Technology-Driven Innovations in Supply Chain Management

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Abstract— *India has been rapidly developing homes and infrastructure for the last decade. Delays in building projects are prevalent and severely damage projects in numerous ways. Material shortages and delays in material availability are major causes of building project delays internationally. However, the major underlying reasons vary every country. The main source of material shortage is the origin or availability of materials. However, inefficient materials procurement and inventory management systems, as well as late identification of the materials needed, were revealed to be the leading causes of material delivery delays. The observations were supposed to help formulate or revise critical policies to ensure project completion on time. Cost overruns, time overruns, contract cancellation, arbitration, and litigation are studied successively. The increasing prevalence of project delays is directly influencing the timely delivery of construction projects. Corrupt practices, lack of quality materials, incorrect design, slow delivery of materials, slow approval and receipt of completed project work, improper site management and performance, late budget/fund release, and ineffective project planning and scheduling should be investigated as influential causes of delay. This study assesses the impact of construction delays and possible solutions.*

This project explores the impact of technological innovations on supply chain management, focusing on efficiency, decision-making optimization, and ethical and social implications. The objective is to evaluate how these innovations influence supply chain performance, considering various technologies and their implications. The study also addresses obstacles and opportunities in implementing these innovations. Special attention is given to the role of data analytics and real-time information in enhancing decision-making, highlighting potential benefits and drawbacks. The project concludes by examining the ethical and social repercussions of technology adoption in supply chain management. Overall, this study contributes to understanding the transformative effects of technology on supply chains, emphasizing key factors for successful implementation and ethical decision-making.

Keywords—SCM, logistics, resources, CBA, Disputes, Material management, Technology-driven innovations, supply chain management, efficiency, challenges, opportunities, data analytics, real-time information, decision-making optimization, etc.

INTRODUCTION

Definition of SCM

A supply chain can be defined as “The network organizations that are involved, through upstream and downstream linkages, in the different processes and activities that produce value in the form of products & services in the hands of the ultimate consumer”.

Supply chain management is the process of planning, implementing and controlling the operations of the supply chain as efficiently as possible. Supply chain management encompasses the planning and management of all activities involved in sourcing, procurement, conversion, and logistics management activities.

(Material, equipment, personnel) entirely proceed from supply points to the construction site. Supply chain in construction is more concerned with the planning and directing discrete quantities of materials to the construction site where the object is assembled from incoming materials.

According to our observation, the definition by Cristopher, 1998 has the one which is better explanation of the SCM as the definition states the basic purpose of SCM in a very organized and simple manner to understand. Construction industry faces lots of challenges with regard to problems associated with productivity. Productivity is one of the most important factors affecting the overall performance of any organization, whether large or small and the problems are usually associated with performance of labour. The performance of labour is affected by many factors and is usually linked to the performance of time, cost, Resources, disputes material and quality. Inefficient management of construction resources can result in low productivity. Therefore, it is important for construction managers to be familiar with the methods leading to evaluate the productivity of the equipment and the laborers in different crafts. To achieve the income expected from any construction project in general, it is important to have a good controlling hand on the productivity factors that contribute in the integrated production composition, like SCM, labour, equipment, cash flow, etc... While there are several input resources in a transformation process, labour productivity plays a particular role. A deeper comprehension of the factors influencing productivity can enable

managers to more effectively allocate limited resources, provide workers with better support, or increase workers' motivation.

The critical effects of delay investigated are cost overruns, time overrun, termination of contract, arbitration, and litigation sequentially Delay management in construction industry is a main factor responsible for delays in construction of project and the growing rate of project delay is directly affecting the timely delivery of construction project. So, the influential causes of delay investigated should be corruption, unavailability of utilities at site, inflation or price increase in materials, lack of quality materials, incorrect design, slow delivery of materials, slow in approving and receiving of complete project work, improper site management and performance, late release of budget/funds, and ineffective project planning and scheduling successively as unique to the construction project. This study evaluates the effect of delay on construction of project and remedial measures to prevent the delay in Indian construction industries.

The benefits for individual companies in the supply chain include:

- Reduced real costs, with margins maintenance
- Incentive to remove waste from the process
- Greater certainty of out-turn costs
- Delivery of better underlying value to the client
- More repeat business with key clients
- Greater confidence in longer-term planning

Productivity rates are used as indicators of the construction time performance. They are used in planning and scheduling of construction, controlling of the cost and worker performance, estimating and accounting.
Changes in labour productivity shows whether output is increasing or decreasing per worker and is often used in wage settlements to compensate workers for productivity improvements. Growth in productivity is the key to higher living standards as a country can sustain real wage increases without losing competitiveness, only if labour productivity grows.
If a company wishes to reduce risk, increase profits, or gain market share, there is direct need within the firm to have accuracy data on and use of labor productivity.
The most challenging issue in Construction industry is labour productivity. Labour productivity directly effects on the construction performance. If a company wishes to reduce risk, increase profits, or gain market share, there is direct need within the firm to have accuracy data on and use of labor productivity.

The various processes in supply chain management are:

1. Supply chain strategy
2. Logistics
3. Product lifecycle management
4. Procurement
5. Asset Management
6. Enterprise application
7. Supply chain planning

Supply chain strategy:

The strategy of an enterprise identifies how a company will function in its environment. The strategy specifies how to satisfy customers, how to grow the business, how to compete in its environment, how to manage the organization and develop capabilities within the business, and how to achieve financial objectives.

Logistics:

Logistics is the flow of material goods and services from their place of origin to the final customer (consumer). The aim is to ensure the adequacy of place (moving goods to places where there is a demand for them) and time (maintaining the right stocks levels and proper distribution of goods/services). Future capacity planning for logistics (warehousing and transportation) operations is another process related to network planning. Based on the projected sales plans, the network planning process can help in projecting warehousing and transportation capacity needs over the years. Analyzing these requirements can help in better planning for a growing network. Such plans may require changing warehousing capacity by opening new warehouses, expanding existing ones, mechanizing warehouses to increase throughput, and negotiating transportation contracts in advance to address the projected changes for the transportation capacity.

Product lifecycle management:

Product life cycle is the cycle through which every product goes through from introduction to withdrawal or eventual demise. These stages are:

Introduction: When the product is brought into the market. In this stage, there's heavy marketing activity, product promotion and the product are put into limited outlets in a few channels for distribution. Sales take off slowly in this stage. The need is to create awareness, not profits.

The second stage is growth. In this stage, sales take off, the market knows of the product; other companies are attracted, profits begin to come in and market shares stabilize.

