Barriers to Supply Chain Management In The Construction Industry Of Pakistan

Final Year Project UG 2017

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Dedicated

To

*Our Advisor, Dr. Khurram Iqbal Ahmad
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ABSTRACT

Construction in Pakistan is mostly project-based, requiring productive and systematic use of available resources. In contemporary world, Supply Chain Management approach has become a principal element in construction project management which helps in enhancing the productivity and efficacy of construction projects. Since, the implementation of Supply Chain Management requires a systematic management approach along with effective technological aid, it may discourage the contractor especially in developing countries like Pakistan. Consequently, this research focuses on the identification of barriers to Supply Chain Management in the construction industry of Pakistan. For acquisition of data, a questionnaire survey was conducted. After an in-depth literature review, extensive research lead to the recognizance of nineteen crucial barriers to the successful implementation of Supply Chain Management approach. These barriers were categorized into four broader categories, namely, Strategic Barriers, Cultural Barriers, Technical Barriers, Individual Barriers and Organizational Barriers. These recognized barriers were incorporated into the questionnaire in the form of Likert Scale items with a range of five possible responses to rank their perceived significance of each barrier. Due to the ongoing pandemic, quantitative technique of data collection was used which included the circulation of questionnaire among various construction organizations. The collected data was analyzed statistically and using Factor Analysis, the results helped identify seven major factors. This study helps identify the deep rooted hindrances faced by construction industry of Pakistan for the initiation of Supply Chain Management system and will help us better understand the challenges that may pave the way for the establishment of Supply Chain Management in the construction industry of Pakistan and similar developing countries in the years to come..

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LIST OF ACRONYMS

SCM	Supply Chain Management
ICT	Information and Communication Technology
SPSS	Statistical Package for Social Sciences
GDP	Gross Domestic Product
CPEC	China Pakistan Economic Corridor

CHAPTER 1

INTRODUCTION

1.1 General

Supply Chain Management (SCM) is the management of the flow of goods and services, including all processes that transform raw materials into final products. Construction industry is very vital for a country's economy, especially for developing countries like Pakistan. This sector accounts for 7.61% of the employed labour force in our country. According to the Economic Survey of Pakistan, it contributes to 2.53% of Gross Domestic Product (GDP). In recent times, the competition within the construction industry has increased manifold. The China-Pakistan Economic Corridor (CPEC) is another boost to the construction sector. Therefore, the contractors have to work on strategies that increase the quality of their services while also decreasing the production unit costs, thus providing a competitive advantage to the construction firm. For this purpose, the successful implementation of Supply Chain Management (SCM) technique is important as the construction process includes a variety of stakeholders such as client, engineers, architects, suppliers, contractors and sub-contractors which provide different services.

1.2 Supply Chain Management in Construction Industry

The structure of the construction industry comprises of clients, contractors, subcontractors, consultants and suppliers of construction material. Due to the unique characteristics of construction industry, it encompasses multiple supply chains, such as labor-supply chain, material-supply chain (raw material and precast material suppliers) and equipment-supply chains (manufacturers and equipment suppliers). The small and medium-sized industries in less developed countries such as Pakistan have problems in responsive coordinated supply chain management mainly due to the limited resources and because lack of expertise. Also, it has other issues such as design problems, inefficient coordination, lack of commitment and coordination among clients and suppliers, inefficient communication, and lack of top management support [1]. For the success of SCM in construction sector, the commitment to the cause by top managerial brass is utmost important [2].

1.3 Barriers to Supply Chain Management

A successful supply chain management eliminates cost-and-time overruns while increasing the process efficiency which provides a competitive advantage to the construction firm (3). Even though there maybe a win-win approach for both the

contractor and supplier but still there maybe many barriers in the successful implementation of Supply Chain Management. Major barriers identified by researchers such as, [4], [5], [6], [7], [8], [9], [10], [11], [12] and [13] are summarized and listed below:

1. Less availability of company information systems which enable sharing of information with the suppliers,
2. Insufficient consultants to guide the firms,
3. Negative impact on quality because of long-term working relation with the same supplier,
4. Supplier provided materials having inappropriate quality,
5. Inadequate informational technology infrastructure,
6. For the contractor, the clients are more important than the subcontractor and suppliers,
7. Cost-oriented and short-term goals in the construction industry,
8. Due to potential risk and problems associated with the new system, suppliers lack interest,
9. Cost-oriented and short-term goals in the sector require a short-term relation with the supplier,
10. Hindrance in implementation because of a a large variety of suppliers involved in a project,
11. No application of quality systems by suppliers,
12. Project-based work in construction sector,
13. Management of stock not easy,
14. Increased transportation cost and supplier distance,
15. Lack of trust due to hostile relations in the construction process,
16. Internal procedures of industry are a barrier to the establishment of cooperation with the suppliers,
17. Inadequate understanding of Supply Chain Management by top management,
18. Supplier's lack of interest in long-term association,
19. Low trust in supplier's commitment,
20. Unsupportive organizational structure for a cooperation with the suppliers,

Top management not ready for adaptation to new management styles.

1.4 Problem Statement

Due to the increasing competition within the construction industry and for the contractors to have a competitive advantage over other firms, as well as to reduce cost and time overruns, thus increasing the productivity and profits associated with the construction projects, the successful implementation of Supply Chain Management (SCM) technique is inevitable. But to implement SCM is not an easy task as it has many barriers associated to it. The identification of these barriers is very crucial for successful integration of SCM in the construction sector. It is only possible after identifying these barriers that we can come up with solutions and progress towards a successful Supply Chain Management (SCM) system for developing countries such as Pakistan.

1.5 Objective

1. To identify barriers to the successful integration of Supply Chain Management in the Construction Industry of Pakistan.

2. To highlight the significance & benefits of Supply Chain Management system in Construction Industry.

1.6 Thesis Structure

Followed by Introduction in Chapter 1, a detailed Literature Review has been provided in Chapter 2 which provides an insight to the significance of Supply Chain Management, the benefits associated to it and the barriers to the successful implementation of Supply Chain Management in construction industry.

Chapter 3 explains the in-depth experimental methodology adopted for this research study. The results of tests and their critical explanations have been presented in chapter 4.

The conclusions drawn from this research work and recommendations for future study are summarized in chapter 5 of this thesis

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CHAPTER 2

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LITERATURE REVIEW

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2.1 SUPPLY CHAIN MANAGEMENT

2.1.1 Terminology

Supply chain management is a vast term with great significance in the corporate world. It is generally defined as the network of different entities that work together from the lower to upper sector in order to produce the desired and valuable outcomes for the users.

SCM isn't related particularly with the development business. The idea of SCM was first presented in the assembling industry[14]. The controlled stream and development of items and administrations from the start point until the utilization stage is known as supply chain management. [15]. Toyota is one of the primary global organizations who embraced the (JIT) framework for conveyances. This procedure guarantees that the perfect measure of provisions be conveyed at the correct time with perfection and viability. It assists the providers to have a direct cooperation with the creation line [14]. Store network the executives is likewise characterized as the arrangement of methods that focuses on the reconciliation of the multitude of gatherings included to such an extent that the items are delivered at the perfect time, and at the correct cost [16]. Not long after the execution of store network the board in the assembling business, the accomplishment of the technique was noticed. Because of its achievement in assembling industry, a few analysts recommended it to be carried out in the development business too [17].

In construction industry, different parties namely client, contractors, subcontractors, and clients etcetera, work uniquely in their specified tasks to produce favorable results. The efficient coordination between these separate parties in a way that all of them are involved equally in the overall delivery of the project, is known as supply chain management in the construction industry. The most fundamental objective of supply chain management in the construction industry is to develop and maintain such a course of work that helps all the members of the project team in better utilization of resources and in timely and efficient achievement of the expected goals [18].

2.1.2 Adoption of SCM

The adoption of the set of rules of supply chain management has been a difficult task in the construction industry because of several reasons. The adoption is impeded mainly because of the reason that the construction industry has deeply rooted traditional values that don't allow supply chain management. Construction sector is one of the very old industries in the world and it is distinctive for being behind in areas of innovation, and supply chain management [19].

Despite of the difficulty of the adoption of SCM, some researchers have come up with strategies for its adoption. In order to adopt successful supply chain, partnering and incentive based contracting are the two most important factors [14]. Selection of suppliers, and balanced resource allocation are critical for the successful supply chain. Effective decision making considering the strategies with partners and suppliers in order to make a better coordination and forecast of demand can be pretty useful in the successful supply chain management [20]. Joint working and joint venture are most important for the adoption of supply chain management. In a joint working environment, workers not only share their duties but also provide the expertise required to complete the project, regardless of that expertise be their expected duty or not [21].

There is a need to facilitate inter-organization relationships, build trust among parties and achieve mutual benefits to take away the deep rooted barriers of traditional culture and adopt the SCM at operational level [22]. Some changes are required for the adoption of effective supply chain management; these changes include ensuring fair payments, educating the people of construction sector, enhancing communication skills, raising awareness about the work of all other type of organizations associated to the construction supply chain, knowing the benefits of effective supply chain management and partnering, building trust between the parties, and readiness to share knowledge with other parties involved [22]. [23] suggested that a collaborative culture is necessary for the adoption of effective and coordinated supply chain within the construction industry. This collaborative culture consists of the following elements:

1. Mutual benefits.
2. Flow of information within the supply chain.
3. Transparency of information.
4. Understanding and communication between all parties.
5. Goal congruence.
Corporate emphasis on SCM.

2.1.3 Significance of SCM

Supply chain management if adopted effectively can prove to be of great significance. The concept of SCM is supposedly new and innovative keeping in mind the old and traditional nature of construction sector; and that innovativeness is the reason of the significance of supply chain management because it helps in the success of overall project. It breaks apart the old established set of approaches to conduct work among various organizations towards a single and agreed outcome, and focuses rather on the theory that because of everyone being determined towards a single and final result, having a coordinated supply chain will have a significantly positive impact on the project success.

A construction project involves a number of parties, therefore combined and joint team working among the parties is very important to achieve the project success [24]. One of the very important aspect of supply chain management that adds greatly to its significance is that it allows all the parties to get involved and play their effective roles and have a say in the overall delivery of the project that automatically increases the quality of the project. This early involvement develops in the suppliers and subcontractors a sense of responsibility to provide their services rather than just to provide products. If suppliers and subcontractors are involved early during the procurement process similar to that of the contractors, it would be an opportunity to the relevant parties to share their additional expertise which could result in potential cost savings and can give rise to two way communication among the partners [25]. Having the supply chain management in the construction industry is critically advantageous for the client in terms of better project quality and better delivery of the final project. SCM gives rise to a comparatively equal and profitable environment for every party involved. Expanded overall revenues for all gatherings, diminished disturbance and stress, improvement of no fault culture and shared comprehension among the gatherings, and fulfillment of much better reputation for the project worker could be accomplished by means of integrated supply chain management. [26].

