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Analysis of Construction Supply Chain and Identification of Risks Involved in it

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Abstract - *The construction industry has struggled to integrate Supply Chain Management (SCM) concepts and develop models to aid decision-making and planning. The purpose of this research is to improvise the CSC by identifying several factors affecting Supply Chain Management implementation in construction projects, which, once implemented, would assure effective Supply Chain Management in the construction industry. Construction projects confront many hazards throughout their lifespan due to the inherent complexities and subtle interconnections between varied parties involved in the construction process. As a result, good risk management throughout the project's supply chain is vital to minimize schedule and expense overruns, which, if not adequately controlled, will lead to project failure. Risk management decisions in construction supply chains that can be applied for a variety of projects would save construction companies a lot of money. This paper identifies the key risk factors in implementation of construction supply chain. Firstly, the important factors and function in CSC are identified through a literature review and wide questionnaire survey. Then the major risks related to these factors are then proposed and categorized. Data analysis techniques such as single factor ANOVA test, chi-square test are adopted for data analysis.*

Key Words: Supply chain management, Construction industry, Risk management, Construction projects, engineer to order, etc

1. INTRODUCTION

Construction industry is critical to a country's economic success. Because of industrialization, urbanization, and infrastructural development, it is critical for growth. The construction industry is both diverse and disorganized. In addition, the majority of construction companies are small and medium-sized businesses. Supply chain management that is both efficient and long-term is critical to a project's success. It is not repetitive or generic, as it is in the manufacturing industry. It's one-of-a-kind, project-specific, and only exists for a limited time. Furthermore, extrinsic factors such as weather conditions have an impact on project completion. A construction project's supply chain could include number of businesses, including contractors, subcontractors, material and equipment suppliers, engineering and design organizations, and consulting organizations. Construction projects also necessitate a high level of coordination among many stakeholders, who may have competing interests throughout the project's life cycle and entail a variety of short and long-term business to business relationships. The procurement of each item and service entails risks at numerous points along the supply chain. Numerous natural and man-made calamities (e.g. earthquakes, economic crises, war, terrorist attacks, and sanctions) have disrupted supply chain activities in prior decades. It has been discovered that considerable evidence of the frequency of man-made disasters causing disruptions has been increasing significantly since the twentieth century. It is found that the frequency and size of these disruptions are growing (Blackhurst, Craighead, Elkins, & Handfield, 2005). Because supply chain interruptions are unavoidable, all supply chains are fundamentally dangerous. As a result, good risk management in construction supply chains is critical to the successful completion of building projects. A systematic method to identifying emerging hazards in the construction SC is a vital step for SC members to effectively manage risks; yet, there is a scarcity of trustworthy information to help in this process (Aloini et al., 2012). Using a mixture of literature synthesis and a questionnaire survey, this paper tries to examine potential risks in the construction SC. Supply Chain Management Risk management is becoming increasingly relevant in most aspects of management decision-making and control. Individual hazards are frequently interrelated, making supply chain risk management complex. As a result, efforts that are intended to minimize one risk may actually worsen another. Due to the inherent intricacies and nuanced interconnections between diverse stakeholders involved in the construction process, construction projects face multiple risks throughout their existence. As a result, good risk management throughout the project's supply chain is vital to minimize schedule and expense overruns, which, if not adequately controlled, will lead to project failure. Despite the importance of this issue, there is a disconnect between project risk management literature and practice, with managers preferring to

depend on their personal experiences rather than employing available analytical techniques. The adoption of best practices from the manufacturing business (such as SCM and SCRM) in the service business, on the other hand, is mostly ignored.

