# A STUDY OF SUPPLY CHAIN MANAGEMENT AND ORGANIZATIONAL PERFORMANCE IN CONSTRUCTION PROJECTS.

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***Abstract*** **–** The study of supply chain management and organizational performance in construction projects is an emerging field of research and discussion in today's global world. The concept of supply chain management (SCM) is already being used in the manufacturing industries and has helped those industries in increasing their efficiency, profits by reducing waste and increase in safe work culture. Now it's time for implementing this technique and utilizing its benefit for construction projects. The effectiveness of construction supply chain management (CSCM) is the key for gaining competitive advantage in the market and is also contributing significantly to the organizational performance. The aim of this study is to understand the relationship between CSCM performance and construction sector organizational performance in context to Indian Projects. The emphasis will be to predict the various factors which influences the project performance in correlation to construction supply chain management and how those factors can significantly help us in gaining a competitive advantage through effective construction supply chain (CSC), which will ultimately improve performance of the construction projects. In this research, the issues of the inter-organization problems that effect CSCM are identified and studied for their interrelatedness, for improving project performance and to accelerate the innovations in the construction projects. This research design is an exploratory study based on the degree to which the research question has been crystallized. This study utilizes survey using highly structured questionnaire as the method of data collection and further data analysis using statistical tools SPSS to predict the final results. The various statistical approach that is used to analyze the final data will include regression analysis, exploratory factor analysis and reliability analysis. A total of 30 responses from responded spread over the industry have been gathered through the instrument developed and data were analyzed. Using multiple data collection methods, including site visits, interviews in terms of questionnaire survey, and observational data, the uncertainties in live projects are identified and categorized using the framework to demonstrate its application and suggestion is given to organization for developing the SCM factors.

***Keywords – Supply chain management, Organization Performance, Competitive advantage.***

## 1. INTRODUCTION

Construction the process of constructing a building or infrastructure. As construction, industry differs from manufacturing industry in many aspects. Manufacturing typically involves mass production of similar items without designated purchaser, while construction typically takes place on location for a known client. Construction Industry contributes nearly about 11 percent of the GDP of the developed countries. It involves multiple steps such as Planning, Design, Financing and Execution to make any project successful.

Infrastructure sector is a key driver for Indian economy. The sector is highly responsible for propelling India's overall development and enjoys intense focus from Government for initiating policies that would ensure time-bound creation of world's class infrastructure in the country. Infrastructure sector includes power, bridges, roads, dams and urban infrastructure development. In 2016, India got 19th places in World Bank's Logistics Performance Index (LPI), to rank 35th amongst 160 countries.

Outlook for the construction sector is very positive with the government ready to mobilize $1 trillion investment plan over the next five years. It's about 80-100 percent of this plan can be a reality if the core issues are addressed from the root level. The construction activity is highly dependent on government policies apart from direct projects awarded by the government institutions and approval for clearances are a must for smooth functioning of the industry.

The construction industry in India is highly fragmented. There are number of unorganized players in the industry, which works on the sub-contracting basis to execute more critical projects, now a day's bids are increasing placed in consortium. However, the profitability of the construction project varies across different segments. Complex technologies, Savvy projects can fetch higher profit margins for construction companies as compared to low technology projects like road construction.

## 2. OBJECTIVES

- To determine various factors which influences the project performance in relation to construction supply chain management by giving rank.
- To determine the correlation between effective construction supply chain management and construction project performance.
- To recommend suggestions to maximize the efficiency of Supply chain management to organization.

## 3. RESEACH METHODOLOGY

Research Methodology will be designing a questionnaire survey by which we can find out the factor affecting the construction supply chain management which directly affects the organizational performance in construction projects. The basic approach will be the Rating or Ranking the factors that influence the CSCM ultimately leading to effective organizational performance of construction industry in context to India.

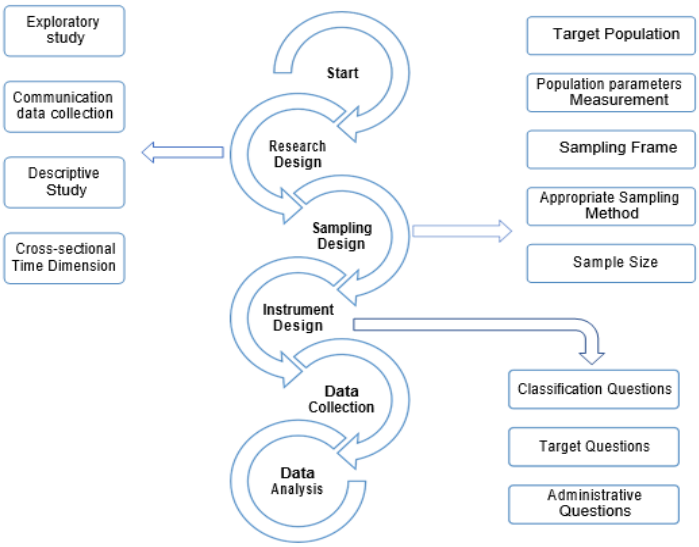


**Fig 1: Research Methodology**

## 4. DATA COLLECTION

A case study has been taken to collect factual data. A bungalow project consists of B+G+1 storied bungalow, 1 Club house, 1 Swimming pool, 3 Water bodies, Mandir, Shoe cabin, Formal Living, Informal living, Kitchen, 10 Bedrooms, Home theatre, 1 Lift, 6 Servant rooms, with all up to date standards and specifications. Total plot area is of 60,000 Sq. Ft & Built-up Area is 35,000 Sq. Ft.