The most dominant and distinctive feature of supply chain management is that this theory advocates for the benefits of not only the clients but of all the parties involved in the supply chain of construction sector. It advocates for the equality of all the parties and everyone is benefited once the supply chain management is effectively adopted. For instance, different parties in the construction supply chain if diligently work together as a team equally and responsibly in a friendly and coordinated fashion, they would not only be successful in achieving much better success in the project but they would also be working in the future projects and would most probably be recommending each other wherever they go for their respective future projects. So, having a successful SCM in the construction sector is beneficial for all the parties in terms of not only the project they are currently working on but also of their future projects. Supply chain management helps in achieving goal congruence, productivity, and reduction of wastes [27].

2.2 BARRIERS TO SCM

2.2.1 Nature of Construction Industry

Construction industry is one of the oldest industries in the world with its values, principles and approaches way too traditional and systematically orthodox. Unlike many other industries, it has been difficult for the supply chain- being the innovative and rather new ideology- to be implemented in the construction industry. The nature of construction industry is fragmented and disjointed. Too many parties are involved within the project related to construction. There are a number of organizations working alongside in a construction project; from client to contractors and consultants, contractors to subcontractors and suppliers, and also from subcontractors and suppliers to their subordinate outsourced subcontractors and suppliers, the size of the entities and the number of people are huge that makes the construction industry fragmented in nature. This fragmentation may occur due to the reason that many of the contractors or subcontractors may not know how to conduct a specific task for which they are hired, so they further hire other trained officials to do the job [28].

This is one the most important obstruction in the way to adopt effective supply chain. To have a coordinated structure that allows the streamlined flow of products and services among so many parties is evidently and explicitly difficult. The other hurdle within the construction industry is that it does not have constant contractors and suppliers. The supply chain ends with the project and for the new project, new supply chain is needed as the parties working with the new project would be new. A construction company has many supply chains depending upon the number of projects [29].

The following figure shows the vast number of organizations and the connections between them in the construction industry [29]:
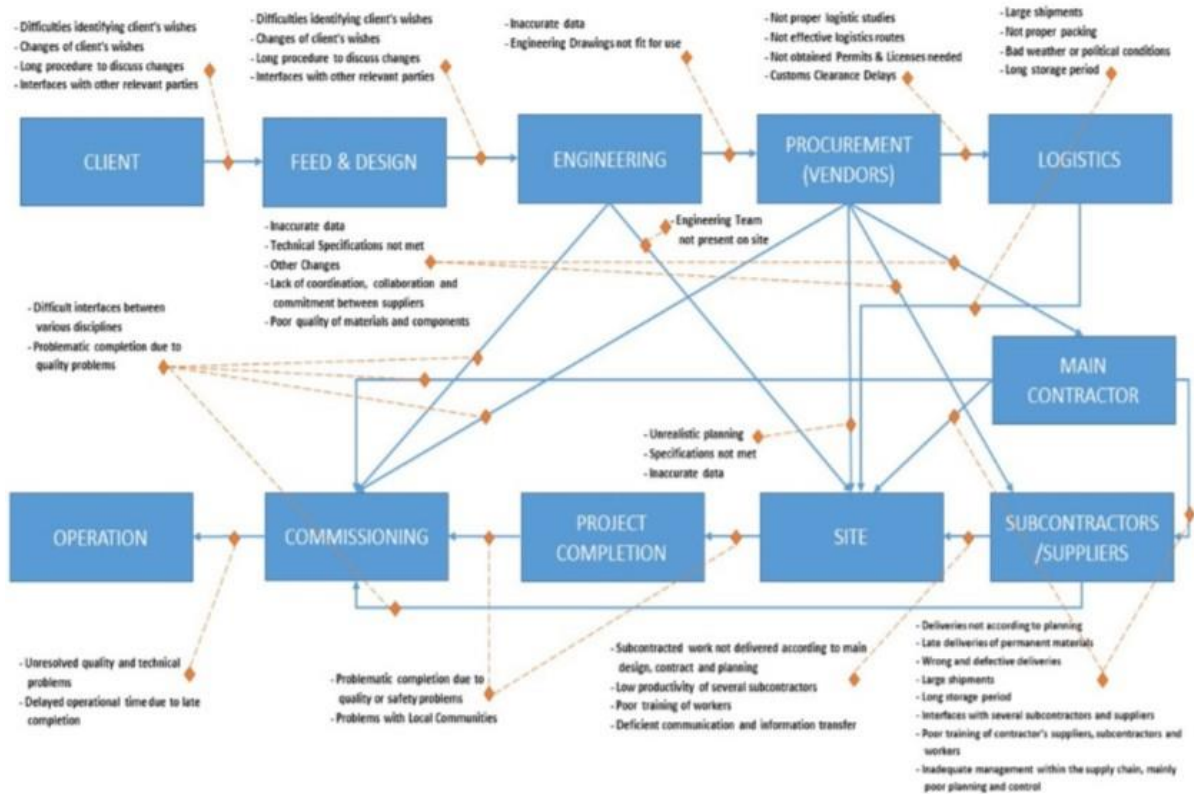
Figure 1: System of multiple parties' relationships in a construction project

The construction industry is eminently disjointed, including the separation between construction sector and design sector, and the lack of communication and coordination among parties [24].

2.2.2 Potential barriers

Supply chain implementation in the construction industry is a difficult task because of the number of hindrances in its way. Many of the people currently working in the construction industry in different areas of the world- especially in the underdeveloped country such as Pakistan- they don't really know about the concept of SCM and the far-reaching benefits it could generate if adopted effectively which makes its implementation ironically difficult. An unaware group of people would never be responsive and courageous towards SCM implementation. In Lagos, Nigera, the major barriers facing supply chain management are lack of public awareness, lack of knowledge about environmental impacts, and lack of legal enforcement [30]. In order to have a fruitful supply chain, it is necessary for everyone to show austere responsibility on their part and to be punctual with their assigned tasks. Everything associated with the supply of products and services should be given prudent care to avoid any predicaments and disruptions during the ongoing flow of supply. Delays in the supply of materials and other resources, overcapacity and deficiency of warehouses, loading and unloading of goods, and transportation of products are the possible risks in the supply chain which could restrict the adoption of SCM. Just like any other management task, it is essential for the productive functionality of construction supply chain to have a supporting, knowledgeable, and responsive leadership behind. If to cope the disjointed structure of construction industry with the consolidated, coordinated, and innovative idea of SCM, it is almost implausible to get success in this matter if the people leading are not concerned. Lack of effective leadership, and lack of competence are the two most critical barriers in the way of SCM [31].

Attitude problems, inaccurate flow and low quality of information, and financial and cost related problems are the barriers to the supply chain coordination [22]. The ego clashes, superiority complexes, and unnecessarily rude attitudes that occur between the people of different organizations (most prominent in upper and lower corporate classes) prompts resentment for each other, working in the same project. Six groups of challenges to construction supply chain were noticed and are given as follows [32]:

- Complexity of supply chain processes.
- Multi-trades supply chain members.
- Inefficient sharing of information.
- Separation between the design and production operations.
- Short-lived construction supply chain network.
- Competitive nature of supply chain.

Along with the dire need of awareness of the fruitfulness of the supply chain management, it is also important to have a proper systematic guidance of it. Some of the most critical and potential barriers to SCM noticed by [14] are as follows:

- Lack of guidance to create alliances with supply chain partners.
- Lack of development measures for monitoring the alliance.
- Lack of integration of the internal departments of the company.
- Organizational resistance.
- Lack of information systems.

Soo-Yong Kim & Viet Thanh Nguyen in 2020 were studying about the critical barriers to the implementation of supply chain management in construction industry. [33] In

their study, they reviewed the literature on the subject and came up with the 22 most important barriers. These barriers are shown in the following table:

No.	Barriers to the CSCM implementation	Description
1	Lack of understanding SC concept	Parties do not understand their own role and others in the CSC. The parties do not understand SCM and its benefits.
2	Passive sub-contractors and suppliers	Lack of involvement of sub-contractors and suppliers in the SC at earlier stages of the project.
3	Inappropriate tending methods	It is common that the contracts are awarded to lowest price rather than the anticipated value of the project.
4	Inappropriate organizational structure to support SC	The organizational structure is bureaucratic and inappropriate to support the CSC.
5	Lack of communication and information exchange	Ineffective communication flow and inefficient information sharing in the CSC.
6	Unwilling to share risks and benefits, and emphasizing self-interest	Parties usually focus on personal interests. The parties resist treating others fairly.
7	Lack of genuine collaboration and good working relations	Uncooperative working relationships, lack of support, separate decision making, not informing stakeholders about improvement activities.
8	Lack of training in SCM	Parties, especially small companies such as sub-contractors and suppliers, often have little training on knowledge and skills relating to SCM.
9	Organizational resistance to SCM	The organizations are not always willing to reach a new approach. This problem is probably because they mainly have a defensive and conservative culture, preventing change and encouraging maintaining of the status quo.
10	Lack of usage of IT system	Although the application of information technology is useful, parties resist or hesitate to invest.
11	Lack of trust among parties in SC	Parties are unwilling to work together or share information because they afraid that the other party will take their advantages or use the information in an unethical manner.
12	Lack of commitment to SC	Lack of long-term relationships and partnering. Non-responsiveness to requirements of other SC members, lack of incentive and funds for innovations and product development.
13	Lack of common goals among parties in SC	Parties behave in independent manners. They lack common project objectives to meet the end-users requirements.
14	Lack of competence of parties in SCM	Parties lack technical and managerial competences in SCM.
15	Lack of effective leadership	When the leadership role is taken, parties' internal business processes can integrate into the SC business processes and each member of the band is playing the same tune. A strong leadership will drive the direction of the chain.
16	Ineffective problem solving mechanism	Problems are inevitable during a project. The ineffective problem solving mechanism may give rise to conflicts and disputes between the parties. The contract system lack provisions related to disputes and conflicts resolution.
17	Anticipated rewards unclear	Parties have limited or unclear incentives to encourage them to perform well in the CSC.
18	Power domination and frequent contractual non-commitments	The failure to comply with contract and power domination among the parties may bring a negative attitude in working together. For example, because of a difference in the power position between subcontractors and main contractors, main contractors with arrogant and win-lose attitudes will bully and treat with little respect to their subcontractors.
19	Complexity and harsh of SC process	CSC includes the multiple trading members, the problems of CSC are stemmed from the interfaces of different members. The nature of the SC is always competitive.
20	Temporary or short-term SC network	Organizations need to be reconfigured for each new project although the procedures can be the same for similar construction projects. Construction is a typical make-to-order SC, with every project creating a new prototype or product in temporary SCs.
21	Lack of understanding customer requirements	Parties do not pay much attention to their customers' requirements. The parties do not understand what is really the their customers' requirements.
22	Fragmented characteristics of the construction industry	The construction industry is extremely fragmented with issues such as the separation between design and construction, the lack of communication and collaboration among parties. High fragmentation of these operations leads to the multi-domain characteristic in CSC.

