payement	F1	0.677	0.378			
	Miscalculations and Over Calculations	F1	0.749	0.311			
	Contract Clause Unrealistically and Unfairly	F1	0.738	0.33			
	Ambiguous Contract Provision	F1	0.737	0.354			
	Over Design by Design Team	F1	0.745	0.371			
	Role Conflict Among the Participants	F1	0.551	0.405			
	Contract Low Bid	F1	0.563	0.481			
	Late Instruction from Designer	F1	0.764	0.28			
	Unrealistic Clients Expectation	F1	0.749	0.314			
	Error and Incomplete Technical Specification	F1	0.52	0.389			
Cambodian Law on Construction	Operations Site Have License Engineer Check Quality	F2	0.823	0.228	10.73	1.77	0.86
	Construction Site Achieved Puplic Security Safety Environment	F2	0.533	0.412			
	Design Document Signed By License Designer	F2	0.73	0.379			
	Construction Registered at Board of Construction	F2	0.651	0.381			
	Having Fire Safety	F2	0.538	0.365			
Quality of Construction Project	Performance-Based Purpose	F3	0.519	0.242	10.13	1.41	0.88
	Avoid Disputes and Claims	F3	0.709	0.306			
	Motivation Empowerment Employees	F3	0.829	0.238			
	Enhancing Customer Satisfaction	F3	0.571	0.34			
	Completion Project Time	F3	0.555	0.284			

Table D.3: Summary Value of C.R for Models 1 & 2

ID	Factors	Σ(Load)^2 (A)	Σ(Error) (B)	C.R A/(A+B)	Status
1	Stakeholder Involvement	3.54	0.84	0.81	OK
2	Project Funding	5.51	0.77	0.88	OK
3	Construction Materials	3.08	0.79	0.80	OK
4	Project Management Competence	9.73	1.74	0.85	OK
5	Project Complexity	60.76	3.83	0.94	OK
6	Construction Disputes	132.83	6.08	0.96	OK
7	Cambodian Law on Construction	10.73	1.77	0.86	OK
8	Construction Quality Management System	41.87	2.68	0.94	OK
9	Quality of Construction Projects	10.13	1.41	0.88	OK

Convergent Validity of Model Measurement

Model 1: Independent (X)-Mediation CQMS (M)-Dependent (Y)

Summary table of standardized regression weight, and value of Convergent validity average (AVE) for model 1.

Table D.4: Value of Convergent Validity for Model 1

		Estimate	Square (Loading)	AVE
Supplier	F1	0.712	0.507	
Sub Contractor Involvement in Project	F1	0.712	0.507	0.501
Engineer Involvement	F1	0.699	0.489	
Sufficient Product Technical Requirement	F2	0.755	0.570	
Project Cost Estimation	F2	0.862	0.743	0.638
Construction due to Owner	F2	0.776	0.602	
Quality of Materials	F3	0.860	0.740	
Material or Equipment Specification	F3	0.743	0.552	0.564
Cost of Materials	F3	0.760	0.578	
Source of Mateirals	F3	0.623	0.388	
Solution Development	F4	0.767	0.588	
Effective Project Management System	F4	0.639	0.408	
Management Commitment	F4	0.604	0.365	0.530
Motivation	F4	0.756	0.572	
Leadership	F4	0.660	0.436	
Conflict Managment	F4	0.902	0.814	
Number of Project Goals	F5	0.600	0.360	
Lack of Resources and Skills	F5	0.617	0.381	
Lack of Experience with Partners	F5	0.734	0.539	
Technical Risks	F5	0.571	0.326	
Level of Competition	F5	0.596	0.355	
Lack of Experience in the Country	F5	0.787	0.619	0.502
Political Influences	F5	0.765	0.585	
Involvement of Different Time Zones	F5	0.792	0.627	
Number of Different Languages	F5	0.756	0.572	
Interference between Existing Sites	F5	0.765	0.585	
Number of Locations	F5	0.757	0.573	
Lack External Advisers Propoerly Qualified	F6	0.777	0.604	
Lack Top Management Involvement	F6	0.803	0.645	
Lack Cooperation from Suppliers	F6	0.743	0.552	
Lack Communication Routes	F6	0.742	0.551	
Standard Difficult to Interpret	F6	0.666	0.444	0.523
Insufficiency Project Time	F6	0.546	0.298	
Lack Training Program Quality	F6	0.621	0.386	
Difficulties Cooperation Middle Manager Quality	F6	0.786	0.618	
Lack of Employee Involvement	F6	0.784	0.615	
Performance Based Purpose	F7	0.650	0.423	
Avoid Disputes and Claims	F7	0.852	0.726	
Motivation Empowerment Employees	F7	0.843	0.711	0.519
Enhancing Customer Satisfaction	F7	0.644	0.415	
Completion Project on Time	F7	0.703	0.494	
Satisfaction Contract Specification	F7	0.587	0.345	