2. Literature Review

2.1 Construction Supply Chain Management

The goal of this paper is to launch a special issue focused on the construction industry and its SC management. Its goal is to compare and contrast some of the distinctions and similarities between conventional manufacturing and its alternatives. The construction industry's market is primarily local and highly variable. The construction "product's" lengthy endurance contributes to the volatility. Before the customer order arrives, the product specification process reveals various degrees of specifications: engineer to order, change to order, configure to order, and choose a variant. Only a small portion of a project is completed by a construction company's own workers and resources. This is a risk-spreading and risk-mitigation strategy designed to compensate for market volatility. The primary difference between building and manufacturing is that construction is project-based and discontinuous, whereas manufacturing involves continuous processes and connections. Management of supply chain relationships, on the other hand, is particularly difficult in project-based sectors due to demand fluctuations. Projects, the technical, financial, and other aspects of each project's uniqueness and in socio-political aspects, as well as the project's complexity. (Segerstedt & Olofsson, 2010)
Based on a review of some important research issues relevant to construction supply chains, the aim of this study was to explain some of the many perplexing questions trying to link managers of overwhelmingly complex construction supply chain management (CSCM). This research used a qualitative technique of triangulation in combination with foundational analysis methods and soft system methodology to validate the dynamic CSCM frameworks in a coal-based thermal power plant project. Finally, this research offers practical suggestions for future research in the field of multidisciplinary construction projects. This research provides a knowledge basis that might aid in enhancing management effectiveness in achieving construction project goals for strategic value development. This research offers an information base that could assist in enhancing managerial effectiveness in achieving construction project targets for strategic value creation. (Beheraa, Mohantya, & Prakashb, 2015)

SCM offers opportunities for the construction industry to have more project control, raise income, and minimize time, costs and waste. Although the material and construction chains are the largest, the CSC consists of several classes. Integrating the construction and material chains helps to create further coordination, a smoother flow of information and a more effective exchange of information across the construction chain that supports the decision-making process. SCM faces many difficulties in the construction industry related to inadequate preparation of logistics, lack of collaborations and strategic alliances with suppliers, resistance to change and issues with communication. In order to create a successful integrated supply chain, long-term relationships need to be formed between consumers, manufacturers, contractors and other parties in the supply chain, to form open contact networks and to benefit from each other's experience for the greater good. Early participation of both stakeholders, training of project workers, fair payment, knowledge of the benefits of incorporation, comprehension of current contractual documents and being familiar with them. If aimed at all parties in the supply chain, including the main contractor, subcontractor and supplier, the total construction costs will be minimized. (Al-Werikat,2017)

A chain of issues originates from a lack of cooperation in the construction supply chain. The aim of this paper is to add to our understanding of CSC coordination and how a lack of it can influence their SC output. Coordination involves a number of processes, with the provision of information from unit of analysis suppliers being the key focus here. This supplier insight helps the construction management sector to make analytical implications by explaining on how closely coupled participants in construction, such as suppliers, are affected in terms of information availability. Earlier analysis in this field viewed all suppliers as though they were all the same. The managerial contribution is in deciding what sort of information suppliers will benefit from. (Backstrand & Fredriksson, 2020)

2.2 Improvisation and Integration of CSC

In view of the industry's current fragmentation, the authors argue that supply chain information systems should be applied in a systematic, staged manner to provide comprehensive solutions to supply management issues. We look at what we've learnt from supply chain IT applications in production and building in this paper. This research is used to establish guidelines for CSC capability-related information technology sets to aid implementation efforts. The construction industry will certainly adopt and adapt some of the technologies, procedures, and systems thinking used in manufacturing SCM as the Internet matures and business process automation in the manufacturing SC increases. (Vaidyanathan & O'Brien, 2004)

Present a conceptual framework of construction supply chain integration (CSCI) to address the CSC issues. This explains the main components of CSCI in a detailed way. A brief overview of existing supply chain challenges in

the building industry is presented. Detailed inquiries are focused on a systematic literature analysis, organizational relationship, collaboration, coordination, feedback, trust and incentive. As one of the major problems of the construction industry, the degree of integration in construction procurement remains one of the key problems of the construction supply chain, primarily due to the characteristics of the industry. The lack of strategic partnerships, the culture of mistrust between partners and the fractured supply chains create tremendous challenges for players in the construction sector and make it less integrated. (Zhendong & Zhenmin, 2010)

The construction industry has a considerable negative impact on the environment. Environmental and societal issues are forcing the building industry to 'go green.' Green supply chain management has the ability to enable sector transformation through a holistic approach. In recent years, research on GSCM in building has increased, although it has not yet been properly brought together. A systematic literature review (SLR) is offered, using the methodology's high requirements of rigour and transparency. A total of 44 papers were included in the comprehensive analysis from a total of 207 publications found during the initial search. The articles are characterised in terms of the publication outlet, the date of publication, the geographic setting, the methods employed, the tools and techniques employed, the conceptual description, and the role of stakeholders. This study used a systematic literature evaluation to provide a comprehensive and thorough perspective on Green SCM research published in the construction industry before the end of August 2017. The examined academic work has a major impact on the advancement of Green SCM in building. The evaluated sources were categorised by publication outlet, publication date, geographic setting, methods used, tools and techniques, conceptual definition, and stakeholder role. The importance of the studies' practical consequences was also emphasised. A recommended categorization of research techniques and a detailed description of Green SCM have emerged from the synthesis. (Badi & Murtagh, 2019)