Table 1: Barriers to the adoption of SCM in the construction industry

2.2.3 Analysis of Barriers

Salami in 2016, computed and published the results of the analysis of barriers to the adoption and implementation of supply chain in construction industry of Turkey. [34] The researchers developed a well-researched questionnaire in which about 21 questions-each question related to a single important barrier- were included. All the questions were answered in terms of 1 to 5 likert scale rating and the results were than analyzed using factor analysis techniques to come up with top most critical and challenging barriers to the implementation of SCM. The following tables shows the findings of the analysis:

Factor No	Implementation barriers in supply chain relationships	Frequency %*	Ranking
1. Factor	Lack of trust to the suppliers	22,4	7
2. Factor	Lack of information technology infrastructure and resistance of the suppliers to change.	77,9	1
3. Factor	Short-term and price-oriented approaches	57,7	4
4. Factor	Lack of top management support	39,3	6
5. Factor	Production being project-based and large in volume	50,9	5
6. Factor	Widely spread contentious relationships in the industry	57,9	3
7. Factor	Difficulties in accessing the resources	59,8	2

Table 2: Top most critical barriers to the adoption of SCM in the construction industry

In 2020, Soo-Yong Kim & Viet Thanh Nguyen established 22 barriers from the literature review and further developed a questionnaire that was then distributed among various parties to record the answers in the terms of likert scale rating. [33] After the results were recorded, the analysis was performed to come up with the most potential barriers out of the 22 barriers that resist the SCM adoption. The following table shows the findings of the analysis:

Factor	Factor score	Rank
Lack of knowledge and competence	4.05	1
Lack of support and active participation from parties	3.91	2
Confronting culture and adversarial behaviour	3.79	3
Deficiencies in the contract system	3.56	4
Inherent difficulties in SCM	3.37	5

Table 3: Top most potential barriers to SCM implementation

2.2.4 Causes of Barriers

The sources of failure of a coordinated supply chain are lack of law and regulation, labor strikes, communication lack, and inconsistencies in technology. Supply chain management is a public matter, and the proper adoption of supply chain management benefits the whole of society in terms of good and efficient development, and better corporate relationships. This matter cannot get a practical shape until the government takes it as a priority and introduces some legitimate rules that will prevent most of the barriers to appear in the implementation of SCM. It is very important for the ruling officials to establish some set of guidelines as well to curb the occurrence of barriers. It has been noticed that small and medium

size industries in under developed countries are facing problems in responsive coordinated SCM due to the lack of resources, and inappropriate and improper guidelines [35].

The factors that may be responsible for the disruptive environment of supply chain are terrorism, exchange rate fluctuations, and uncertainties in demand and supply.

2.3 SCM: A CASE OF PAKISTAN

2.3.1 Background

Construction industry plays a vital role in a country's economy, especially for developing countries like Pakistan. According to Pakistan Economic Survey, the country's construction industry accounts for 2.53% of Gross Domestic Product (GDP) and the sector employs 7.61% of the employed Pakistani labor force. The CPEC agreement between Pakistan and China is another boost to the construction sector. Therefore, the contractors have to work on strategies that increase the quality of their services while also decreasing the production unit costs, thus providing a competitive advantage to the construction firm. For this purpose, the successful implementation of supply chain management focusing on the use of firm's suppliers, operations and technological capabilities is integral.

The construction industry of Pakistan is in the developing stage. The competition has increased and the environment has become a bit hostile in recent times. The causes of this situation are technological advancements, high demands, and the globalization process for SCM on Pakistan's construction industries [36].

2.3.2 Factors Impacting The Construction Supply Chain

Pakistan, being behind in the overall innovative construction practices, is also falling behind in the effective adoption of construction supply chain management. The awareness is raising through some channels but still, it is a long journey up to the point of accomplishment. Many of the deep rooted barriers are responsible for the difficulties in the adoption of SCM in Pakistan's construction sector. In 2019, Gabol and Siddiqui, two researchers of Karachi, studied the factors impacting the success of supply chain management in the construction industry of Pakistan. They consolidated much of the factors in five major groups which according to them if cater for accurately, then that would be enough for a responsive supply chain. For the validity of their hypothesis, they conducted a survey by developing a questionnaire in which all of those five groups were incorporated. That questionnaire was then distributed among the employees of construction industries of Karachi and about 120 people responded in terms of likert scale rating to that questionnaire. Based on the results acquired, Structured Equation Modeling (SEM) software was used to run analysis. The results of the analysis show, that the hypothesis that the following five factors play the most important role in having a

responsive supply chain in the construction industry of Pakistan, is true and valid [37]:

1. Top management commitment.
2. Organization factors.
3. Mutual understanding and trust.
4. Honest relationship and decision making.
5. Accurate information sharing.

In 2020, Abas et al. studied the critical risk factors in the construction supply chain of Pakistan. The researchers developed a questionnaire on the basis of the well-researched risk factors and distributed it among the people associated with the construction industry. On the basis of the data acquired in terms of likert scale rating, the analysis was performed. The results of the analysis ranked the risk factors based on their severity and are shown in the following table:

Risk factors	Severity index (%)	Rank
PC-1 preparation	59.33	18
Funding	93.89	1
Procurement unit of contractor	78.45	15
Financial capability of contractor	80.01	13
Management team of contractor	81.56	12
Communication infrastructure	83.61	8
Escalation of material prices	87.23	6
Technical person availability	85.63	7
Cash flow	89.78	3
Shortage of material/equipment	90.05	2
Low bid	75.21	16
Bad weather	89.05	5
Bureaucracy and political influence	82.32	10
Terrorism	89.25	4
Regulatory authority	79.81	14
Government policies	72.91	17
Iso certification	50.34	19
Inflation	82.45	9
Law and order situation	81.79	11

Table 4: Ranking of the risk factors based on their respective severity

CHAPTER 3

RESEARCH METHODOLOGY

3.1 DEVELOPMENT OF RESEARCH FRAMEWORK

To distinguish issues in carrying out SCM in Pakistan, contribution from key partners of the development business (advisors, customers, workers for hire, providers and subcontractors) was needed to measure their discernment about the current issues in the business and their recommended arrangements. This was important to think about what the partners considered were obstacles in their development with what this investigation recognized as the principle issues inside the development business.

Hence, impression of partners were considered fundamental to distinguish issues inside the development business so that proposed answers for improve the execution limit of the business are coordinated towards these spaces. The review was expected to unite hindrances to SCM as recommended by the business players and specialists.

3.1.1   Shortlisting Of Relevant Research

Key factors were identified for the selection of relevant literature review. A quantitative approach was adopted for the extraction of existing research papers of high significance with respect to our area of concern. An in depth study led to the shortlisting of 20 papers based on the following factors:

Complexity	Comparative Advantage
Compatibility	Conformity with Business Situation
Organizational Motivations	Lack of Standards (Reverse Rank)
Economical Feasibility to Apply	Attitude towards technology adoption
Trust and Cooperation Among Stakeholders Required	Benefit to Suppliers
Perceived Benefits	Enabling environment
Technical Risk	Cultural change among industry stakeholders
Innovative Approach	Incorporation of Internal Factors
Incorporation of International Stakeholders	Incorporation of External Factors
Observability	Extent of Information distribution required
Technical Feasibility	Market Scope
Adaptability in Pakistan	Globalization Potential

External Support (In implementation)

Each research paper was thus assigned a literature score against each factor mentioned above ranging from High, Medium to Low. The cumulative literature score was thus calculated to ensure reliability of the existing research.

Sr.	Category	1		2	
		Frequency	**Ranking**	**Frequency**	**Ranking**
	Journal	**The International Journal of Advanced Manufacturing Technology**		**International Journal of Production Economics**	
	Title of Paper / Author	**AN ISM APPROACH FOR THE BARRIER ANALYSIS IN IMPLEMENTING SUSTAINABLE SUPPLY CHAIN MANAGEMENT AN EMPIRICAL STUDY**		**A HIERARCHIACAL FRAMEWORK OF BARRIERS TO GREEN SUPPLY CHAIN MANAGEMENT IN THE CONSTRUCTION SECTOR**	
	Year of Publication	**2017**		**2012**	
	Factors Affecting Adoption of SCM				
1	Complexity	1	High	1	Medium
2	Compatibility	1	Medium	1	High
9	Organizational Motivations	1	Medium	1	High
10	Economical Feasbility to Apply	1	Low	1	Low

3.1.2 Consultation With Experts

Experts of the field including experienced field personnel, scholars and researchers were thus approached for their expert opinion in order to narrow down crucial areas of concerns for the identification of barriers to SCM in Pakistan. Their judgement, combined with the research background allowed the adoption of the best way forward to carry on this research.

3.1.3 Selection Of Study Population

The study population was categorized into the following main targets:

Construction Firms
Design Consultancy Firms
Clients' Firms
Subcontractors' Firms
Suppliers' Firms
Others (Engineers, Architects, PhD Students)

Table 6: Target Categories

Team Members
Owner of the Firm

Table 7: Target Subcategories

3.1.4 Adopted Areas Of Concern

The following areas of concerns were narrowed down:

1	Strategic Barriers
2	Cultural Barriers
3	Organizational Barriers
4	Technological Barriers
5	Individual Barriers

Table 8: Areas of Concern

3.1.5 Categorization Of Barriers

Barrier Categories	Supply-Chain Management Barriers
Strategic Barrier	Political Instability
	Lack of creation of supply chain alliances
	Short-term decision-making perspectives
	Unchecked transportation costs
	Preference to project-based production over mass production
	Lack of top management commitment and support
Cultural Barrier	Prioritization of client over supplier and subcontractor's needs.
	Mistrust among employees and supply-chain partners
	Excessive hiring of a single subcontractor and impacts on quality
	Subcontractors and suppliers are not allowed to participate in the early stages of the project
Technological Barrier	Lack of information technology use by suppliers
	Poor ICT structure (information system and electronic trade systems) of companies to share information with suppliers
Individual Barrier	Lack of education to employee and supplier employee
	Resistance to change of management system by suppliers
	Lack of motivation of suppliers to invest in quality management
	Lack of necessary tools, management skills and knowledge
Organizational Barrier	Hindrances in stock storage and management for suppliers
	Low information quality, insufficient information exchange and, less transparency along with limited communication
	Serious problems with payments between customers, main contractors, sub-contractors and suppliers
	Lack the framework and measurement system

Table 9: Barrier Categories

3.2 DEVELOPMENT OF MEASUREMENT TOOL

In order to investigate the objectives established for our research study, we conducted a survey of key industry players and researchers in order to assess current capabilities for the implementation of supply chain management in projects by highlighting pragmatic barriers.