Model 2: Independent (X)-Mediation CL (M)-Dependent (Y)

Summary table of standardized regression weight, and value of Convergent validity average (AVE) for model 2.

Table D.5: Value of Convergent Validity for Model 2

		Estimate	Square (Loading)	AVE
Project Participants with Unexpected Condition	F1	0.712	0.507	0.520
Blaming	F1	0.682	0.465	
Different Profession	F1	0.613	0.376	
Fraud and Faith on Works	F1	0.742	0.551	
Impolite and Lack of Courtesy Among Each Professional Parties	F1	0.764	0.584	
Desire to be Always Rights on the Option Given	F1	0.767	0.588	
Anger Rudeness and Hatred Toward Other Parties	F1	0.752	0.566	
Disputes Over Payement	F1	0.777	0.604	
Miscalculations and Over Calculations	F1	0.749	0.561	
Contract Clause Unrealistically and Unfairly	F1	0.738	0.545	
Ambiguous Contract Provision	F1	0.737	0.543	
Over Design by Design Team	F1	0.745	0.555	
Role Conflict Among the Participants	F1	0.651	0.424	
Contract Low Bid	F1	0.663	0.440	
Late Instruction from Designer	F1	0.764	0.584	
Unrealistic Clients Expectation	F1	0.749	0.561	
Error and Incomplete Technical Specification	F1	0.620	0.384	
Operations Site Have License Engineer Check Quality	F2	0.823	0.677	0.548
Construction Site Achieved Puplic Security Safety Environment	F2	0.633	0.401	
Design Document Signed By License Designer	F2	0.830	0.689	
Construction Registered at Board of Construction	F2	0.751	0.564	
Having Fire Safety	F2	0.638	0.407	
Performance Based Purpose	F3	0.619	0.383	0.556
Avoid Disputes and Claims	F3	0.809	0.654	
Motivation Empowerment Employees	F3	0.929	0.863	
Enhancing Customer Satisfaction	F3	0.671	0.450	
Completion Project on Time	F3	0.655	0.429	

Table D.6: Summary Average Value Convergent Validity for Models 1 & 2

No	Factors	AVE	Status
1	Stakeholder Involvement	0.501	OK
2	Project Funding	0.638	OK
3	Construction Materials	0.564	OK
4	Project Management Competence	0.530	OK
5	Project Complexity	0.502	OK
6	Construction Disputes	0.520	OK
7	Cambodian Law on Construction	0.550	OK
8	Construction Quality Management System	0.523	OK
9	Quality of Construction Projects	0.560	OK

Discriminant Validity of Model Measurement

Table D.7: Summary Square Roof of Convergent Validity

No	Factors	AVE	Sqrtroot.(AVE)
1	Stakeholder Involvement	0.501	0.708
2	Project Funding	0.638	0.799
3	Construction Materials	0.564	0.751
4	Project Management Competence	0.530	0.728
5	Project Complexity	0.502	0.709
6	Construction Disputes	0.520	0.721
7	Cambodian Law on Construction	0.550	0.742
8	Construction Quality Management System	0.523	0.723
9	Quality of Construction Projects	0.560	0.748