One of the most important aspects in enhancing construction supply chain performance is construction supply chain integration (CSCI), especially for projects combining building information modelling (BIM) and prefabrication. CSCI has been extensively explored, yet there is still no agreement on its definition, scope, or benchmark. Researchers have pointed out that, given the rapid rise of information technology applications in the construction sector, the degree of application, efficacy, and trends of CSCI need to be examined more systematically and in depth. The goal of this research is to define the concept, scope, and goals of SCI, as well as to identify common research subjects. The fragmented nature of the construction industry makes CSC integration extremely difficult (Vrijhoef and Koskela 2000). First, most construction projects are transitory supply chains that must be adjusted for each project due to the uniqueness and complexity of the construction process, which raises the variability and unpredictability of CSC integration. (Lu, et al., 2019)

A supply chain network has been planned for inventory management in this report, which includes not only the project site storage facility but also an ancillary warehouse for materials storage. Multi-criteria decision-making methods were used to assess the best location for the warehouse. The problem of ordering the necessary sum to the project site, while taking into account an additional warehouse is solved mathematically in this analysis. To put an end to the debate, a numerical example was given. This result confirms that uncertainty variables can have a huge effect on cost estimation. The objective sum would increase if the fuzzy triangular number is used and three distribution costs are calculated, though using two or less numbers will minimise the margin cost. (Mohammadnazari & Ghannadpour, 2020)

The construction supply chain is analysed in this analysis using a bi-objective linear programming mathematical model. To accomplish this aim, the real environmental impacts of vehicles are considered in terms of distance, pollution rate, and road slope. In the proposed green supply chain, this paper also addresses the synergy between supplier selection and project planning and scheduling. The CSC is evaluated in this analysis using a two-objective linear programming mathematical model that takes into account the actual environmental impacts of vehicles based on distance, pollution intensity and road slope. In this report, the SC is also implemented into the model, while also taking into account the project's time constraints in order to reduce logistical costs, pollution rate, and gas emissions are also minimized. (Rezahoseini, et al., 2021)

2.3 CSC Risk Management

Risk drivers, risk management influencers, decision maker attributes, risk management responses, and success results are all part of a broader Supply Chain Risk Management System. The emphasis is on risk management influencers, considering the fact that other elements have been discussed in the operations literature. The case study showed that Supply Chain Risk Management is a disorganised mechanism involving a number of stakeholders. According to the facts, not all of the players are active or "on stage" at the same time, nor are they continuously involved in the decision-making process. Others are brought in to provide reassurance to the key Risk Management players, while others are brought in to provide some form of protection in the

event that risk management fails. (Ritchie & Brindley, 2007)

Recently, SCRM has grown in popularity as a study topic. Since a few years ago, a number of papers have been published, each with a different focus and methodology. The purpose of this paper is to conduct a literature review of SCRM. Conceptual, descriptive, empirical, exploratory cross-sectional, and exploratory longitudinal papers published between 2000 and 2007 are analysed and grouped into five categories: conceptual, descriptive, empirical, exploratory cross-sectional, and exploratory longitudinal. We also considered the categories of hazards, the unit of analysis, the industry sectors, and the risk management strategies discussed in the publications. Understanding the many types of risks, their likelihood of occurrence, and their consequences is a good place to start when developing successful risk management techniques. (Vanany & Pujawan, 2009)

How the substantive causes of project risk in construction supply chains can be identified and classified is the main research issue discussed in this article. A three-phase structure for uncertainty identification & categorization is proposed. The analytical analysis reported in this paper shows how the structure can be applied to the ETO (engineer-to-order) project community. Using various methods of data collection, including site visits, interviews, and business conferences, the uncertainties are defined and classified using the system to illustrate its use in five projects. To cover a variety of construction projects, the structure thus defined is generalized. This paper is valuable because the instability circle, a proven model that has not yet been implemented in the construction industry, is generalized and refined. The model has recently only been applicable to high volume, routine sectors of make-to-stock. (Gosling, et al., 2013)

