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A Study on Factors Influencing in Construction Supply Chain Management

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ABSTRACT: In the present competing environment, the supply chain in the construction industry is meeting a variety of risks. Hence, the limiting factors for the improvement of Supply Chain Management were identified by reviewing various works of literature. Totally 30 factors were identified and grouped into 4 sections. The questionnaire survey was circulated in an online platform via Google forms. Target people of the study were mainly focused on the contractors and who were involved in construction projects. Statistical tools were used to analyze the data collected through questionnaire by Relative Importance Index (RII) method and Descriptive statistics with the aid of Microsoft excels and Statistical Package for the Social Science (SPSS) respectively. Supply chain management is highly imperative while the goods from one party to another till it approaches the end-users or buyers without any losses, counterfeit, procrastination, etc.

KEYWORDS: RII, Supply chain, Supply chain management

I. INTRODUCTION

A. General

Supply Chain Management has been established to increase productivity, reduce time, increase cash-flow efficiency and minimize risk [4] and also whenever the customer demands for a quality goods and more certain services the appropriation of changes should be an ease. A Supply Chain (SC) can be defined as a network of members linked together by flow of materials, information, and funds to reduce overall system cost [2]. The supply chain structure depends on the intermediaries and the participants in construction projects. In general, the facilities in the supply chain are supplier, manufacturer, distributor, wholesaler, and retailer. Modern firms operate in a rapidly changing complex environment [3] and often depend on elaborate networks of supply chain associates to transport goods and services in the right quantity at the right time and place under determined cost and quality. It's completely helped numerous companies to improve profits and from the many years in global markets. The successful SCM applications of Walmart, P&G, Ford, and Dell are the main examples of this SCM [6]. If the members are not regulated, it may direct to reduced performance of the complete SC. Coordination between members can be managed by knowledge sharing mechanism, and any of the things in the sharing may cover supplier's capability, consumer demand, inventory management and inventory levels of different members.

B. Supply Chain Management

The supply chain has been defined as "the network of organizations that are involved, through upstream and downstream linkages, in the different processes and activities that produce value in the form of products and services in the hands of the ultimate customer" [5].

C. Factors Affecting Supply Chain

Based on a comprehensive review of the literature, the factors affecting SC were identified as shown in Table 1. These factors were extracted because it was the most identified factors by different researchers [7]. Effective coordination can be covered by "communication". There may be an interrelationship among some of the factors, it is appropriate to consider them separately because each factor represents a main aspect of a supply chain relationship.



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Table 1 Factors Affecting SCM

SECTIONS	INFLUENCING FACTORS
Efficiency of supply chain organization	 Inventory Transportation Lead Time Purchasing Production Planning
Supply chain collaboration	 Improved customer service Increased profitability Increased market competitiveness Cost reductions within your organization Benefits to the client Benefits to your supplier Improved quality assurance
Supply chain relationship suppliers	 Reliable delivery date Accurate order fulfillment Level of complaints/ returns Delivery at specified time Flexibility Handling of complaints Quality of materials Quality of service Trust
Supply chain relationship between organization and clients	 Reliability of supply Top management support Trust Mutual interest Manpower development More frequent meetings Joint business planning Creating standardization of processes Simplifying the bidding process

II. LITERATURE REVIEW

B. Amade, et.al (2016) [1] this paper, identifies and evaluate the constraints to the application of supply chain management in the project delivery. The study designed in both quantitative and qualitative methods. Among four firms the questionnaire and interview was conducted for the data collection. The data is analyzed using Severity Index (SI) and Cronbach's alpha reliability with SPSS software and also in Microsoft excels programmed software. In this study 24 factors are identified as the constraints to the application of supply chain management. The most important constraints identified are Lack of understanding of supply chain management concept (SI=50.76), Trust within and outside the organization (SI=50.31), Standardization (SI=49.32). Thus the study recommends effort should be made by the crucial participants in the projects.

V. Charles Durai, et.al (2016) [2] in this paper, a study on significant relationship between the respondents demographic variables and its attitude regarding supply chain management are discussed. Totally 100 samples were collected. Hypothesis formed based on the objectives. Statistical tools such as one-way of variance (ANOVA) and correlation method were used to analyze the data. The study finds that above 10 years, experience group has higher mean value.