The third stage is maturity, where sales grow at slowing rates and finally stabilize. In this stage, products get differentiated, price wars and sales promotion become common and a few weaker players exit.

The fourth stage is decline. Here, sales drop, as consumers may have changed, the product is no longer relevant or useful. Price wars continue, several products are withdrawn and cost control becomes the way out for most products in this stage.

Procurement:

The purchasing of raw materials or goods from suppliers is essential to supply chain efficiency. The use of flow charts or workflows can help mitigate instances of redundant vendor analysis/ research and can also help to streamline purchase order creation.

Asset Management:

Assets refer to fixed assets, which are the long-term pieces of property that businesses use to create their profits. Assets are not sold quickly like inventory—they are invested in, managed, and eventually phased out in favor of newer investments. Assets need to be managed over the course of their useful life, for a few reasons. One reason is that they are integral to everyday processes and need to always be in working order.

Enterprise Application:

Earlier known as enterprise resource planning (ERP) system; suite of integrated software modules and a common central database and collects data from many divisions of firm for use in nearly all of firm's internal business activities; Information entered in one process is immediately available for other processes.

Built around thousands of predefined business processes that reflect best practices
Example as below:

- Finance/accounting: General ledger, accounts payable, etc.
- Human resources: Personnel administration, payroll, etc.
- Manufacturing/production: Purchasing, shipping, etc.
- Sales/marketing: Order processing, billing, sales planning, etc.

Supply chain planning:

Supply chains in many industries suffer from an excess of some products and a shortage of others, owing to an inability to predict demand. Therefore, the first step in devising an effective supply chain strategy is to consider the nature of the demand for the products that the company supplies. Supply chains have become more extended and dynamic due in part to global trade and market demands. There are three traditional functions in the supply chain: procurement, production, and distribution (Thomas & Griffin, 1996). Within these stages are multiple functions and numerous activities to undertake, all of which require diligent, integrated, and well-coordinated planning to fulfill demand.

LITERATURE REVIEW

Amelie Meyer, Wiebke Walter and Stefan Seuring, "The Impact of the Coronavirus Pandemic on Supply Chains and Their Sustainability: A Text Mining Approach, Research Topic 11 March 2021

This paper shows that certain SC topics like risk, resilience, disruption, and sustainability vary in their news coverage on the type of newspaper and the number of coronavirus disease 2019 infections. The time period was split into three phases regarding the course of the number of infections and differences in the news coverage of the phases that can be distinguished already: (1) the onset of the crisis, (2) the peak and lockdown, and (3) managing SCs during the crisis
Followings are the major findings from above paper:-

- The impact of the coronavirus pandemic on SC has been analyzed by using text mining techniques on newspaper articles from general and supply and logistic press.
- The focus changes from trade, demand, logistics, and manufacturing in combination with disruption, impact, and risk toward technology, increase, and commerce and from being problem-focused toward solution-focused.

Warwick McKibbin and Roshen Fernando, the Global Macroeconomic Impacts of pandemic: Seven Scenarios" 2 March 2020

This paper demonstrates that even a contained outbreak could significantly impact the global economy in the short run. These scenarios demonstrate the scale of costs that might be avoided by greater investment in public health systems in all economies but particularly in less developed economies where health care systems are less developed and population density is high.
Followings are the major findings from above paper:-

- This study indicates the possible costs that can be avoided through global cooperative investment in public health in all countries.
- These critical policy interventions for decades, yet politicians continue to ignore the scientific evidence on the role of public health in improving the quality of life and as a driver of economic growth.

Marino Arturo and Ariel Meyuhas, "Fab Labor Productivity Improvement through a Combined Modeling Approach"2019

This case study describes a staffing modeling method developed by The MAX Group for increasing direct labor personnel productivity through providing a complete representation of how the operators work, how effective they are and how to optimize their assignments. This modeling technique combines two important aspects together which uniquely addresses Fab management concerns about speed of execution and accuracy of information to make useful decision in real time. This modeling technique was developed and used in multiple factories globally and is a proven tool that helps Fabs today to increase floor personnel productivity and effectiveness.
Followings are the major findings from above paper:-

- In this paper, we take the unconventional way of improving labour productivity by minimizing time wastages caused by non-value added activities.
- This study with improvement action focuses on time wastage in queuing for metrology tools and handling of control wafers.

Muhammad Sher Gabol, Dr. Danish Ahmed Siddiqui, the factors impacting the success of supply chain management in the construction industry of Pakistan, 2019

Present study is conducted to investigate the impact of top management commitment on supply chain responsiveness with mediating role of organizational factors, mutual understanding, and flow of information, relationship and decision making.
A sample of 120 respondents is collected from various construction projects. In survey process adopted questionnaire is used to investigate the hypotheses. The study used descriptive statistics, structural equation modeling, factor analysis, reliability analysis, and correlation analysis.

Followings are the major findings from above paper:-

- Based on SEM and CFA it is supported that responsiveness of supply chain is directly and significantly affected by top management commitment and indirectly affected by mediators including information sharing and mutual trust.
- Yet results did not support indirect effect of organizational factors and relationship & decision making.
- Findings of the study implies that the effectiveness of supply chain could be quantified and adopted by industry professionals for comparing the effectiveness of SCM for a benchmarking purpose

Anu V. Thomas and J. Sudhakumar, "Factors Influencing Construction Labour Productivity: An Indian Case Study", Journal of Construction in Developing Countries, 2022

Construction productivity is of interest to researchers and practitioners because of its impact on the performance of construction projects. Despite various studies to identify factors influencing productivity in other countries, no study has addressed productivity issues in India. This paper reports the results of a questionnaire survey of project managers, site engineers, supervisors and craftsmen, in the state of Kerala in India, to identify the factors influencing construction labour productivity.

Followings are the major findings from above paper:-

- The top five factors identified as having a significant impact on productivity:
- Timely availability of materials at the worksite,
- Delayed material delivery by the supplier,
- Strikes called by political parties or hartals,
- Frequent revisions of drawings/design, resulting in additional work/rework and
- Timely availability of drawings at the worksite.
- The findings provide a better understanding of the factors influencing productivity in the Indian context and will aid construction practitioners in making effective plans for productivity improvement

Artificial Intelligence and Parametric Construction Cost Estimate Modeling: State-of-the-Art Review Haytham H. Elmousalam, ASCE 2020

This study reviews the common practices and procedures conducted to identify the cost drivers that the past literature has classified into two main categories: qualitative and quantitative procedures. In addition, the study reviews different computational intelligence (CI) techniques and ensemble methods conducted to develop practical cost prediction models. This study discusses the hybridization of these modeling techniques and the future trends for cost model development, limitations, and recommendations. The study focuses on reviewing the most common artificial intelligence (AI) techniques for cost modeling such as fuzzy logic (FL) models, artificial neural networks (ANNs), regression models, case-based reasoning (CBR), hybrid models, diction tree (DT), random forest (RF), supportive vector machine.