This paper discusses the application of the FMECA (Failure Mode, Effects, and Criticality Analysis) method and discrete event simulation to analyze supply chain risks, locate vulnerabilities, and calculate the impact of a ready-mix concrete supply chain interruption. Interviews with managers of concrete batch plants and current data on demand, production and delivery performance served as input for assessment. They have offered a systematic approach that can be used to facilitate the preparation and supply of ready-mix concrete by concrete suppliers. Based on our results, various mitigation techniques were proposed. A technique of productive and criticality analysis (FMECA) failure mode combined with simulation modelling approach for Just-in-Time supply chains risk management has been introduced in this paper. (Azambuja & Chen, 2014)

The potential reasons prompting overload/abundance/excess stocks in stock administration of development organizations and their effects on stock expenses. Inventory network the board in itself is a worth chain which includes streams of data and items through different hubs beginning from getting crude materials, fabricating the planned items, delivering the completed items to wholesalers, merchants, retailers, introducing the materials to projects. It is profoundly significant that precise data is kept up at each degree of store network regarding request estimate to decide the measure of stock to be kept in stock to meet the business edges and client support assumptions. Overload in development production network is additionally a basic issue. By and large, this exploration gathers information from various sources to distinguish the variables causing overflow stock circumstances and their effects on stock administration costs as capital expenses, stock expenses, stockpiling expenses and dangers. The examination likewise incorporates a re-enactment model to exhibit the expense of conveying abundance stock. At last, the conversation ponders how the expenses of holding overabundance stock can grow out of real deals edges of stock close-by. (Xie & Palani, 2018)

Modular building systems, which take advantage of advanced manufacturing, transport, and assembly processes, are currently replacing conventional in-situ construction methods. This change presents a challenge to construction supply chains, which have traditionally focused exclusively on raw material transportation. This study proposes a mathematical model for developing and maximising risk-averse logistics configurations for modular construction projects with organisational instability. The system discussed in this study will provide information on inventory adjustments over time and through the project's entire supply chain. This degree of data transparency is crucial for efficient output buffer control, as well as resource and capital consumption management across their entire operations portfolio. (Hsu, et al., 2020)

The assumed constant lead time limits the traditional economic order quantity (EOQ) approach for determining re-order point in the construction material procurement cycle. In a real-world building project, the lead time is rarely constant. This work used a PERT-based simulation model to determine the best re-order point and order size, with the goal of lowering the average order size. The simulation is done on the STROBOSCOPE simulation framework, which was developed by University of Michigan academics. Each phase of the procurement process is modelled using the duration data acquired from a building project. This research describes a simulation method for modelling building project supplier chains. It uses PERT to model the uncertainty in the duration of each supply chain activity. The simulation findings reveal that two parameters, order size (aka Economic Order Quantity) and minimum re-order threshold, have a considerable

influence on both idle time and average inventory level. (Kulkarni & Halder, 2020)

Production network hazards in development projects regarding life cycle and comparing partners. The exploration was coordinated with two phases. In the principal stage, a deliberate writing audit joined by a substance examination was led dependent on dangers in development supply chains (CSCs) to distinguish research holes, propose future exploration bearings, and backing resulting steps. At that point, three centre gathering conversations (FGDs) were performed by industry agents to (1) determine life cycle chances in CSCs, (2) partner indicated dangers to related partners, and (3) guarantee the job of every partner in CSCs. Consequences of the substance examination demonstrate that relationship, correspondence, and manageability are the most as often as possible analysed exploration zones, while advancement and hierarchical learning, provider weakness, and exchange are ignored in the writing The discoveries can be helpful for specialists by showing research holes, and for development organizations looking to build their inventory network execution through life cycle and partner draws near. (Koc & Gurgun, 2021)

3. METHODOLOGY

In this study, it is aimed to survey and suggest some methods for improvising supply chain management in construction industry of, along with identifying the risk factors affecting SCM and possible solutions for mitigation of these factors.
In order to fulfil the research aim of this study, proper methods must be chosen. This chapter mainly consist the method of performing the research study, selected according to the previous literature, and properties of various methods. The outline of this chapter includes the following:

- An extensive literature review of:
    1. The importance of a supply chain in construction
    2. Integration and improvisation of construction supply chain
    3. Risk management in construction supply chain and its management
- Questionnaire survey and data collection
- Data Analysis
- Identification of risks
- Implementing risk analysis
- Results and Conclusion

The methodology of this research study is divided in following steps in order to complete this study effectively. This research study is based on questionnaire survey. The questionnaire will be prepared on the basis of literature review from available resources. The questionnaire will be then sent to various professionals of construction industry. The criteria for selecting participants will be based on the experience in construction projects, interest in relevant field and qualification. Also the interviews or discussion will be conducted.