3.2.1 Selection Of Type Of Questionnaire

A quantitative approach was chosen because it allows for the use of statistical tools to objectively assess data, making the results more reliable [38]. The cross-sectional survey approach was chosen because it offers numerous desirable benefits, including greater representativeness, impartiality, and replicability [39], all of which were relevant and ensured that the research method used was appropriate for the study's objectives.

The current study also advocated for the cross-sectional survey design, which entails using a questionnaire to collect data for a specific investigation from any given sample of population elements.

3.2.2 Synthesis of Question Statements

Except for those pertaining to the respondents' profile, all nineteen statements mentioned below were to be addressed using a Likert Scale of 5; 1 indicating "Strongly Disagree" and 5 indicating "Strongly Agree."

1. *Political instability hinders any prospects of implementation of the supply chain management system.*

2. *Many consultancies lack the expertise to guide construction firms to create alliances with supply chain partners.*

3. *Short-term objectives and price-oriented approaches in the sector adversely affect the supply of quality product.*

4. *Transportation costs between suppliers and project sites are very high.*

5. *Project based production of supplies for construction industry is preferred over systematic massproduction.*

6. *Senior management in construction firms is hesitant regarding innovations in managerial system for the supply chain.*

7. *The clients/employer's needs are almost always prioritized over the needs of suppliers and subcontractors.*

8. *The lack of mutual trust often inhibits the possibility of cooperation between suppliers and construction firms.*

9. *Hiring the same supplier for multiple projects for a long duration negatively impacts quality.*

10. *In most projects, subcontractors and suppliers are not allowed to participate in the early stages of the production process*

11. *Use of information technology by the suppliers is inadequate due to lack of existing infrastructure.*

12. *Many construction companies do not have an information system and /or electronic trade systems for real-time information sharing with their suppliers.*

13. *Most organizational bodies lack understanding regarding the concept of supply chain management.*

14. *Suppliers hesitate regarding proposal of a revised management system due to potential risks.*

15. *Suppliers are not concerned with investing in quality management systems to win the buyer's trust.*

16. *Management and storage of stock of supplies hinders suppliers' interest in supply chain management.*

17. *Low information quality, insufficient information exchange and, less transparency along with limited communication prevents cultivation of mutual trust between supplier and construction firm.*

18. *Serious problems with payments between customers, main contractors, sub-contractors and suppliers are bound to occur due to hostile relationships.*

19. *Most construction companies lack the framework and measurement system to keep track of supply chains.*

3.3 DATA COLLECTION

In order to investigate the objectives established for our research study, we conducted a survey of key industry players and researchers in order to assess current capabilities for the implementation of supply chain management in projects by highlighting pragmatic barriers.

3.3.1 Selection Of Medium Of Communication

The measurement tool is devised in the form of an online questionnaire, keeping in mind the current on-going pandemic SOP's. Furthermore, the audience is psychologically expected to provide more authentic responses without external influence which is unavoidable in face to face settings for recording responses. Thus, the target audience was contacted via emails and other relevant social media platforms.

3.3.2 Verification Of Respondents

In April 2021, 109 questionnaires were returned by respondents. Out of which, 2 were deemed to be unsuitable and were thus deleted. This resulted in 107 acceptable surveys, with a usable response rate of 98.17 percent.

3.3.3 Distribution Of Targeted Respondent Categories

The consultants and contractors were nominated from a comprehensive list given by the Pakistan Engineering Council (PEC). The list was first verified in order to identify contractors and consultants. Consulting firms shortlisted were randomly picked. Apart from that, suppliers, subcontractors and SCM research students were also incorporated in the respondents pool.

Contractor firms	37.6%
Client firms	21.1%
Supplier firms	3.7%
Subcontractor firms	2.8%
Note: Some respondents were part of multidimensional firms, thus involved in multiple categories.	

Table 10: Distribution of Targeted Respondent Categories

DATA ANALYSIS AND RESULTS

4.1 FORMATION OF DATA SET

In this approach, we checked the Likert Type Items, extracted ordinal data for analysis, categorized factors using Mean of Likert Items (Strategic, Cultural, Individual, Technical, Organizational) and subsequently, inserted value labels (1: Strongly Disagree, 2: Disagree, 3: Undecided, 4: Agree, 5: Strongly Agree)

4.2 NORMALITY CHECK

Since our sample size is 107 (>100), we consider Kolmogorov-Smirnov Normality Test. Significance for all variables is <0.05, thus being statistically significant and subsequently, Not Normally Distributed. For further confirmation, we took Log Base 10 of the variables, and data was still proven to be Not Normally Distributed.

Tests of Normality						
	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
S	.127	107	.000	.959	107	.002
C	.094	107	.022	.978	107	.077
T	.185	107	.000	.868	107	.000
I	.108	107	.004	.957	107	.002
O	.107	107	.004	.968	107	.012
a Lilliefors Significance Correction						

Table 11: Normality Check

Tests of Normality						
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
log_S	.136	107	.000	.888	107	.000
log_C	.123	107	.000	.932	107	.000
log_T	.236	107	.000	.801	107	.000
log_I	.151	107	.000	.933	107	.000
log_O	.092	107	.027	.965	107	.007
a. Lilliefors Significance Correction						

Table 12: Normality Check of Log Values

4.3 FACTOR ANALYSIS

Retaining Factors Tests:
Eigen Values   2.Scree Plots

Principal Components Analysis

We conducted Principal Components Analysis. Eigen values greater than 1 were set to be retained in extraction. We then conducted Bartlett's Test of Sphericity: A significance p value of <0.01 is less than 0.05, it implied that data is statistically significant, thus variables are significantly correlated.

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.611
Bartlett's Test of Sphericity	Approx. Chi-Square	407.651
	df	171
	Sig.	.000

Table 13: KMO and Bartlett's Test

Number of components retained by SPSS are 07 during Factor Reduction. These 7 components sufficiently explain the relation between initially selected 19 barriers. The cumulative percentage of Variance of 62.38% is the percentage of variance accounted for by these 7 components. (Which lies in the range of 40-60% in which most solutions typically exist)

Component	Initial Eigen values			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.659	19.257	19.257	3.659	19.257	19.257
2	2.002	10.535	29.792	2.002	10.535	29.792
3	1.498	7.882	37.674	1.498	7.882	37.674
4	1.460	7.686	45.360	1.460	7.686	45.360
5	1.141	6.006	51.366	1.141	6.006	51.366
6	1.076	5.666	57.031	1.076	5.666	57.031
7	1.017	5.351	62.382	1.017	5.351	62.382
8	.957	5.036	67.418			
9	.907	4.773	72.191			
10	.783	4.119	76.310			
11	.756	3.980	80.290			
12	.692	3.642	83.933			
13	.675	3.553	87.485			
14	.571	3.007	90.492			
15	.463	2.435	92.927			
16	.418	2.200	95.127			
17	.367	1.933	97.060			
18	.321	1.690	98.750			
19	.238	1.250	100.000			

Table 14: Principal Component Analysis
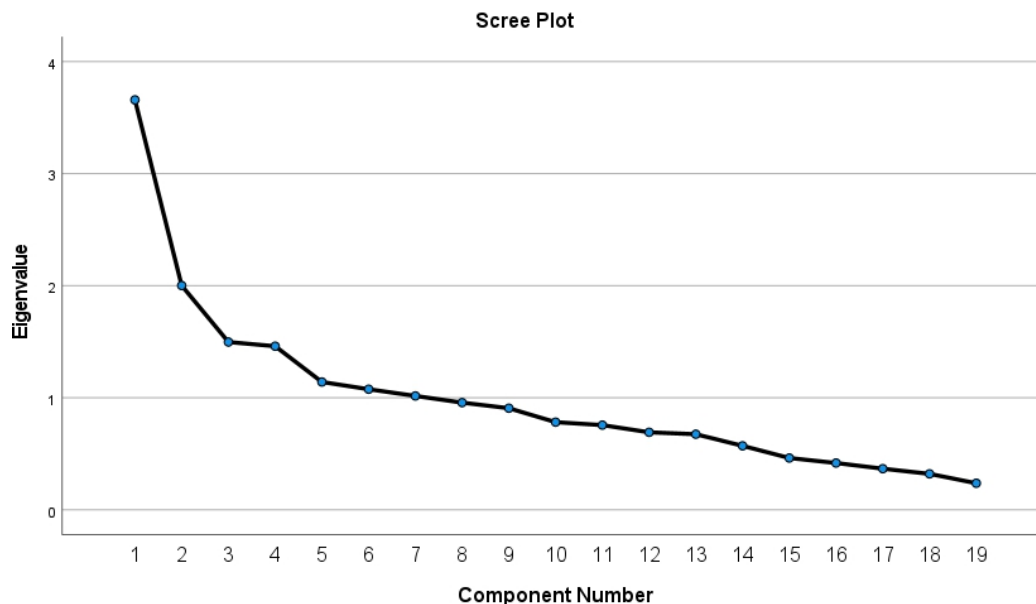
Figure 3: Scree Plot of Eigen Values

The curve in the above graph shows a slightly linear trajectory after the seventh component, so this test also results in having the first seven factors as the reduced components.

4.4 COMPONENT MATRIX AND COMMUNALITIES

Component Matrix helps us identify individual relation between items and components.

Component Matrix[a]

	Component						
	1	2	3	4	5	6	7
s1	.469	.266	-.233	.279	-.022	.299	.294
s2	.308	-.054	.315	-.445	-.290	.342	.288
s3	.474	.259	.236	-.194	-.145	-.180	-.493
s4	.158	.647	.153	-.156	.046	-.136	.159
s5	.227	-.096	.605	.296	-.134	-.021	-.445
s6	.480	.169	.168	-.243	-.269	-.294	.165
c1	.293	-.474	.267	.238	.379	.306	-.007
c2	.449	.299	.208	-.084	.509	.098	.063
c3	.456	-.298	.392	.256	-.411	-.055	.231
c4	.275	-.045	.096	.682	.060	-.242	.261
t1	.468	.282	-.195	.399	-.095	.241	-.307
t2	.553	.176	-.294	.100	-.250	-.166	.106
i1	.539	-.224	-.360	-.232	-.041	-.063	-.266
i2	.473	-.134	.045	-.204	.453	-.308	.003
i3	.480	-.599	-.224	-.202	-.085	-.039	.102
o1	.516	-.137	.278	-.265	.161	.272	.064
o2	.465	.448	-.224	-.005	-.030	.418	-.103
o3	.492	.187	-.053	.078	.236	-.366	.109
o4	.499	-.456	-.397	.026	-.005	-.023	-.120

Extraction Method: Principal Component Analysis.

a. 7 components extracted.

Table 15: Component Matrix

Whereas communalities help identify the percentage of variance in a certain item accounted for by the components. Identified components were named, depending on the above calculations.