PhongThanh Nguyen, et.al (2018) [6]in this paper a study is done to identify the factors which are inhibiting the



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application of supply chain management for the Vietnamese construction industry. The questionnaire survey was framed, including past studies, also with the experts. The target people of the study are those who worked with prime contractors and involved in construction projects. Face-to-Face interview was also conducted. The analysis of data is done using descriptive statistics analysis and Explanatory Factor Analysis (EFA). In this research, the subject focused mainly on the contractors at construction phase of the projects.

Venugopal Reddy Battula, et.al (2020) [8]the paper, gives an overview of desperate factors which inhibits the involvement of supply chain management for the business development in the construction industry. The questionnaire survey was framed, including past studies, also with the experts. Face-to-Face interview was also conducted. In this study more than 10 organizations are considered. Collected data's are analyzed by RII method and ranking of factors are done based on the mean value of RII. The findings of the paper results that contractors should provide solution, for the improvement of supply chain management application.

III. RESEARCH OBJECTIVE

To identify the factors influencing the supply chain management through questionnaire survey and analyze the data by Relative Importance Index (RII) method and Descriptive statistics with the aid of Microsoft excels and Statistical Package for the Social Science (SPSS) respectively.

IV. RESEARCH METHODOLOGY

A. Questionnaire Design

The research in this study were carried out by framing a questionnaire and conducting a survey among the contractors and who are involved in the construction projects to know about the opinion regarding the level of scale in supply chain management in their organization. The questionnaire were designed considering the supply chain management under various categories namely efficiency, developing of collaboration, relationship with suppliers, relation between organization and clients, communication with clients. The impact of the factors was analyzed from the views of contractors. In this study five point likertscale were used to determine the level of satisfaction extent regarding their supply chain management. The likert scale ranges from 1 to 5.

Where,

5 - refers to "very important" or "very strong" or "strongly agree" or "high extent"

1 - refers to "unimportant" or "very weak" or "strongly disagree" or "low extent"

B. Statistical Tools Applied

The following methods were used to analyze the data collected through questionnaire survey:

- Relative Importance Index (RII)
- Descriptive Statistics

C. Relative Importance Index

The RII were used to rank the different factors affecting on application of Supply chain management. The formula used for calculating relative importance index are [8]

RII = Sum of weights $(W1 + W2 + W3 + ... + Wn) / A \times N$ Where,

W= weights given to each factor by the respondents and will ranges from 1 to 5 where "1" is low extent and "5" is high extent.

A= highest weight and

N= total number of respondents.

D. Descriptive Statistics

The data analysis was carried out by finding the mean and standard deviation of various factors under each sections with the aid of SPSS. For easier interpretation, the mean value were converted into percentage score using the formula percentage score = (Mean value -1) x 25.

This were carried out by making an assumption that mean score of 1 corresponds to 20 percentage, 2 corresponds to 40 percentage, 3 corresponds to 60 percentage, 4 corresponds to 80 percentage, 5 corresponds to 100 percentage. Then the factors were ranked accordingly.



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V. RESULTS AND DISCUSSION

A. General

The limiting factors which inhibit the improvement of supply chain management were identified from the survey and are presented as follows.

B. Relative Importance Index (RII) Technique

The RII were used to rank the different factors affecting on application of Supply chain management.

a. Efficiency of Supply Chain Organization

The various factors were ranked by calculating the Relative Importance Index (RII) value using the above mentioned formula. It can be observed from the Table 2 that Lead time has the highest RII value of 0.694, while Inventory has the least RII value of 0.396. Transportation has a value of 0.455. The factors like Lead time, purchasing and transportation were influencing the SCM.

Table 2 Ranking of Efficiency of Supply Chain Organization based on RII value The relation between the various factors and their RII values were represented in the form of graph as shown in Fig 2.