Improving the Results of the Earned Value Management Technique Using Artificial Neural Networks in Construction Projects Amirhossein Balali, Alireza Valipour, Research Article, 21 October 2020

The aim of this study is to minimize the shortcomings of the Earned Value Management (EVM) method using an Artificial Neural Network (ANN) and multiple regression analysis in order to predict project cost indices more precisely. A total of 50 road construction projects in Fars Province, Iran, were selected for analysis in this research. An ANN model was used to predict the projects' cost performance indices, thereby creating a more accurate symmetry between the predicted and actual cost by considering factors that influence project success. The input data of the ANN model were analysed in MATLAB software. A multiple regression model was also used as another analytical tool to validate the outcome of the ANN

Cost estimation and prediction in construction projects: a systematic review on machine learning techniques Sanaz Tayefeh Hashemi, · Omid Mahdi Ebadati, Springer Article, 6 September 2020

Papers have been thoroughly investigated based on the application area, method applied, techniques implemented, journals, which have been published in, and the year of publication. The most important outcome of this study is to find out the different analytics methods and machine learning algorithms to predict the cost estimation of construction and related projects and aid to find out the suitable applied methods.

Cost Estimation Performance in the Construction Projects: A Systematic Review and Future Directions Mohammad Waffy Fazil, International Journal of Industrial Management (IJIM), 17-5-2021

These papers were then analyzed, synthesized, and summarized in terms of the distribution across countries and citation influences. The factors of cost estimation performance were clustered into several themes with most of the factors in control themes. The factors in control themes are cluttered based on Organizational Control Theory (OCT). However, control themes provide less conceptual basis and dynamic to explain cost estimation performance and relationship among the factors. Therefore, this study reclassified other factors of cost estimation performance with reference to Contingency Theory (CT) and Task Technology Fit Theory (TTFT). Hence, a new framework with a relationship among the factors and cost estimation performance was developed

Application of Artificial Intelligence for the Estimation of Concrete and Reinforcement Consumption in the Construction of Integral Bridges Zeljka Beljkas, Milos Knezevic, Snezana Rutes and Nenad Ivanisevic, Research Article, 8th June 2020

The research on the use of artificial intelligence for the estimation of concrete and reinforcement consumption and the selection of optimal models for estimation; the estimation model was developed by using artificial neural networks. The best artificial neural network model showed high accuracy in material consumption estimation expressed as the mean absolute percentage error, 8.56% for concrete consumption estimate and 17.31% for reinforcement consumption estimate.

Optimization of structural elements in highly seismic areas using neural networks, V. Arana, M. Sanchez and P. Vidal2IOP Conference Series: Materials Science and Engineering2021

The aim of this research is to use Artificial Neural Networks (ANN) to dimension structural elements in regular 6-storey buildings. The necessary data for the training of the algorithm was elaborated manually with the help of the ETABS software; these were 30 buildings of reinforced concrete with a system of structural walls. The configuration and training of the neural network was carried out in the MATLAB software. The validation was carried out in an additional analyzed building in which the concrete savings were calculated, and the requirements of the current regulations were verified.

Predictive Statistical Cost Estimation Model for Existing Single Family Home Elevation Projects Arash Taghinezhad, Carol J. Friedland, Research Article, 07 June 2021

Determination of project effectiveness through benefit-cost analysis (BCA) relies on the expected avoided flood loss and the project cost. Conventional construction cost estimates are highly detailed, considering specific details of the project; however, mitigation project decisions must often be made while considering only highly generalized building details. To provide a robust, generalized project cost estimation method, this paper implements data modeling and mining methods such as multiple regression, random forest, generalized additive model (GAM), and model evaluation and selection with cross-validation methods to hindcast elevation costs for existing single-family homes based on average floor area, increase in floor elevation, number of stories, and foundation type.

The Implementation Factors of Information and Communication Technology in the Life Cycle Costs of Buildings Peter Mésároš, Tomáš Mandicák, Marcela Spišáková, Research Article, 25 March 2021

This is mainly the sum of costs during the construction project's individual stages, such as ownership, implementation, maintenance, and liquidation of the building. Budgetary constraints, environmental conditions, lack of communication, and skilled labor availability affect costs and time, even during the maintenance phase. These factors can also significantly affect the cost-effectiveness and efficiency of design management and the construction phase. This means that there is a close link between the maintenance phase and the design and construction phase.

Develop an artificial neural network (ANN) model to predict construction projects performance in Syria Rana Maya, Bassam Hassan, Ammar Hassan, Journal of King Saud University – Engineering Sciences, 2 May 2021

The purpose of this paper is to enable members of the construction project team to understand the factors, which they must closely monitor to complete the project with the required performance. Therefore, the research aimed to develop an artificial neural network (ANN) model to predict construction project performance based on the above factors.

Aim

"The aim of this research was to evaluate the various types of factors in supply that occur in construction projects and the reasons why time management occur and the measures that can be implemented to reduce or eliminate these delays by mitigation or acceleration of supply chain management".

Objectives

- To assess the impact of technology-driven innovations on supply chain efficiency.
- To analyse the challenges and opportunities of implementing technology-driven innovations in supply chain management.
- To design Questionnaire Survey with pilot analysis using SPSS Tool
- To examine the role of data analytics and real-time information in optimizing supply chain decision-making.
- To Identify the potential ethical and social implications of technology-driven innovations in supply chain management

Problem statement

To study supply chain management, low labour productivity on site such effect on construction site and find out the best solution for the efficient work by reducing the cycle time that increase project performance

Need of study

Supply chain management involves firms collaborating to enhance strategic positioning and operational efficiency.
It impacts the speed and efficiency of service delivery, balancing these factors with cost reduction strategies is crucial.
Initially, marketing, distribution, planning, manufacturing, and purchasing operated independently with their own goals.
The industrial revolution highlighted the need to integrate these functions, leading to the concept of supply chain management.
Supply chain management acts as a decision-making process between strategy and operation, fostering coordination and effective management.
It serves as a relay team, where individual functions are competitive, requiring coordination for overall success.