Communalities

	Initial	Extraction
s1	1.000	.599
s2	1.000	.678
s3	1.000	.682
s4	1.000	.537
s5	1.000	.730
s6	1.000	.532
c1	1.000	.676
c2	1.000	.614
c3	1.000	.741
c4	1.000	.681
t1	1.000	.657
t2	1.000	.534
i1	1.000	.600
i2	1.000	.585
i3	1.000	.699
o1	1.000	.536
o2	1.000	.653
o3	1.000	.488
o4	1.000	.630

Table 16: Communalities Check

4.5 EXTRACTION OF FACTORS

From the Component Matrix, we identify the following seven factors for barriers to supply chain management based on significant Eigen values.

1. Inadequate information technology infrastructure and lack of awareness regarding managerial transformation.

2. Lack of transparency and information exchange among stakeholders.

3. Lack of framework to assess accountability and commitment of stakeholders.

4. Mindsets in favour of project-oriented small-scale production processes.

5. Client primacy over supplier and lack of supply chain alliance formation.

6. Mistrust among client and suppliers.

7. Short-term and price-oriented approaches

4.6 STATISTICAL DEVIATIONS IN PERCEIVED BARRIER CATEGORIES

Strategic Barriers:
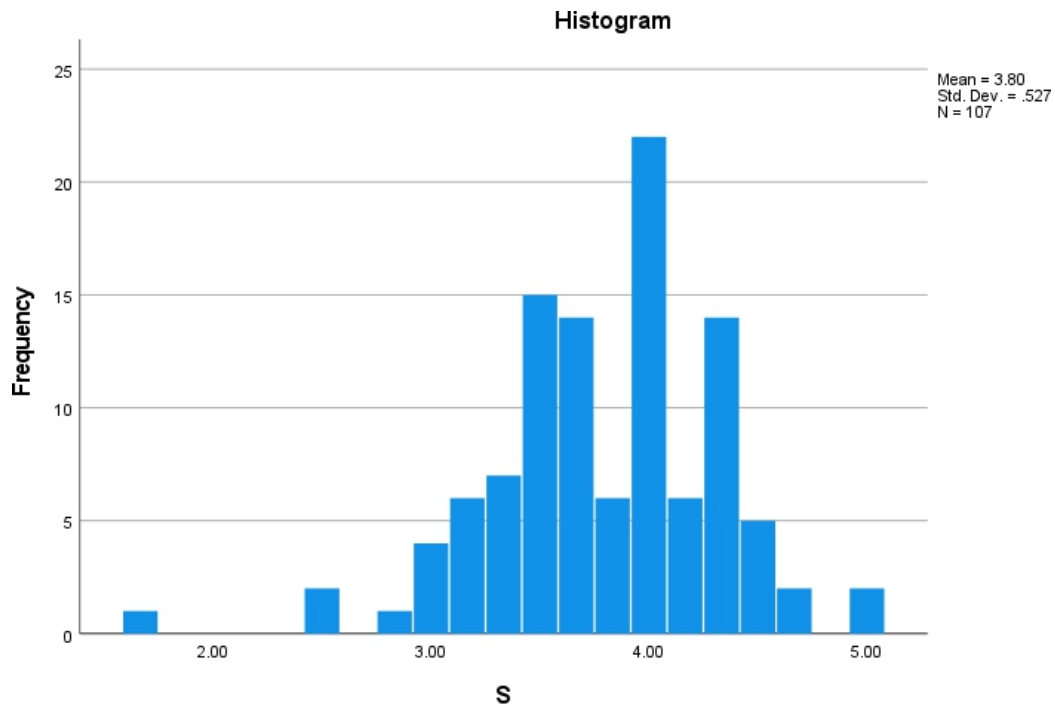
Figure 4-1: Statistical Deviation in Strategic Barriers
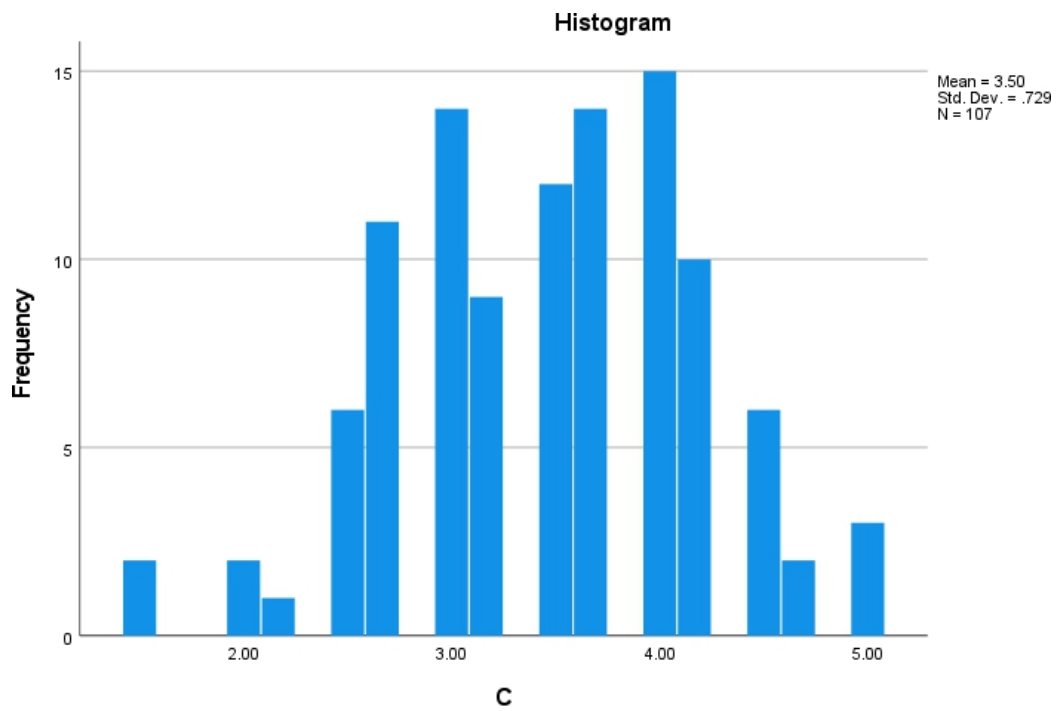
Cultural Barriers:

Figure 4-2: Statistical Deviation in Cultural Barriers

Technical Barriers:
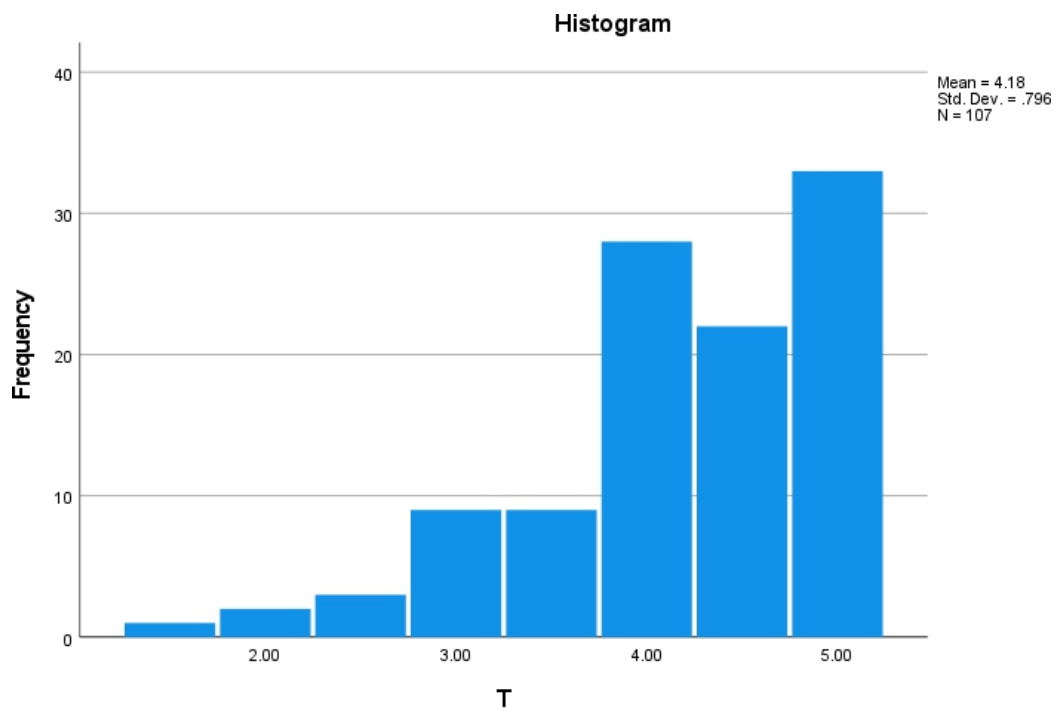
Figure 4-3: Statistical Deviation in Technical Barriers

Individual Barriers:
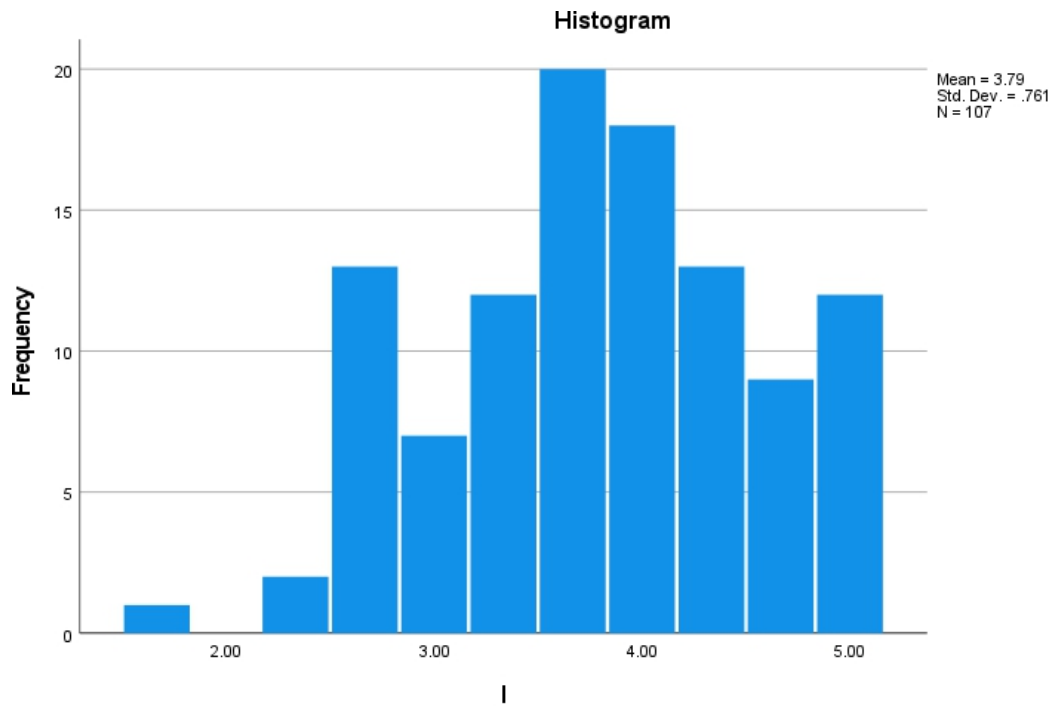
Figure 4-4: Statistical Deviation in Individual Barriers