Fig 2 Efficiency of Supply Chain Organization and their RII values

b. Developing Supply Chain Collaboration

The ranking of developing supply chain collaboration on the basis of their RII values were presented in Table 3. It can be inferred that Improved customer service influences the SCM, since it possessed the highest RII value of 0.821. The Increased profitability and Benefits to your supplier ranked at the bottom and it were suggested as less influencing factors for the successful collaboration of SCM.

Table 3	Ranking	of Developi	ng Supply	Chain	Collaboration	based on RII value
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FACTORS	RII VALUE	RII(%)	RANKING
Lead Time	0.6936	69.36	1
Purchasing	0.6681	66.81	2
Transportation	0.4553	45.53	3
Production Planning	0.4000	40.00	4
Inventory	0.3957	39.57	5



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The relation between the various factors and their RII values were represented in the form of graph as shown in Fig 3.

RII value



Fig 3 Developing Supply Chain Collaboration and their RII values

c. Supply Chain Relationship with Suppliers

FACTORS	RII VALUE	RII (%)	RANKING
Improved customer service	0.8213	82.13	1
Benefits to the client	0.7617	76.17	2
Improved quality assurance	0.7319	73.19	3
Increased market competitiveness	0.6809	68.09	4
Cost reductions within your organization	0.6043	60.43	5
Increased profitability	0.3915	39.15	6
Benefits to your supplier	0.4426	44.26	7

It can be observed from the Table 4 that factors like flexibility and handling of complaints were at lower rank. Both quality of materials and accurate order fulfillment have same RII value of 0838 and were ranked second. The RII value of trust were 0.783 and delivery at specified time value were 0.744. The level of complaints/returns may also be focused for the betterment of supply chain relationship with a supplier. Hence these factors influence the SCM.

Table 4 Ranking of Supply Chain Relationship with Suppliers based on RII value

	FACTORS	RII VALUE	RII (%)	RANKING
The	Reliable delivery date	0.8638	86.38	1
	Quality of materials	0.8383	83.83	2
	Accurate order fulfilment	0.8383	83.83	3
	Quality of service	0.8085	80.85	4
	Trust	0.7830	78.30	5
	Delivery at specified time	0.7447	74.47	6
	Level of complaints/ returns	0.7362	73.62	7
	Flexibility	0.7064	70.64	8
	Handling of complaints	0.4936	49.36	9

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relation between the various factors and their RII values were represented in the form of graph as shown in Fig 4.



Fig 4 Supply Chain Relation with Suppliers and their RII values

d. Supply Chain Relationship between Organization and Clients

From the Table 5, it can be noted that Trust has a higher RII value of 0.885 and were ranked at the top, while the More frequent Meetings takes the bottom of the list with the RII value of 0.3319. Top management support were ranked second with the RII value of 0.800. Creating standardization were ranked at fifth place with the RII value of 0.689. The ranking of supply chain relationship between organization and clients based on their RII values were listed in the following Table 5.

Table 5 Ranking of Supply Chain Relationship between Organization and Clientsbased on RII value

FACTORS	RII VALUE	RII (%)	RANKING
Trust	0.8851	88.51	1
Top management support	0.8000	80.00	2
Reliability of supply	0.7404	74.04	3
Mutual interest	0.7277	72.77	4
Creating standardisation of processes	0.6894	68.94	5
Manpower development	0.5957	59.57	6
Simplifying the bidding process	0.4511	45.11	7
Joint business planning	0.4085	40.85	8
More frequent meetings	0.3319	33.19	9

The relation between the various factors and their RII values were represented in the form of graph as shown in Fig 5.



Fig 5 Supply Chain Relationship between Organization and Clients and their RII values



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B. DESCRIPTIVE STATISTICS

The Descriptive statistics were used to rank the different factors affecting on application of Supply chain management.

a. Efficiency of Supply Chain Organization

The various factors are ranked by calculating the mean and standard deviation value using the above mentioned software. It can be observed from the Table 6 that Lead time has the highest standard deviation value of 1.349, while Inventory had the least standard deviation value of 0.989. Transportation has a value of 1.057. The factors like Lead time, purchasing and transportation were influencing the SCM.