RESEARCH METHODOLOGY

- It consists of introduction, history, effects of productivity on construction industry, advantages, salient features. Also introduce the objectives of this study.
- Literature review related to the project.
- Analyze the factors affecting labour productivity.
    - Overtime
    - Morale and Attitude
    - Fatigue
    - Stacking of Trades
    - Joint Occupancy
    - Beneficial Occupancy
    - Concurrent Operations
    - Absenteeism and Turnover
    - Mobilize/Demobilize
- Time, Cost Management and material management in Construction site productivity.
- Preventive methods to improve the SCM & Labour productivity.
- Conclusion and lastly discussed on future scope of this project.

Research Framework

1. To study the literature review to know about present scenario of Infrastructure projects and conduct open interviews.
2. Define the objective based on the necessity concluded from present scenario.
3. Preparation of set of questions based on literature review, survey of the SCM, Material, labours, and for conducting the questionnaire survey focused on defined objective.
4. Interviews and discussions with labours to validate the factors like disputes, resources, material chain and time-cost management.
5. Analysis of data, by relative importance index method, obtained from the Questionnaire survey to rank the attributes frequently affecting the performance of the project.
6. Analysis of data, by relative importance index method, obtained from the Questionnaire survey to know the impact of attributes on the project affecting the performance of the project.
7. Productivity and recommendation through case study.

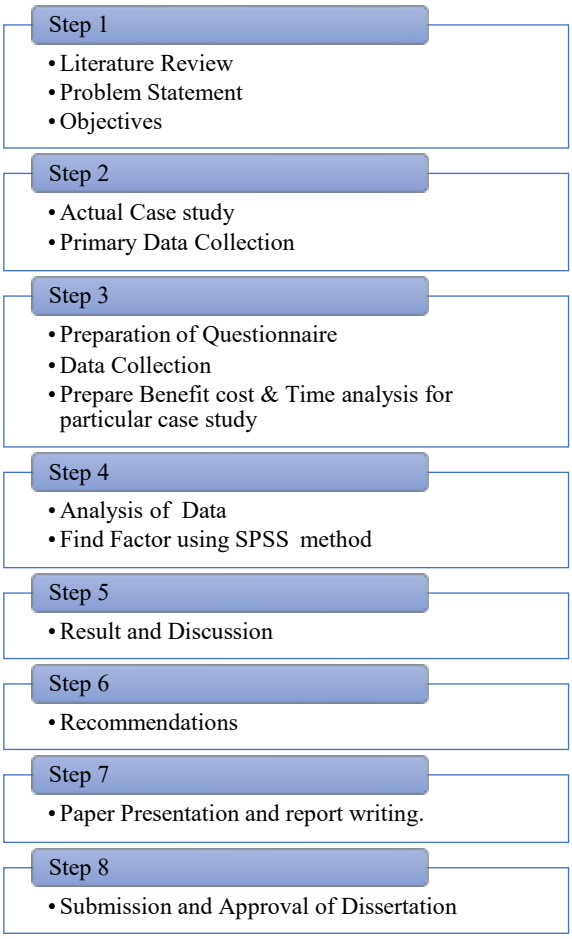


Fig1.1: Flowchart of Methodology

Table 1.1 factors of organization supply chain collaboration by RII method

	Factors affecting SCM & Productivity	A	B	C	D	E	F	G	H	I	J
A	**External Characteristics Factors**										
	Order Variation		√	√							√
	Development Research		√					√			√
	Overtime (acceleration)			√	√	√					
	Economic Condition	√	√								
B	**Project Characteristics Factors**										
	Project Characteristics		√			√			√	√	
	Inclement Weather			√				√		√	
	Location Specification		√	√		√				√	
	Design Requirement										
	Site access		√			√					
	Project Size		√								
C	**Workforce Characteristics Factors**		√								
	Frequent changes in labor				√	√	√	√			√
	Quality Experience & Training										√
	Turnover				√	√					√
	Absenteeism				√		√	√	√		
	Disturbance						√	√			
	Morality							√			
	Communication Problems							√			
D	**Management Factors**										
	Work planning & Scheduling		√	√			√		√		√
	Professionalism of the design team	√	√		√						
	The level of management control			√				√		√	
	Difficulties in employing site supervisor	√	√				√				
	Late Inspection of completed work		√	√							
	Incompetence of site supervisor			√			√		√		
E	**Site & Resource Management Factors**										
	Quality Control	√	√		√		√		√		√
	Information	√	√	√		√		√		√	√
	Communication breakdown	√	√		√						√
	Coordination of subcontractor		√					√			
	Rework	√	√		√				√		
	Congestion	√			√				√		√
	Financial Problem	√	√	√	√		√		√	√	
	Availability of Workforce	√					√	√		√	√
	Sequence of Work	√	√	√	√			√	√	√	

	Availability of materials	√	√				√	√	√		√
	Method and Machinery	√			√			√		√	
	Availability of tools and Machinery	√					√				

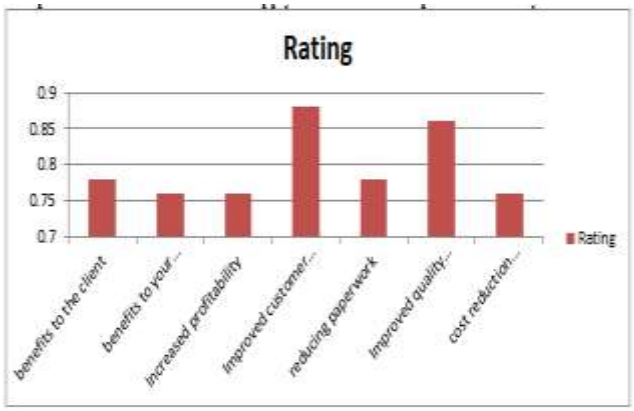
Factors	RII	Rank
Benefits to the client	0.7833	3
Benefits to your supplier	0.7667	5
Increased profitability	0.7667	6
Improved customer services	0.8833	1
Reducing paper work	0.7833	4
Improved quality assurance	0.8667	2
Cost reduction within your organization	0.7667	7

Table 1.2 Factors of successful supply chain relationship with clients by RII method