Organizational Barriers:
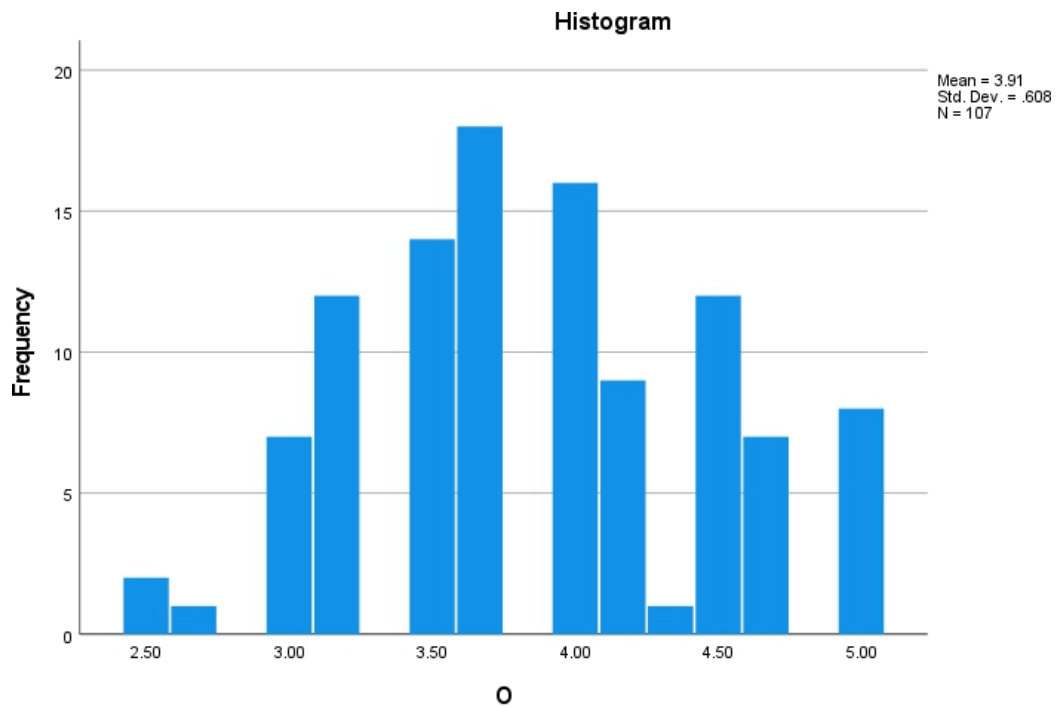
Figure 4-5: Statistical Deviation in Organizational Barriers

4.7 TRENDS IN RECORDED QUESTIONNAIRE RESPONSES

Political instability hinders any prospects of implementation of the supply chain management system.
110 responses
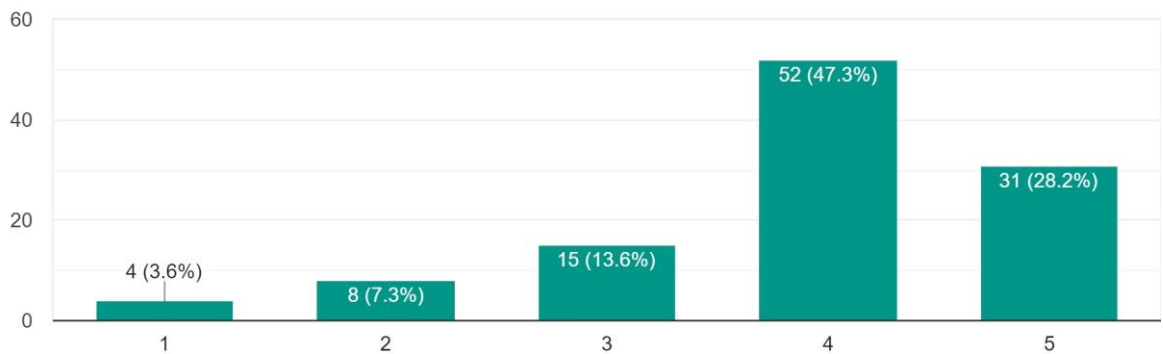
Figure 5-1: Political Instability responses

Short-term objectives and price-oriented approaches in the sector adversely affect the supply of quality product.
110 responses
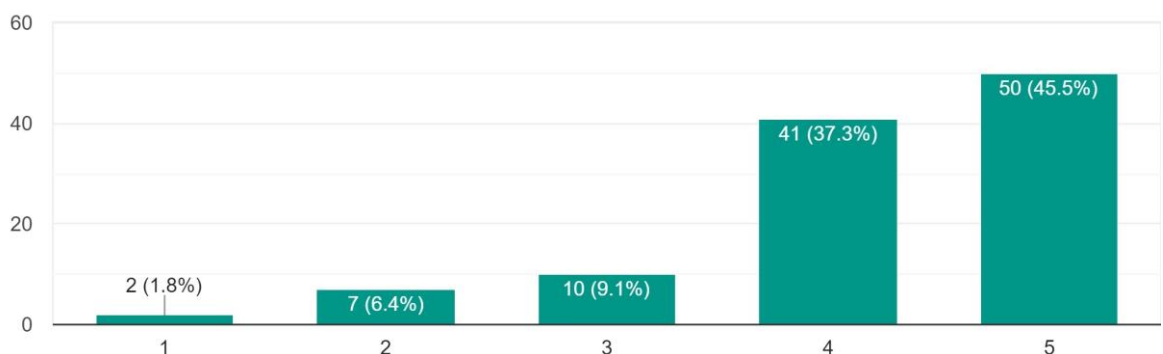
Figure 5-2: Relation of objectives and price oriented approaches to product responses

Transportation costs between suppliers and project sites are very high.

110 responses
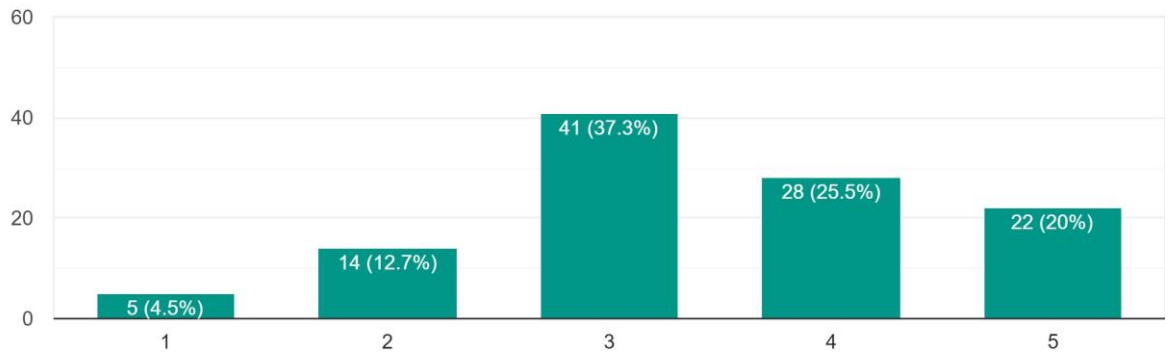
Figure 5-3: Transportation cost responses

Project based production of supplies for construction industry is preferred over systematic mass production.

110 responses
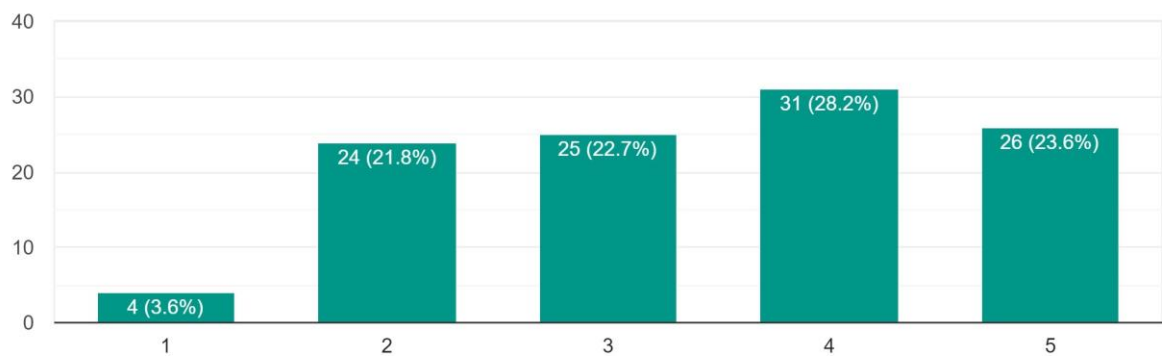
Figure 5-4: Production of supplies responses

Senior management in construction firms is hesitant regarding innovations in managerial system for the supply chain.

110 responses
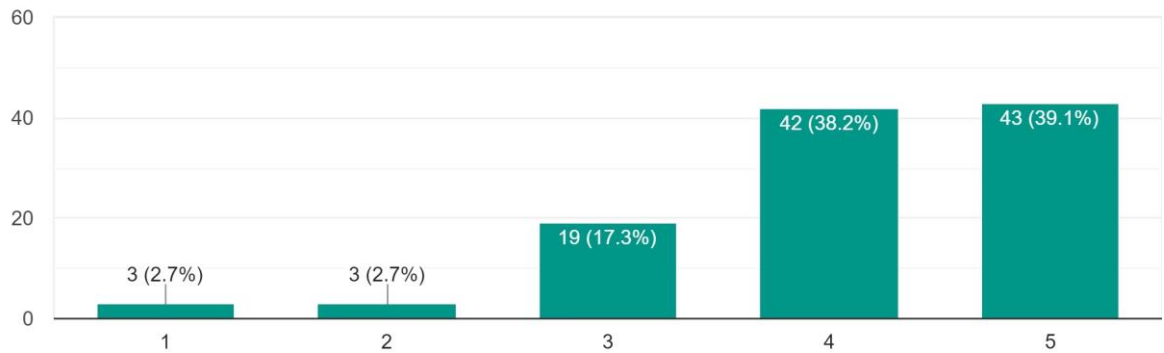
Figure 5-5: Innovations in managerial system responses

The clients/employer's needs are almost always prioritized over the needs of suppliers and subcontractors.