The data will be collected from questionnaire and interviews. This data will be analyzed and the risks involved in CSC will be identified and categorized. Impact of risks of various categories will be assessed. And finally a framework of guidelines for improvising supply chain management in order to handle risks will be suggested, some strategies to reduce waste in all aspects of CSC will also be suggested.

In this stage, the literature review has been performed according to the research work. The research work included a broad range of previously published works which were classified and analysed from construction supply chain management viewpoint. SCM studies during last two decades, specifically in construction field have been investigated in the paper, although none of the reviews about SCM principles were focused on risk management area of construction field.

Reviewing the available literature signified the absence of a construction supply chain risk management (CSCRM), which is theoretically and descriptively focused on risk assessment phase. Based on literature review, thirteen risk factors were identified, which signify the necessity to pay attention to project planning phase.

The third stage of risk identification and classification involves the preparation of a checklist, including different types of risks, identified risk factors, and SCM sub-context. The checklist is based on qualitative method of risk assessment, consisting of a column allocated to the probability value, and three separated columns to consider the impact level of each risk on time, cost and quality.

The questionnaire survey will also be prepared to understand the respondents level of knowledge about the concept of risk management, specifically in supply chain management, and their experience, in order to choose the best possible technique to control and respond the threats in this field.

The following three sections are designed in the questionnaire.

- Background information
- CSCM relevance
- Risk management relevance

3.1 Data Collection

To collect the necessary data for this investigation, the prepared checklists and questionnaire will be sent to construction companies and professionals in construction industry. Directors, quality managers, project managers, executive engineers, procurement and logistics managers, who have enough experience and knowledge about supply chain management in the industry will be the respondents of the survey. In this section key factors of SCM which may be effective on construction project are analyzed. Accordingly, respondents were given questionnaire with some variables and told to rate how these variables have impact on implementation of SCM in construction projects. In which respondent were told to rate their opinions on the Likert scale ranging from Not Important (l) to Very Important (5).

3.2 Data Analysis

The mean scores and single factor ANOVA test values were employed to compute for these variables in supply chain management. The surveys participants will be asked to evaluate the risks occurrence probabilities, along with their impacts on the project's cost, quality and timing. The mean scores and single factor ANOVA test values were employed to compute for these variables in supply chain management. The analysis based on the mean scores and ANOVA test reflected the strengths and weaknesses of the said variables in terms of supply chain management. To interpret the obtained data, the following numerical values and interpretations were used to measure their application in supply chain management in construction project.

4. RESULTS

4.1 Risk Identification

There are several approaches for identifying potential hazards, including checklists, which are popular due to their simplicity and speed. Checklists are mostly constructed based on past information and data obtained from similar projects and other sources of information. As previously stated, the hazards found in this study were mostly based on Aloini et al (2012). In the literature review part, ten risk factors and their sub-contexts were identified and analysed. The issues that were found are categorised hierarchically in the following section based on the concept of risk breakdown structure (RBS). Simons (1999) and Meulbroek (2000) research projects provided the foundation for the framework. This hierarchical arrangement can be seen in table.

Table -1: Risks Identified

Type of Risk	Risk Factor	CSC Sub-context
Strategic	Lack of knowledge regarding CSC	Lack of knowledge regarding CSC
	Use of old techniques	Lack of IT support
	Functions of internal organization	Inventory
		Purchasing
		Transport
		Storage
Operational	Supplier related operational factors	Cost benefits
		Better quality service
		Standardization of processes
		Simplifying the ordering process
		Simplifying construction process
	Poor IT support	Lack of IT support
	Insufficient training and instruction	Organizational culture
		Knowledge transfer