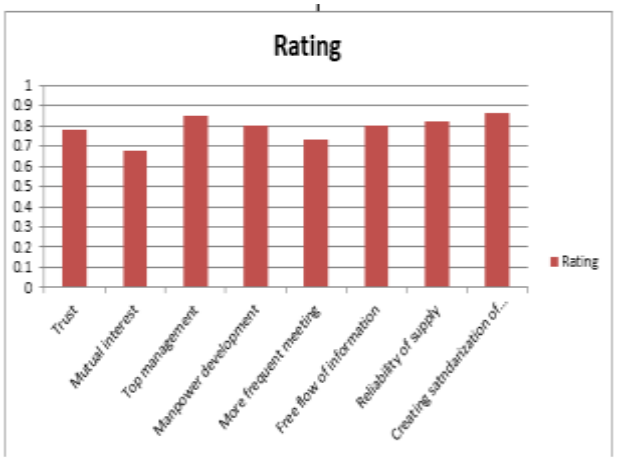
Sr. No	Factors	RII	Rank
01	Trust	0.7833	6
02	Mutual interest	0.6833	8
03	Top management support	0.8500	2
04	Manpower Development	0.8000	4
05	More frequent meeting	0.7333	7
06	Free flow of information	0.8000	5
07	Reliability of supply	0.8167	3
08	Creating standardization of process	0.8667	1

Table1.3: Beneficial factor of supply chain management by RII method

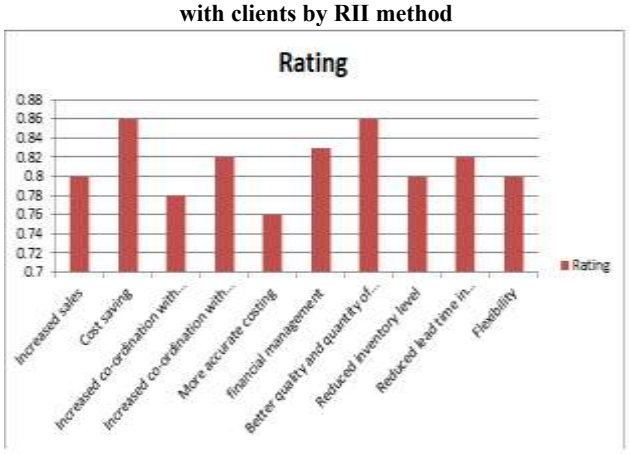
Sr. No	Factors	RII	Rank
01	Increase sales	0.8000	6
02	Cost saving	0.8667	1
03	Increased coordination with supplier	0.7833	9
04	Increased coordination with client/contractor	0.8167	4
05	More accurate costing	0.7667	10
06	Financial Management	0.8333	3
07	Better quality and quantity of information	0.8667	2
08	Reduced inventory level	0.8000	7
09	Reduced lead time in production	0.8167	5
10	Flexibility	0.8000	8



Graph 1.1: Factors of successful supply chain relationship with clients by RII method



Graph 1.2: Factors of successful supply chain relationship with clients by RII method



Graph 1.3 Beneficial factor of supply chain management by RII method

QUESTIONS

[1] Designation
[2] Name
[3] Gender
[4] Email
[5] Your position
[6] Experience
[7] Phone number

[8] Comments

[9] Do you think use of RCC reduce total cost of project?
[10] Will the idle time of project completion is adequate because of RCC material?
[11] Will the tensile strength of RCC is more than usual concrete used for construction?
[12] Will the compressive strength of RCC is more than usual concrete used for construction?
[13] Is using RCC material affecting the overall environmental impact?
[14] Do you think that project will be delayed as a result of the late release of the site, drawings, and materials?
[15] Is the project team heavily reliant on one another for assistance, intelligence, or enforcement to complete their tasks, causing a delay in the constructing RCC project?
[16] Do you believe the errors in layout caused by incorrect data in drawings lead to further work being done?
[17] Do you believe the project team members and staff lack expertise in the using RCC material?
[18] Can you feel there is a lot of uncertainty on the project for the project team members?
[19] Is improper labour management affect delaying of project?
[20] Is delay in project will impact on total project cost?
[21] Does precast RCC panel decrease the cost of project?
[22] Is improper material management affect total project cost and time required for completion of project?
[23] Do you think use of RCC reduces time required to complete the project?
[24] Will the easy formwork and casting of supply chain management is main factor for usage of RCC?
[25] Is insufficient machinery, manpower management affect delaying of metro project?