110 responses
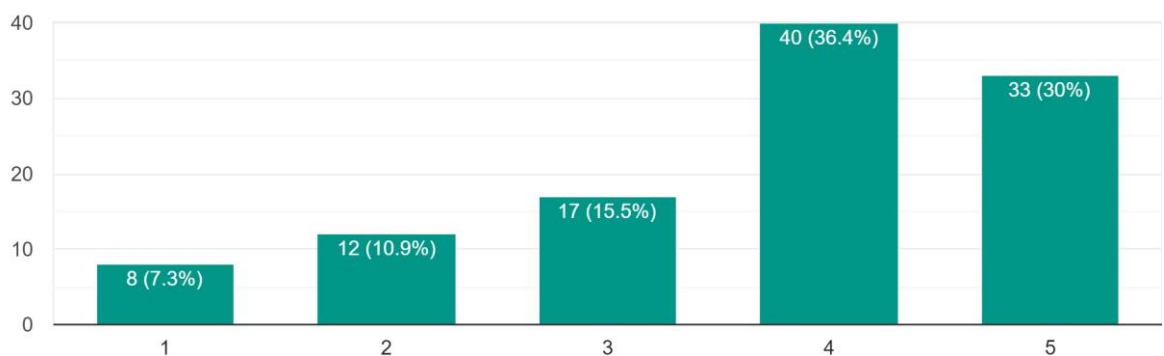
Figure 5-6: Client/Employer needs' responses

The lack of mutual trust often inhibits the possibility of cooperation between suppliers and construction firms.

110 responses
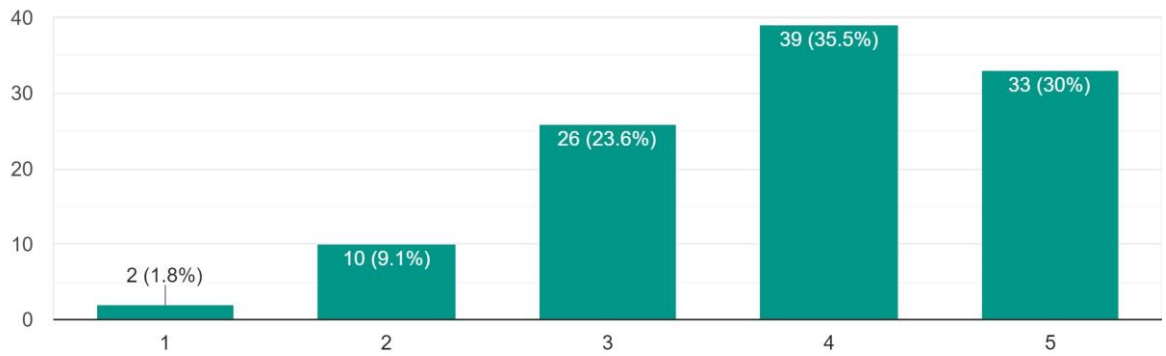
Figure 5-7: Mutual trust responses

Hiring the same supplier for multiple projects for a long duration negatively impacts quality.

109 responses
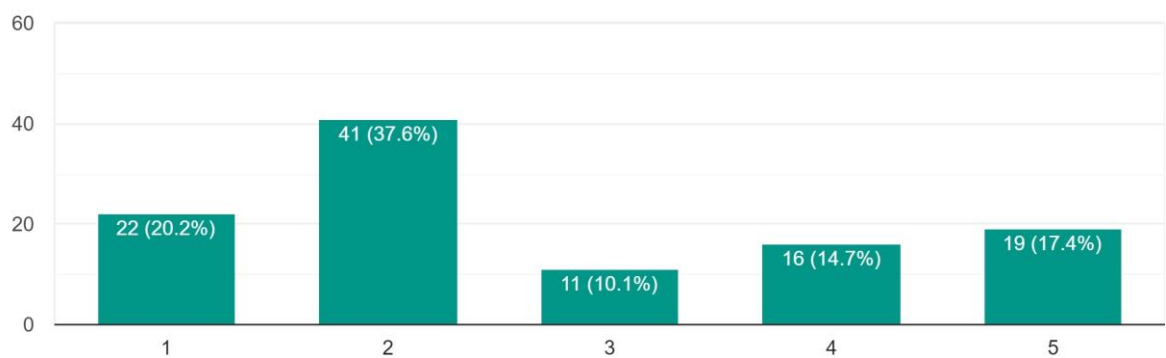
Figure 5-8: Hiring supplier's responses

In most projects, subcontractors and suppliers are not allowed to participate in the early stages of the production process
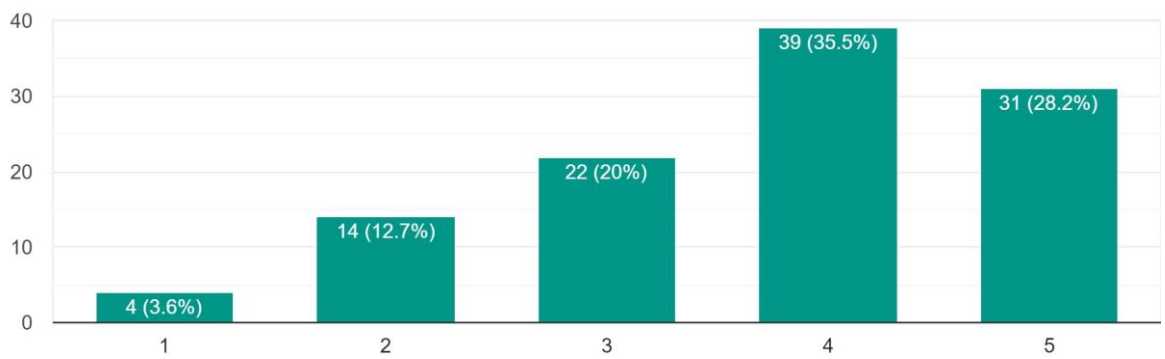
110 responses

Figure 5-9: Subcontractor and supplier participation responses

Use of information technology by the suppliers is inadequate due to lack of existing infrastructure.
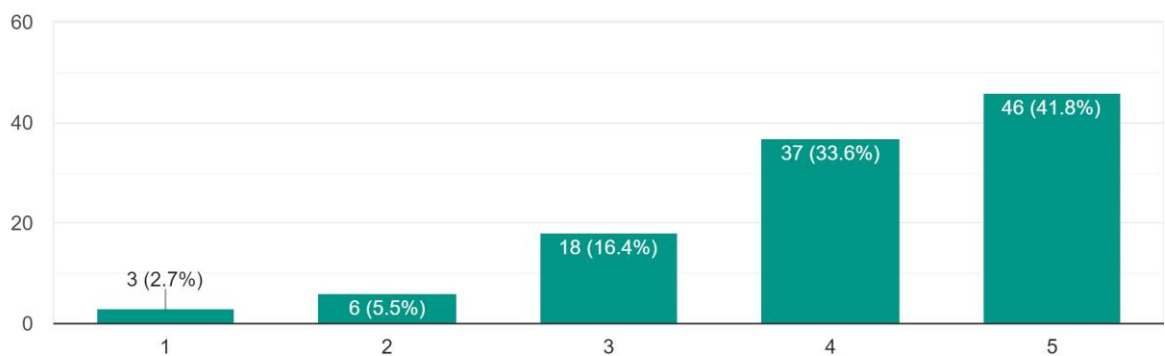
110 responses

Figure 5-10: Use of infrastructure responses

Many construction companies do not have an information system and /or electronic trade systems for real-time information sharing with their suppliers.
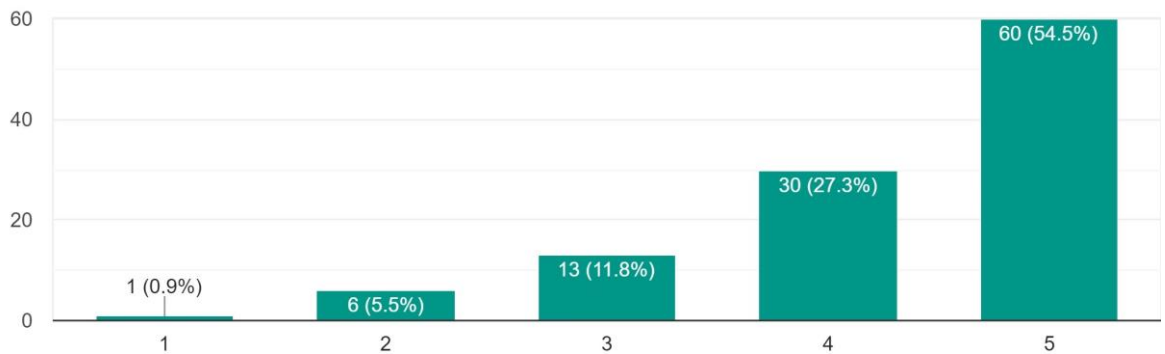
110 responses

Figure 5-11: Lack of ICT system responses

Most organizational bodies lack understanding regarding the concept of supply chain management.
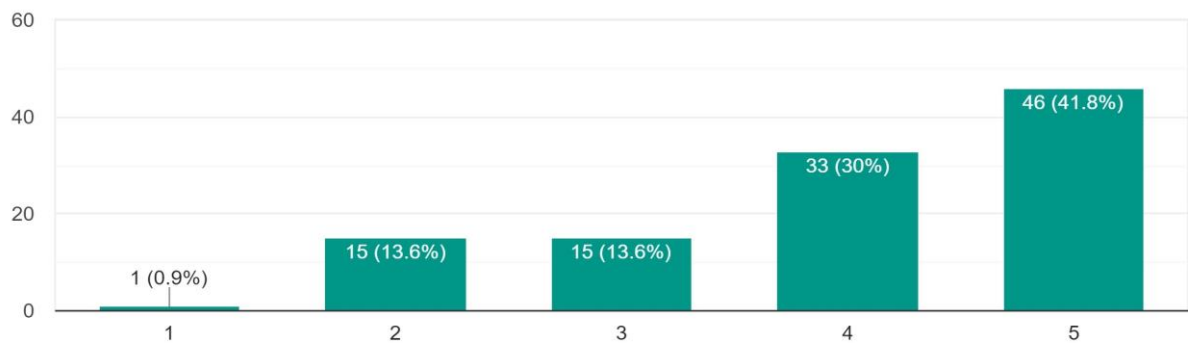
110 responses