Table D.8: Value of Correlation between two Constructs

Model1			Estimate
F1	<-->	F2	0.403
F1	<-->	F3	0.648
F1	<-->	F4	0.646
F1	<-->	F5	0.552
F1	<-->	F6	0.4
F1	<-->	F7	0.58
F2	<-->	F3	0.474
F2	<-->	F4	0.77
F2	<-->	F5	0.886
F2	<-->	F6	0.832
F2	<-->	F7	0.537
F3	<-->	F4	0.671
F3	<-->	F5	0.546
F3	<-->	F6	0.346
F3	<-->	F7	0.623
F4	<-->	F5	0.912
F4	<-->	F6	0.817
F4	<-->	F7	0.788
F5	<-->	F6	0.914
F5	<-->	F7	0.712
F6	<-->	F7	0.762

Model2			Estimate
F1	<-->	F2	0.837
F2	<-->	F3	0.669
F1	<-->	F3	0.717
e1	<-->	e3	0.228
e1	<-->	e8	-0.041
e1	<-->	e9	0.234
e2	<-->	e7	-0.233
e4	<-->	e16	-0.219
e7	<-->	e8	0.351
e7	<-->	e12	-0.162
e7	<-->	e14	0.164
e8	<-->	e9	-0.027
e8	<-->	e11	0.26
e8	<-->	e12	-0.121
e8	<-->	e14	0.291
e10	<-->	e11	0.082
e11	<-->	e12	-0.282
e11	<-->	e13	-0.195
e11	<-->	e14	0.192
e12	<-->	e14	-0.19
e12	<-->	e16	0.213
e19	<-->	e22	0.212
e21	<-->	e22	0.204
e25	<-->	e29	0.292
e27	<-->	e28	-0.442
e4	<-->	e11	-0.258

Table D.9: Value Compared to the Square Root of the AVE

	Stakeholder	Project Funding	Construction Materials	Project Management Competence	Project Complexity	Construction Disputes	Cambodian Law on Construction	Construction Quality Management System	Quality of Construction Projects
Stakeholder	***0.708***								
Project Funding	0.403	***0.799***							
Construction Materials	0.648	0.474	***0.751***						
Project Management Competence	0.646	0.770	0.671	***0.728***					
Project Complexity	0.552	*0.886*	0.546	*0.912*	***0.709***				
Construction Disputes						***0.721***			
Cambodian Law on Construction						0.717	***0.742***		
Construction Quality Management System	0.400	*0.832*	0.346	*0.817*	*0.914*			***0.723***	
Quality of Construction Projects	0.580	0.537	0.623	*0.788*	*0.712*	0.837	0.669	*0.731*	***0.748***

From the above result, we see correlation values are bigger than the square root of the AVE value of convergent validity. So, there are the existents of discriminant validity. Discriminant validity has to eliminate by removing some construct measurements, which square loading weight lower value.

1. Project Funding: PRF5
2. Project Management Competence: PMC2, PMC4
3. Project Complexity: PRC15, PRC16, PRC17, PRC18, and PRC19.
4. Construction Disputes: CC3, CC4, CC5, CC12, CC13, CC15, CC16, and CC19
5. Cambodian Law on Construction: CL3, and CL8
6. Construction Quality Management System: QMS3, QMS4, and QMS6
7. Quality of Construction Projects: QCP1, and QCP6

Model 1: After eliminating those constructs, we observed that model 1 still fit. CMIN/DF (4.124 < 5, OK), GFI (0.807 > 0.8, OK), CFI (0.841 > 0.8), and RMSEA (0.090 < 0.10), and the convergent validity of the 7 factors are more acceptable which value is bigger than 0.50.

Model 2: After eliminating those constructs, we observed that model 2 still fit. CMIN/DF (4.493 < 5, OK), GFI (0.909 > 0.8, OK), CFI (0.921 > 0.8), and RMSEA (0.095 < 0.10), and the convergent validity of the 3 factors are more acceptable which value is bigger than 0.50.