Supply	Absence of conflict resolution process	Trust
		Relationship development
	Inadequate Selection of suppliers	Recommendation
		Price
		Experience
		Market reputation
		Geographic location
	Lack of Communication	Integrated information system
		Free flow of information
	SCM relationship with the supplier	Support from top management
		Mutual business planning
		Supply reliability

1. How does your company select a supplier based on?

Chart -1: Selection of suppliers

Table -2: Selection of suppliers

Sr. No.	Factors	Frequency	Mean Score	p-value	Interpretation
1	Recommendation	52	3.51	0.39083	Highly effective
2	Price	53	3.98	0.25172	Highly effective
3	Experience	53	3.55	0.83573	Highly effective
4	Market reputation	52	3.30	0.28769	Moderately effective
5	Geographic location	53	3.64	0.53927	Highly effective

6	Others	52	2.75	0.39366	Moderately effective
Average Mean Score			**3.46**		**Highly effective**

2. Which functions of internal organization of your company are most important to supply chain management?

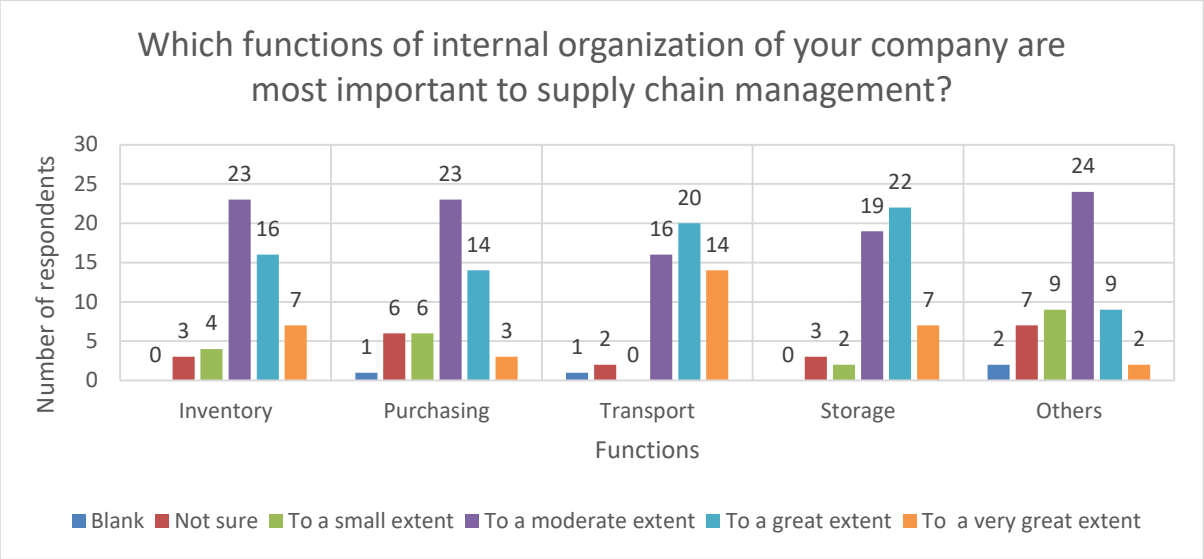

Chart -2: Functions of internal organization

Table -3: Functions of internal organization

Sr. No.	Factors	Frequency	Mean Score	p-value	Interpretation
1	Inventory	53	3.42	0.86490	Highly effective
2	Purchasing	52	2.96	0.44455	Highly effective
3	Transport	52	3.84	0.94845	Moderately effective
4	Storage	53	3.49	0.6557	Highly effective
5	Others	51	2.81	0.95888	Highly effective
Average Mean Score			**3.30**		**Moderately effective**