Figure: BAR Chart

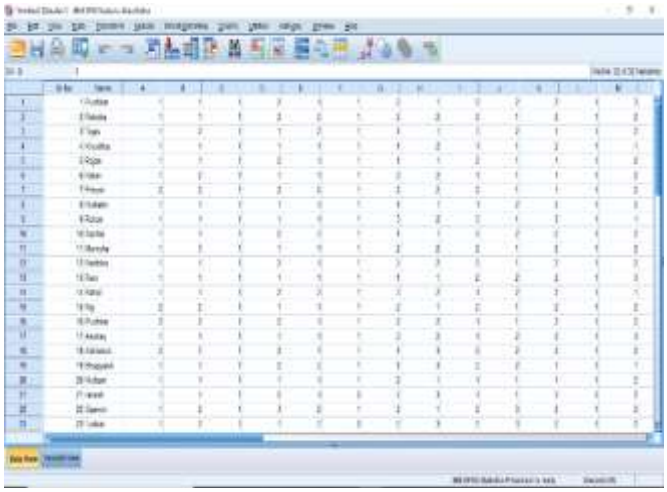


Figure: Data View

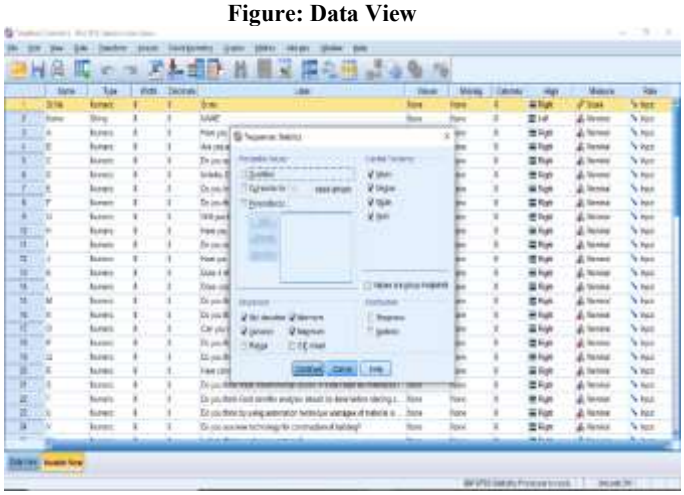


Fig: Mean & Deviation

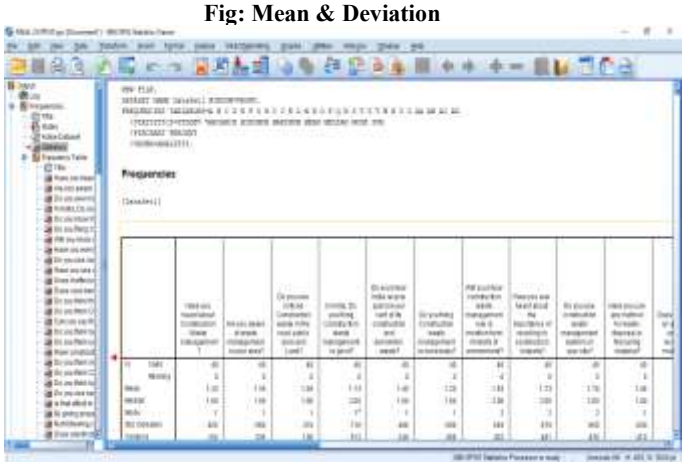


Figure: Output File

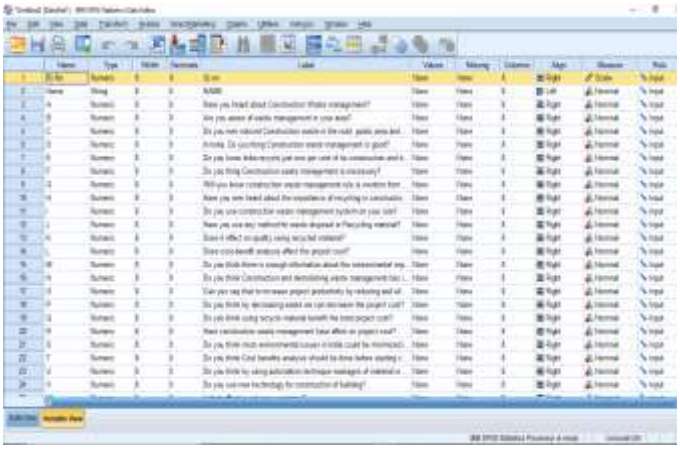
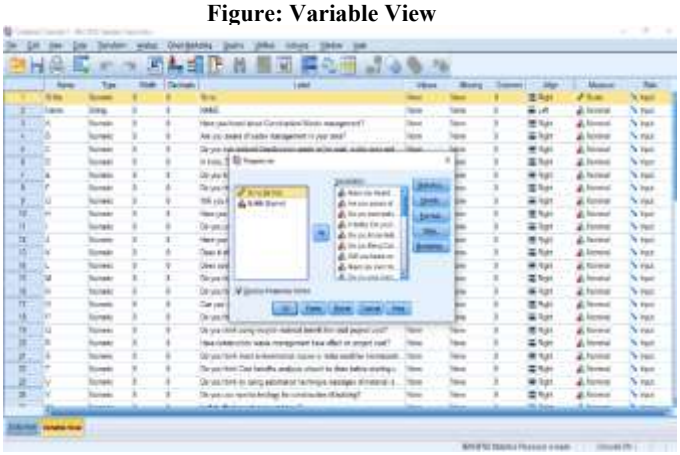
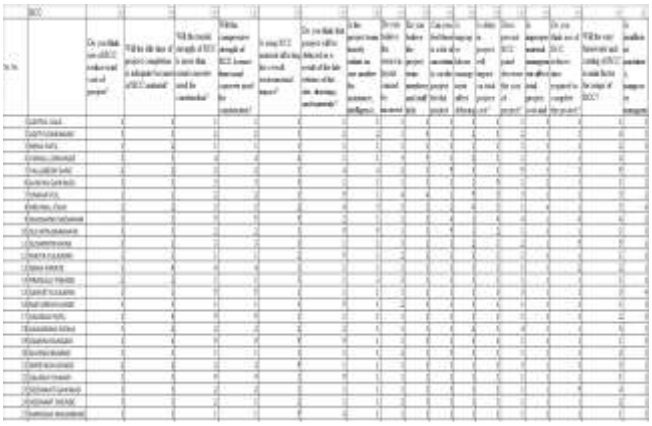


Figure: Variable View

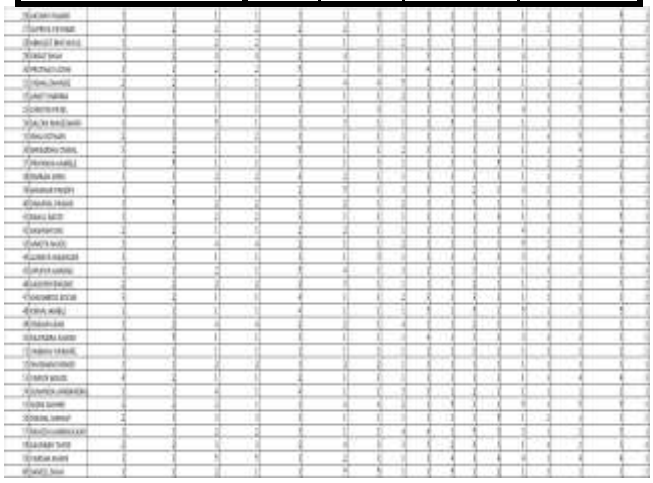


SURVEY REPORT



Do you think use of RCC reduce total cost of project?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	71	71.0	71.0	71.0
	Agree	18	18.0	18.0	89.0
	Neutral	6	6.0	6.0	95.0
	Disagree	3	3.0	3.0	98.0
	Strongly disagree	2	2.0	2.0	100.0
	Total	100	100.0	100.0	



Frequency Table

Will the idle time of project completion is adequate because of RCC material?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	52	52.0	52.0	52.0
	Agree	28	28.0	28.0	80.0
	Neutral	8	8.0	8.0	88.0
	Disagree	6	6.0	6.0	94.0
	Strongly disagree	6	6.0	6.0	100.0
	Total	100	100.0	100.0	

Will the tensile strength of RCC is more than usual concrete used for construction?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	36	36.0	36.0	36.0
	Agree	34	34.0	34.0	70.0
	Neutral	8	8.0	8.0	78.0
	Disagree	10	10.0	10.0	88.0
	Strongly disagree	12	12.0	12.0	100.0