Table D.10: New Average Value Convergent Validity for Models 1 & 2

No	Factors	AVE	AVE (new)	Sqrt Root (AVE)
1	Stakeholder Involvement	0.501	0.501	0.708
2	Project Funding	0.638	0.670	0.820
3	Construction Materials	0.564	0.564	0.751
4	Project Management Competence	0.530	0.600	0.771
5	Project Complexity	0.502	0.590	0.771
6	Construction Disputes	0.520	0.570	0.757
7	Cambodian Law on Construction	0.550	0.640	0.802
8	Construction Quality Management System	0.523	0.600	0.773
9	Quality of Construction Projects	0.560	0.600	0.774

Table D.11: New Value of Correlation between two Constructs for Model 1

			Estimate
F1	<-->	F2	.330
F1	<-->	F3	.645
F1	<-->	F4	.645
F1	<-->	F5	.532
F1	<-->	F6	.402
F1	<-->	F7	.584
F2	<-->	F3	.447
F2	<-->	F4	.789
F2	<-->	F5	.819
F2	<-->	F6	.800
F2	<-->	F7	.600
F3	<-->	F4	.631
F3	<-->	F5	.533
F3	<-->	F6	.321
F3	<-->	F7	.606
F4	<-->	F5	.760
F4	<-->	F6	.770
F4	<-->	F7	.718
F5	<-->	F6	.730
F5	<-->	F7	.703
F6	<-->	F7	.731
e6	<-->	e9	-.092
e8	<-->	e9	.190

e10	<-->	e12	-.084
e10	<-->	e13	.213
e11	<-->	e12	.229
e14	<-->	e16	.179
e14	<-->	e17	-.242
e15	<-->	e16	.168
e16	<-->	e17	-.132
e16	<-->	e18	-.212
e16	<-->	e19	.132
e20	<-->	e22	.169
e20	<-->	e23	.257
e22	<-->	e24	-.121
e22	<-->	e25	-.181
e27	<-->	e28	-.228
e27	<-->	e29	.270

Table D.12: New Value of Correlation between two Constructs for Model 2

			Estimate
F1	<-->	F2	.330
F1	<-->	F3	.645
F1	<-->	F4	.645
F1	<-->	F5	.532
F1	<-->	F6	.402
F1	<-->	F7	.584
F2	<-->	F3	.447
F2	<-->	F4	.789
F2	<-->	F5	.840
F2	<-->	F6	.800
F2	<-->	F7	.600
F3	<-->	F4	.631
F3	<-->	F5	.533
F3	<-->	F6	.321
F3	<-->	F7	.606
F4	<-->	F5	.960
F4	<-->	F6	.880
F4	<-->	F7	.918

			Estimate
F5	<-->	F6	.930
F5	<-->	F7	.803
F6	<-->	F7	.831
e6	<-->	e9	-.092
e8	<-->	e9	.190
e10	<-->	e12	-.084
e10	<-->	e13	.213
e11	<-->	e12	.229
e14	<-->	e16	.179
e14	<-->	e17	-.242
e15	<-->	e16	.168
e16	<-->	e17	-.132
e16	<-->	e18	-.212
e16	<-->	e19	.132
e20	<-->	e22	.169
e20	<-->	e23	.257
e22	<-->	e24	-.121
e22	<-->	e25	-.181
e27	<-->	e28	-.228
e27	<-->	e29	.270

The value of correlation is better and can accept. From the table below, we can see that all correlation factor value is bigger than the corresponding correlation coefficient of the factor. We conclude that the study model is fit and satisfies the validity of both convergent and discriminant. Hence, the model is ok to measure in Structural Equation Model Analysis.

Table D.13: Value Compare to the Square Root of the New AVE

	Stakeholder Involvement	Project Funding	Construction Materials	Project Management Competence	Project Complexity	Constructio n Disputes	Cambodian Law on Construction	Construction Quality Management System	Quality of Construction Project
Stakeholder Involvement	***0.708***								
Project Funding	0.330	***0.820***							
Construction Materials	0.645	0.447	***0.751***						
Project Management Competence	0.645	0.789	0.631	***0.771***					
Project Complexity	0.532	*0.819*	0.533	*0.760*	***0.771***				
Construction Disputes						***0.757***			
Cambodian Law on Construction						0.666	***0.802***		
Construction Quality Management System	0.402	0.800	0.321	*0.770*	*0.730*			***0.773***	
Quality of Construction Project	0.584	0.600	0.606	*0.718*	*0.703*	0.551	0.792	*0.731*	***0.774***

****** This is the End of the Reliability and Validity of Model *******