3. Which factors of supply chain management (SCM) are important in relationship with your supplier?

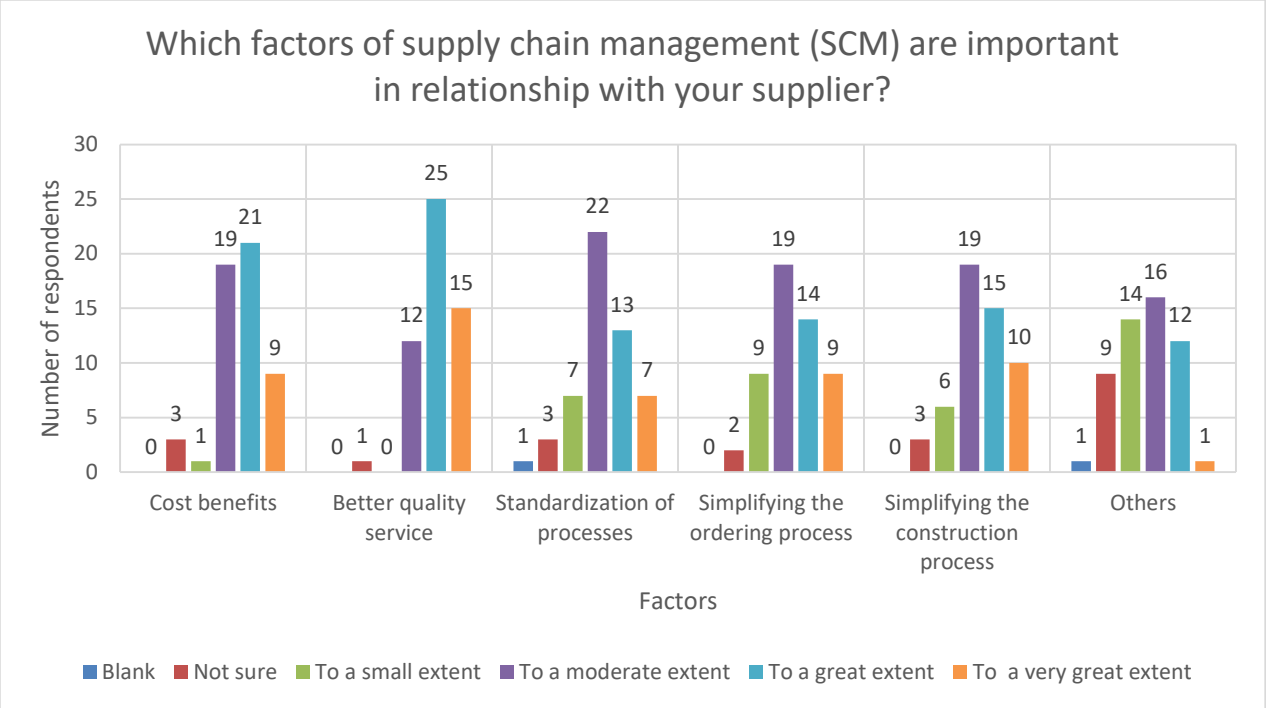

Chart -3: Factors of supply chain management

Table -4: Factors of supply chain management

Sr. No.	Factors	Frequency	Mean Score	p-value	Interpretation
1	Cost benefits	53	3.57	0.68302	Highly effective
2	Better quality service	53	3.93	0.43549	Highly effective
3	Standardization of processes	52	3.08	0.23349	Moderately effective
4	Simplifying the ordering process	53	3.54	0.08206	Highly effective
5	Simplifying the construction process	53	3.50	0.81584	Highly effective
6	Others	52	2.78	0.20978	Moderately effective
	Average Mean Score		**3.41**		**Highly effective**