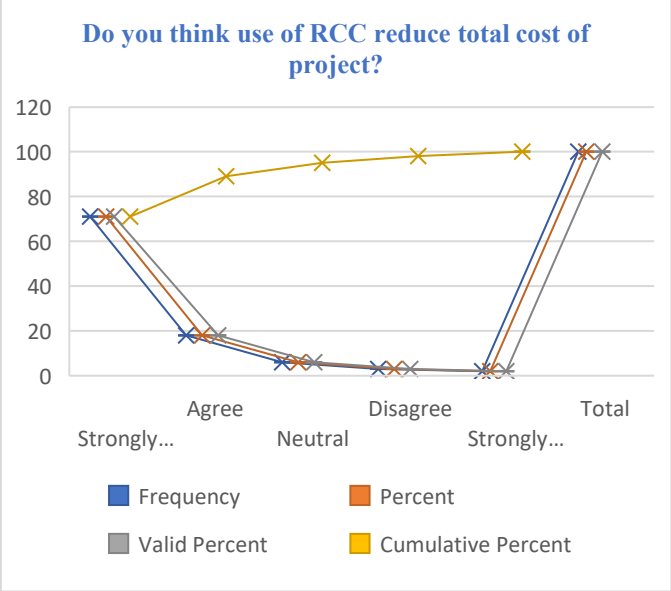
Total	100	100.0	100.0	

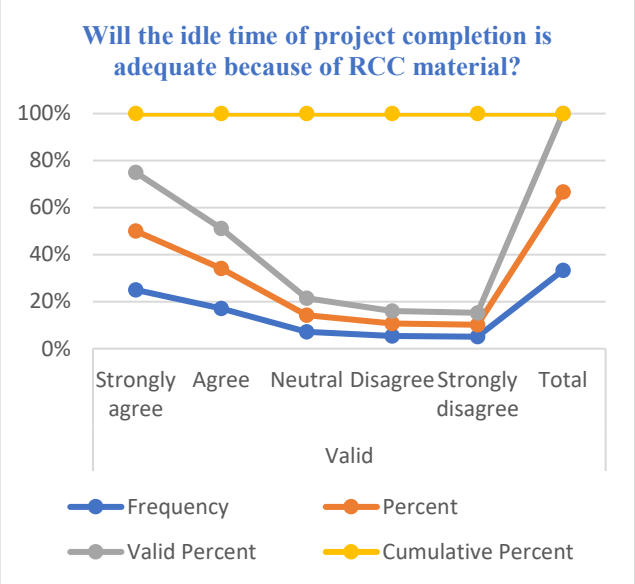
Will the compressive strength of RCC is more than usual concrete used for construction?

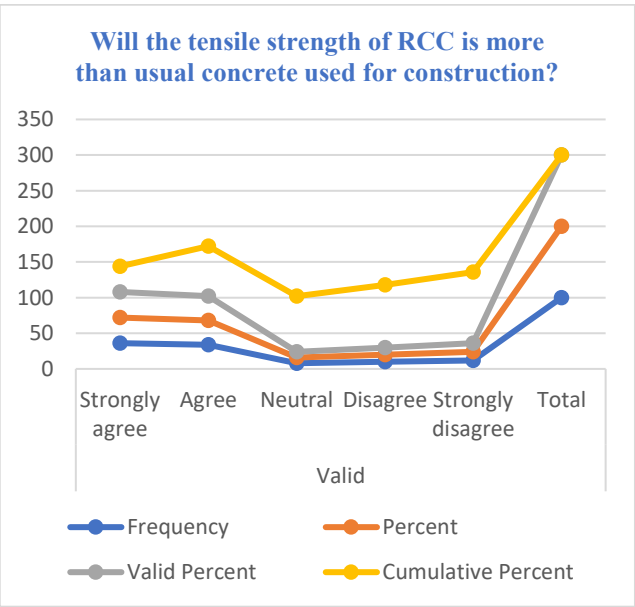
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	49	49.0	49.0	49.0
	Agree	26	26.0	26.0	75.0
	Neutral	7	7.0	7.0	82.0
	Disagree	9	9.0	9.0	91.0
	Strongly disagree	9	9.0	9.0	100.0
	Total	100	100.0	100.0	

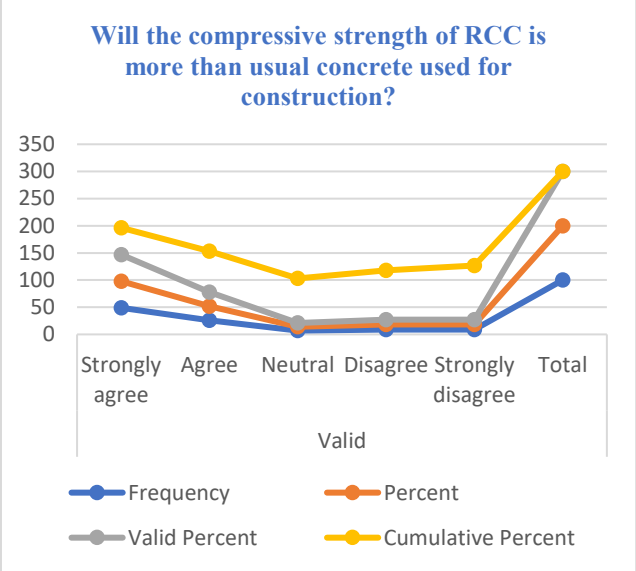
Is using RCC material affecting the overall environmental impact?

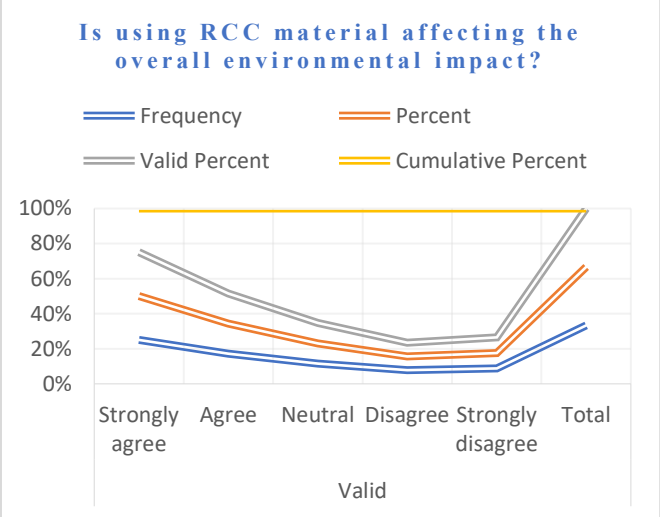
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	42	42.0	42.0	42.0
	Agree	23	23.0	23.0	65.0
	Neutral	14	14.0	14.0	79.0
	Disagree	9	9.0	9.0	88.0
	Strongly disagree	12	12.0	12.0	100.0
	Total	100	100.0	100.0	











COST ESTIMATION OF RCC STRUCTURES

Cost estimation

We need following data before starting preparation of the estimate of a RCC structure.