Tuble of Kunking of Efficiency of Suppry Chain of Sunization based on Mean Value						
Factors	Mean	Std. Deviation	Ranking	Percentage		
Inventory	1.97	0.98884	5	24		
Transportation	2.27	1.05711	3	31		
Lead Time	3.46	1.34893	1	61		
Purchasing	3.34	1.35577	2	58		
Production Planning	2.00	1.02151	4	25		

Table 6 Ranking of Efficiency of Supply Chain Organization based on Mean Value

Based on the calculated Mean values, the relationship between various factors identified and their respective Mean values were plotted graphically as shown in Fig 6.



Fig 6 Efficiency of Supply Chain Organizations and their Mean Values

b. Supply Chain Collaboration

The ranking of supply chain collaboration on the basis of standard deviation values were presented in Table 7. It can be inferred that cost of reduction within the organization influences the SCM, since it possessed the highest standard deviation value of 1.421. The Increased profitability and Benefits to your supplier ranked at the sixth and seventh respectively and it was identified as less influencing factors for the successful collaboration of SCM.



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Table 7 Ranking of Supply Chain Collaboration based on Mean Value

Factors	Mean	Std.	Ranking	Percentag
		Deviation		e
Improved customer service	4.10	0.9832	1	77
Increased profitability	2.95	1.301	6	48
Increased market competitiveness	3.40	1.279	4	60
Cost reduction within your oranagisation	3.02	1.421	5	50
Benefits to the client	3.80	1.172	2	70
Benefits to your supplier	2.21	1.196	7	30
Improved quality assurance	3.65	1.255	3	66

Based on the calculated Mean values, the relationship between various factors identified and their respective Mean values were plotted graphically as shown in Fig 7.



Fig 7 Supply Chain Collaboration and their Mean Values

c. Supply Chain Relationship with Suppliers

It can be observed from the Table 8 that factors like flexibility and handling of complaints were ranked at the bottom respectively. Both quality of materials and accurate order fulfillment have same mean value of 4.1915 and were ranked second.

Table 8 Ranking of Supply Chain Relationship Suppliers based on Mean Value

Factors	Mean	Std. Deviation	Ranking	Percentage
Reliable delivery date	4.31	0.9803	1	82
Accurate order fulfilment	4.19	1.0350	3	79
Level of complaints/returns	3.68	1.2354	7	67
Delivery at specified time	3.72	1.2971	6	68
Flexibility	3.53	1.3163	8	63
Handling of compliants	2.46	1.1581	9	36
Quality of materials	4.19	1.0962	2	79
Quality of service	4.04	0.9078	4	76

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Based on the calculated Mean values, the relationship between various factors identified and their respective Mean values were plotted graphically as shown in Fig8.



Fig 8 Supply Chain Relation-ship with Suppliers and their Mean Values

d. Supply Chain Relationship between Organization and Clients

From the Table 9, it can be noted that Reliability of supply has a standard deviation value of 1.232 and ranked third, while the More frequent Meetings was at the bottom of the list with the standard deviation value of 0.731. The factors like Trust and Reliability of supply can be considered for the improvement of SCM.

Factors	Mean	Std. Deviation	Ranking	Percentage
Reliability of supply	3.70	1.2320	3	67
Top management support	4.00	1.1420	2	75
Trust	4.42	0.7730	1	85
Mutual interest	3.63	1.3092	4	65
Manpower development	2.97	1.4519	6	49
More frequent meetings	1.65	0.7305	9	16
Joint business planning	2.04	1.0206	8	26
Creating standardization of process	3.44	1.1573	5	61
Simplifying Bidding process	2.25	1.1125	7	31

Based on the calculated Mean values, the relationship between various factors identified and their respective Mean values were plotted graphically as shown in Fig9.

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Fig 9 Supply Chain Relation-ship between Organization and Clients, and their Mean Values

VI. CONCLUSION

The study investigates the significant factors which inhibits the improvement of supply chain management. Supply chain inherits all those activities associated with moving goods from the raw-materials stage through to the end user. The objective of the study was to identify the limiting factors for the successful implementation of supply chain management in construction industry. We can understand that supply chain has an effect on profitability and project expectations in terms of cost, time, and quality and risk reduction. Thus the comparative study of both the method is carried, for the top major factors require much importance for the SCM.

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