4. What are key factors in effective CSC relationships?

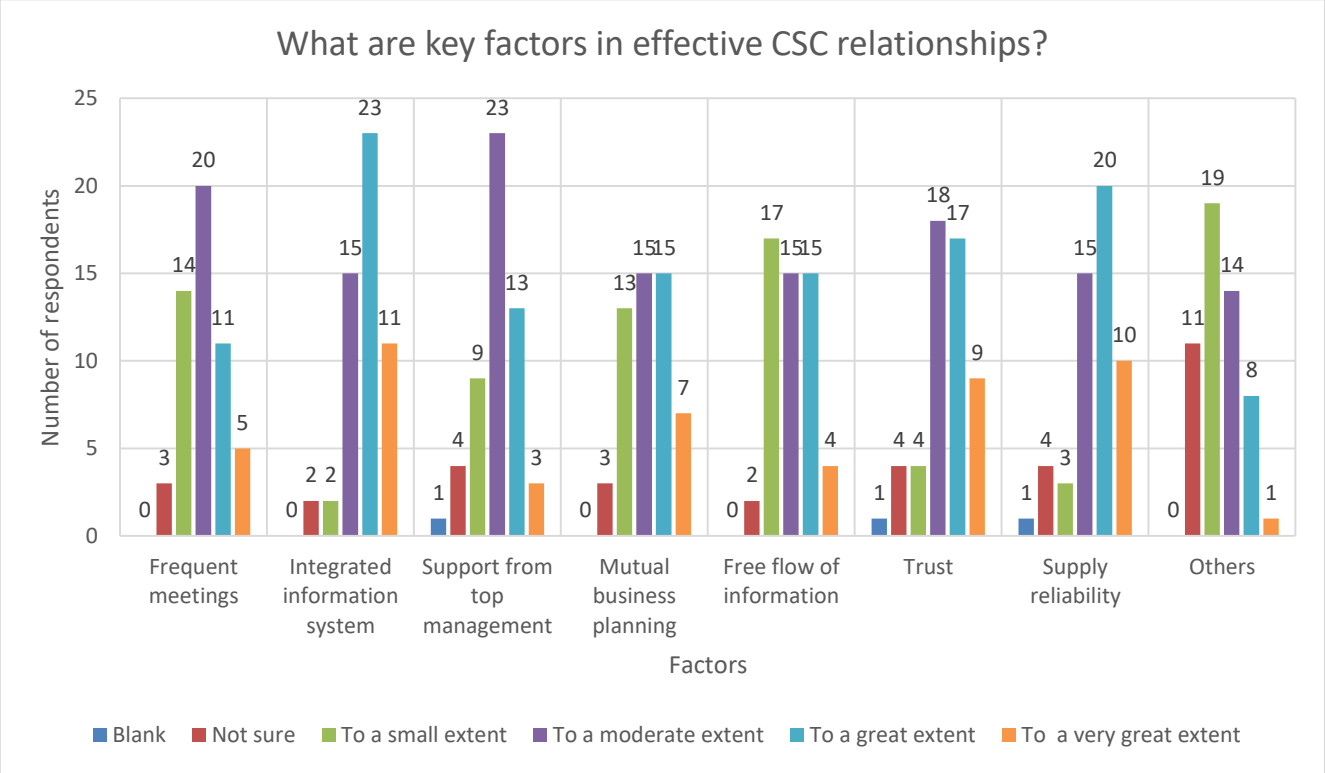

Chart -4: Key factors in effective CSC relationships

Table -5: Key factors in effective CSC relationships

Sr. No.	Factors	Frequency	Mean Score	p-value	Interpretation
1	Frequent meetings	53	3.07	0.58311	Moderately effective
2	Integrated information system	53	3.80	0.46531	Highly effective
3	Support from top management	52	3.08	0.61364	Moderately effective
4	Mutual business planning	53	3.12	0.51514	Moderately effective
5	Free flow of information	53	3.20	0.07897	Moderately effective
6	Trust	52	3.41	0.70221	Highly effective
7	Supply reliability	52	3.48	0.43007	Highly effective
8	Others	53	2.47	0.53154	Poorly effective
	Average Mean Score		**3.20**		**Moderately effective**

5. CONCLUSION AND FUTURE RESEARCH

In comparison to other businesses, the construction sector has been confronted with several risks that, if not adequately handled, will result in project failure. Despite the seriousness of this issue, most project managers choose to manage project risks based on their personal experience rather than employing analytical methods available in the literature. In real-world industrial settings, there are multiple sources of uncertainty, and we need to be able to estimate these uncertainties accurately in order to produce dependable outcomes. If there is a difference in client demand inter-arrival periods, operation times, supplier selection decisions, inventory levels, machinery, and delivery failure rates, different consequences and consequences can be

obtained. Furthermore, the risks and their consequences differ significantly depending on the failure mode group. As a result, this methodology aids practitioners in determining the appropriate levels of all supply chain entities' abilities, which account for ever-changing operational conditions. Because each construction project has its own set of complications and characteristics, it's important to consider these elements when developing a new decision-making tool for project managers. Also, because there is a gap between the research and practise in the field of project risk management, taking into account the managers' experience, as well as applying analytical tools in decision-making processes, is critical to closing this gap. This paper examines how specific supply chain management practices—defined as project-wide practises that organise information, processes, people, and/or firms for the objective of collaboration and integration inside the supply chain—provide integration mechanisms that magnify supply chain integration, facilitate supply chain integration mechanisms, and improve supply chain integration outcomes, and enhance the use of systemic innovation in the delivery of complicated projects in a collaborative manner.

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