Figure 5-12: Lack of conceptual understanding responses

Suppliers hesitate regarding proposal of a revised management system due to potential risks.
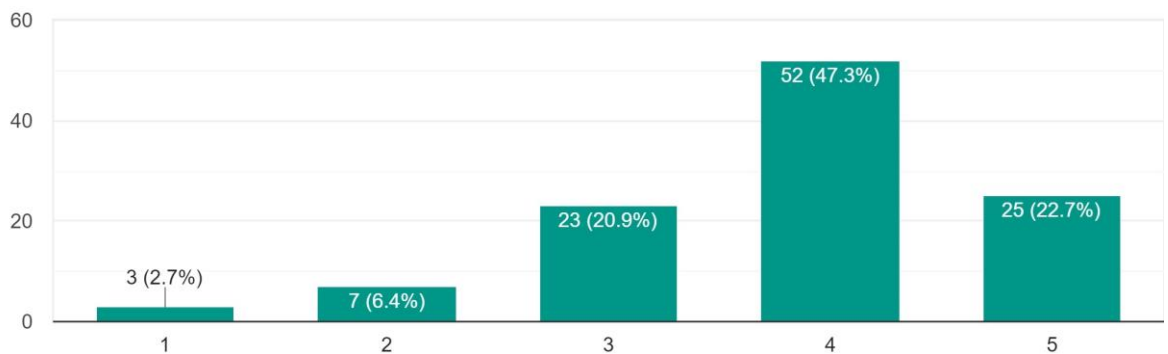
110 responses

Figure 5-13: Potential risks for supplier's responses

Suppliers are not concerned with investing in quality management systems to win the buyer's trust.
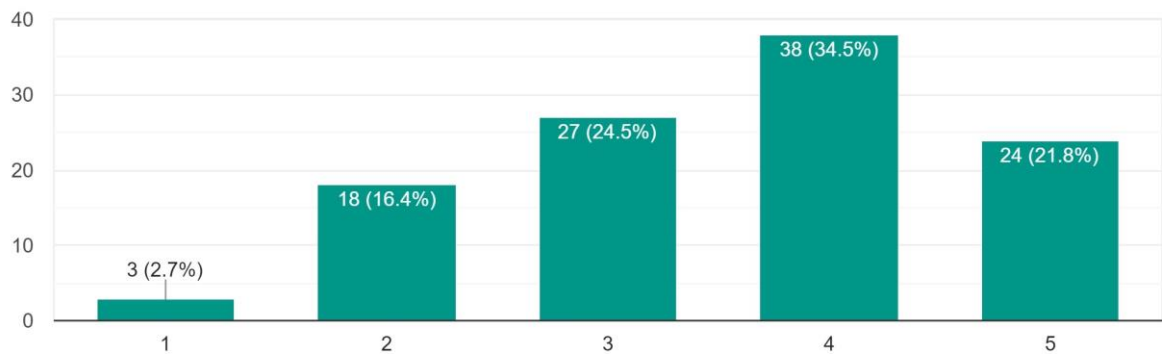110 responses

Figure 5-14: Investment in management systems responses

Management and storage of stock of supplies hinders suppliers' interest in supply chain management.
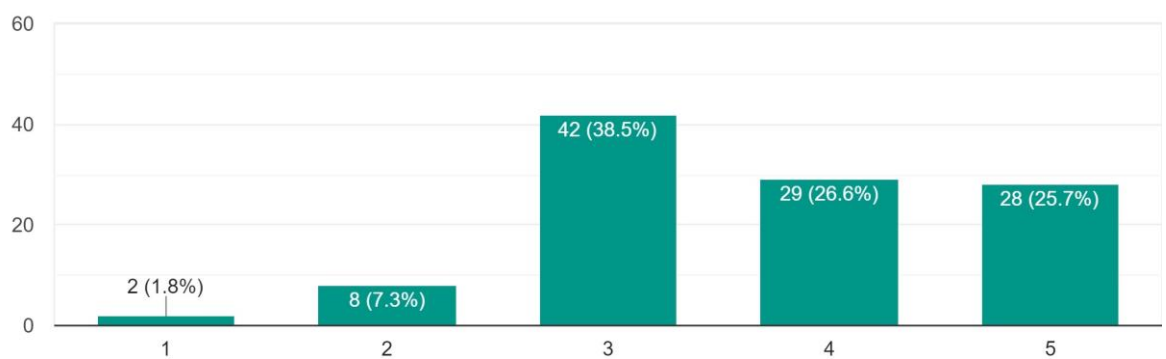109 responses

Figure 5-15: Management of supplies responses

Low information quality, insufficient information exchange and, less transparency along with limited communication prevents cultivation of mutual trust between supplier and construction firm.
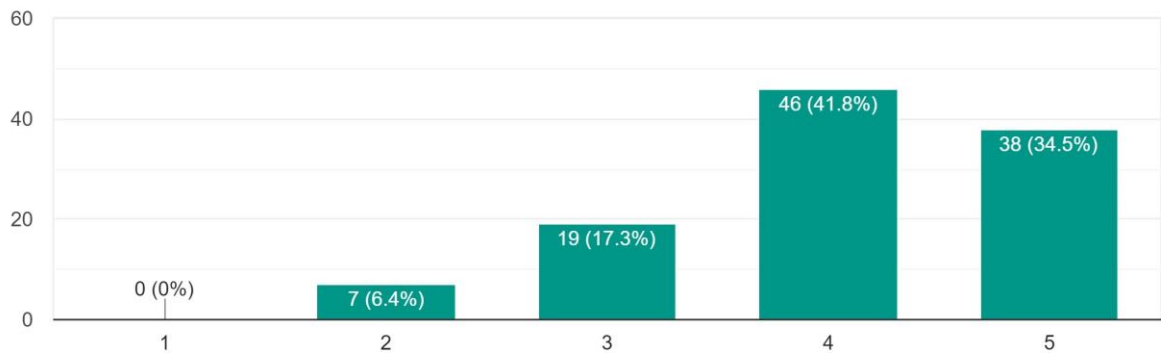110 responses

Figure 5-16: Exchange of information responses

Serious problems with payments between customers, main contractors, sub-contractors and suppliers are bound to occur due to hostile relationships.
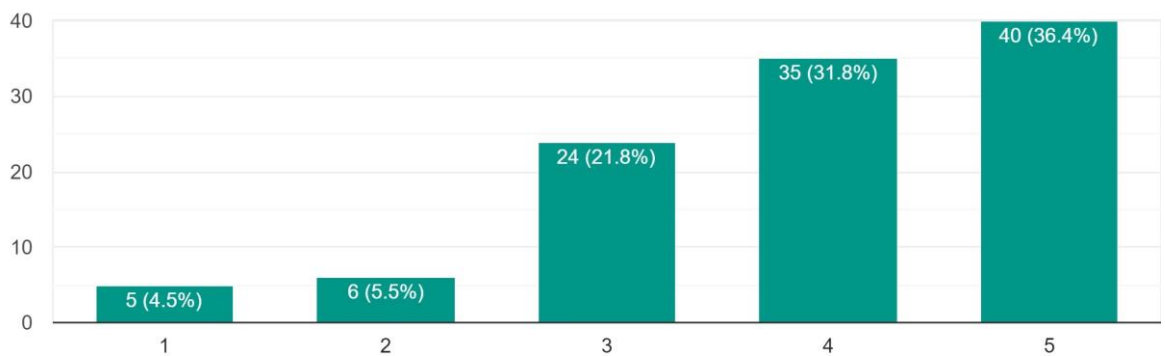110 responses

Figure 5-17: Problems with payments responses

Most construction companies lack the framework and measurement system to keep track of supply chains.
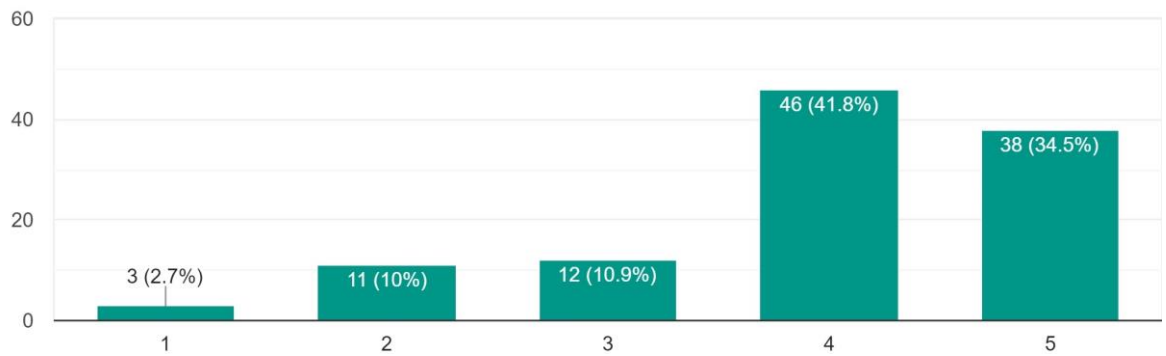
110 responses

Figure 5-18: Lack of framework responses

CHAPTER 5

CONCLUSIONS

1. Research focuses mainly on the challenges to supply chain management adoption faced by stakeholders specializing in the construction industry of Pakistan. According to the results of the questionnaire survey, there are primarily seven factors that characterize the problem.

2. The survey data revealed a commonality of viewpoints on important topics relevant to the five theme areas of concern. Although the percentage of replies may change between groups (and for some types of analysis, these variances must be considered).

3. There is a widespread belief that the quality of human resources available is subpar due to non-competitive training procedures at various levels, and in part to poor and non-competitive remuneration. The situation is exacerbated when low salaries and an unwelcoming professional atmosphere lead to skilled employees migrating overseas.

4. The lacking agreement on executives methods, especially the most minimal value bid practice, alongside high material costs deny them of assets to put resources into HRD or to give pay bundles..

5. The government should start to lead the pack in putting resources into foundation and preparing offices, yet the business will likewise be anxious to share once its business climate improves.

6. Consultants and contractors are regularly inclined towards joint endeavors that will open them to professional management approaches and new advances. Customers are less excited about executing such adjustments. Simultaneously, various contractors raised questions about specific organizations' specialized capacity and corporate trustworthiness.

7. Contractors and experts are fascinated by the inadequacies of the business climate, which incorporate "contract management" struggles from one viewpoint and "economical concerns" on the other.

8. This indicates a lack of administrative reform, insufficient public policy

action, and ineffective client bodies.

9. Except for a few exceptions, most client agencies are hampered with obsolete, deficient, and opaque procurement rules and regulations. Non-competitive compensation structures are discouraging skilled experts from joining and staying with client agency.

RECOMMENDATIONS

1. From the Component Matrix, we identify the following seven factors for barriers to supply chain management based on significant Eigen values.

2. Reforms in the sector are required to boost growth.

3. The following interventions are proposed by us:

4. To solve challenges such as forecasting demand and planning, the establishment of a Construction Industry Development Bank is recommended.

5. Establishment of an independent and effective ombudsman organization to adjudicate and monitor procurement and administrative concerns, which might save significant time spent on conflict settlement. The adoption of an impartial contractor/consultant rating system will vastly enhance procurement procedures.

6. The establishment of a specialized financial institution for the construction sector, which would serve towards the requests of the development business, may assume a fundamental part in the business' development.

7. Training has been acknowledged as the most effective approach for resolving HR concerns inside the industry. To train the personnel, the company should utilize already established technical and vocational establishments.

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