A. Detailed drawings
B. Quantity statement
C. Sanctioned schedule of rates (Either CSR or DSR)
D. Various leads sanctioned by the competent authority for that site.
E. Specifications.

Factors governing the cost of structure

a. Specifications and units of measurements.
b. Materials-quality and their market rates.
c. Labour-skilled, unskilled. Their turnover and wages per day
d. Contingencies like water, transport, electricity and unforeseen items.
e. Overheads.
f. Profits expected.

Drawings:

Drawings of the structure to be constructed are based on the designs. The dimensions of all components and the details of the meshes, bars etc shall be clearly shown in the drawings. Schedules showing the meshes shall be shown.

Components of estimate

A. Materials:

Quantity and Rates From the drawings, the quantities of the materials like steel, mesh, sand and cement can be calculated. For the skeletal steel, from the bar diameters and their spacing in two directions, the weight per unit area can be obtained. From the type and size of mesh and their number of layers, the area of mesh reinforcement can be calculated. From the thickness of the Ferrocrete item, we can get volume of wet mortar in liters. When the mix proportion of the mortar is known, volumes of cement and sand for the dry mix can be calculated. The quantity of water and the additives can be obtained from the proportions prescribed in the specifications.

B. Labour required: The man-hours per unit of construction of ferrocrete items based on our experience; the wages of the skilled and unskilled labour will be as per the rates payable in that area. Labour component of ferrocrete items is on higher side, may go up to 20 % sometime.

C. Contingencies

Generally, the ferrocrete items are fabricated and tied in factory, and then taken to the site for mortaring. Hence the cost of handling, transporting, hoisting and erecting of the cage at site, octroi, water charges etc are considered under contingencies. They vary from 5 to 8 %.

D. Overheads

The key to the best ferrocrete construction lies in its strict supervision. A full time supervisor at site is a must. His charges will have to be considered in addition to office and other expenses, while working out the overheads. Overheads may be taken up to 8 to 10 %.

E. Profits

Ferrocrete construction is a specialized job and profit margins expected in it are higher if the design is complicated.

Cost analysis for single RCC channel

Therefore, cost for 3m RCC roofing channel
Roofing = 900 Rs.
Consider Room size: 10ft. × 10ft.
No. of RCC channel required = 8
Cost of channels required =8×900 =7200 Rs.
Cost of gap filling between channels and installation=1000Rs.

Total cost required for 100sq. ft. =8200 Rs.

Therefore Total cost using RCC channel roofing system = 82 Rs. /sq. ft
Total cost using conventional (R.C.C) roofing system = 125 Rs. /sq. ft
Therefore % saving = 35%

Total Cost analysis:

A) RCC Structure's cost analysis: Approximate costs were made by referring to Chandra Mohan Hangekar's Do-It-Yourself Build Your Home Yourself Book from RCC Society India before

construction of the RCC Structure. Before construction, the total approximate cost amounted to 1,46,8,620 Rs and after construction the total approximate cost was 1,38,4,300 Rs. As a result of the use of reused and locally available materials and reduced further charges, costs were reduced.
B) Load-bearing structure with the same base area cost analysis: The Plinth area method was used to cost the load bearing structure using the Plinth area rate from CPWD 2020. The cost of the load bearing structure was approximately 1,77,4,765 Rs.
C).Cost analysis of RCC structure of same plinth area: Approximate costing of RCC structure was done using Plinth Area Method by considering Plinth area rates from CPWD 2020.Total approximate cost for RCC structure came to be 1,90,8,505 Rs.

Time analysis:
Time analysis was done by using Gantt chart method.
A).Time required for RCC farmhouse came to be 125 Days.
B).Time required for Load bearing structure was calculated by previous industry experience which came to be 180 Days.
C).Time required for RCC structure was calculated by previous industry experience which came to be 250 Days.

CONCLUSION

The results from calculations of RII Method from different stakeholders‟ point of view indicate that the most important factors affecting SCM in construction firms are:

These are the following major factors to the organization supply chain collaboration: Improved customer services, improved quality assurance and benefits to the client.
These are the following major factors that affect the development of a successful supply chain relationship with clients: Creating standardization of processes, top management support and reliability of supply.
These are the major factors that benefit to using Supply chain management: Cost saving, better quality and quantity of information and financial management.

This research is intended to identify the factors affecting supply chain management in construction industry. This study investigates all possible factors through a structured questionnaire. The survey results are subjected to SPSS analysis, and the ranking of factors is calculated using the Relative Important Index (RII) Method. RII ranking helps to understand the criticality of each factor. Supply chain management relationships with the company have a deep impact on customer service in all aspects, and the quality of this service can only be achieved through the successful effective management of chain elements in the way that achieves the customer's satisfaction.

Future Scope

Briefly the scope of the study will be limited to understanding the relationship between SCM performance and construction sector organizational performance in context to Indian Projects. To find out the link i.e. the factor this influences the effective supply chain quality management and organizational performance and their dependencies

Scope of work includes first formulation of the research statement by referring literature of various relevant papers and performing the gap analysis. For that purpose, we have referred 2 journals each from SCM & OP starting from the year 2004 to 2018 and studied them thoroughly.

In many research papers, we found that supply chain management is not so popular in construction industry if we compare this with manufacturing industry. Next step will be formulation of the research methodology, which will comprise of research design, sampling design, instrument design, data collection and data analysis.

We have prepared a web-based questionnaire and floated the same to the target population in the Indian construction industry for collection of data. Based on that response statistical data analysis will be conducted using SPSS software to get the findings and conclusion of the research.

Limitations

Followings are the limitations identified for the research undertaken

- A very few numbers of detailed research have been done in this area limiting the literature available for further study.
- The sampling framework of the research is limited to Indian Construction Projects only.
- Data Collection will be aimed to target population from the top contracting firms which are involved in rigorous SCM practices along with their focus to core business.
- The bad part for communication research is that all communication research has some error.

Since this research will be a cross-sectional study, which are generally carried out once and represent a snapshot of one point in time compared to the longitudinal studies, which are repeated over an extended period and hence can leads to changes over time.

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