Data is collected from requirement of material on site to various sub-contractors, study of available material, study of procedure of procurement of material (Indent making with sanctioning of authorized persons, Making of P.O., quotation survey of various agencies and Ordering of material), checking of Incoming material as per indent specification, stocking of material in store, entries of incoming material on site, installation of material, minutes of meetings held between various agencies, discussion with the Project Coordinator, Contractor, Site Engineer, Site supervisor, quality assurance cell.

Questionnaires survey has been taken from various construction projects to understand CSCM practices. The questionnaires were distributed through various electronic media platform to a variety of respondent working around the construction projects. About 30 peoples have responded to the questionnaire survey.

The respondents were asked to indicate the positions they held in the respective companies and the duration for which the company is in operation. They were provided with options to choose from. About 26.7% of the respondents who participated in the study are from Top management background, 40% were from middle management, while 33.3% were serving as a lower management as shown in Fig 2.


**Fig2: Respondent Background**

Talking about the statistics for company's evaluation in performance of the Supply Chain Management practice. About 50.0% of the respondents who participated in the study are from company with YES, 30.0% of the respondents who participated in the study are from company with NO, 20.0% of the respondents who participated in the study are from company with Not Particular as shown in the Fig. 3.

**Fig 3: Performance of the Supply Chain Management**

## 5. DATA ANALYSIS

### 5.1 Relative Importance Index (RII)

In this research work a total of 55 questionnaire were circulated and question were asked to various professionals to identify the supply chain management factors which affect the organization performance. Data analysis to determine the validity and reliability of the CSCM practice, competitive advantage, and organizational performance instruments. The following section will discuss data analysis used to determine the RII. Before processing the responses, the completed questionnaires were to be edited for completeness and consistency. Objective is to establish the supply chain practices adopted by the firms using Excel to analyze the huge data and inferring results based on the collected data shown in Table 1.

RII = Σ W / (N * A)

W = is the weight given to each factor by the respondence and ranges from 1 to 5, (where 1= Strongly Disagree, 2= Disagree, 3 = Neutral, 4 = Agree and 5= Strongly Agree)

A = is the highest weight (i.e., 5 in this case) and

N = is the total number of respondents.

| FACTORS | RII | RANKING |
|---|---|---|
| Customer Relationship | 0.83 | 1 |
| Organization Performance | 0.79 | 2 |
| Inventory planning and control | 0.783 | 3 |
| Material Waste Management | 0.784 | 4 |
| Material Storage | 0.777 | 5 |
| Material Procurement | 0.773 | 6 |
| Overall efforts of Supply Chain Management | 0.762 | 7 |
| Product Quality | 0.764 | 8 |
| Level of Information Sharing | 0.748 | 9 |
| Competitive Advantage | 0.745 | 10 |
| Lean Practices | 0.737 | 11 |
| Strategic Supplier Partnership (SSP) | 0.737 | 12 |
| Level of Information Quality | 0.728 | 13 |

**Table 1: Relative Important Index**

### 5.2 SPSS ANALYSIS

Also, the objective is to establish the supply chain practices adopted by the firms using statistical tools such as SPSS to analyze the huge data and inferring results based on the collected data. The various statistical approach to be used to analyze the final data includes:

- Exploratory Factor Analysis

- Reliability Analysis
- Regression Analysis

**5.2.1 Exploratory Factor Analysis:**

Exploratory data analysis will be used to present unique and conventional techniques including graphical and tabular devices to visualize the data. The factor analysis will be conducted on the variables to find the items loaded on their respective factors with most loadings above certain value. Using exploratory data analysis (EDA) we will have the flexibility to respond to the patterns revealed in the preliminary analysis of the data. Thus, patterns in the collected data will guide the data analysis or will suggest revisions to the preliminary data analysis plan.

**5.2.1.1 Factor Analysis of Competitive Advantage:**

KMO and Bartlett's Test

| | | |
|---|---|---|
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy. | | .706 |
| Bartlett's Test of Sphericity | Approx. Chi-Square | 51.946 |
| | df | 10 |
| | Sig. | .000 |

**Table 2: KMO & Bartlett's Test**

As per Table 2: KMO and Bartlett's Test, it was found out that our data is reliable and could be further used for factor analysis of competitive advantage (KMO value is greater than 0.5).

**Component Matrix[a]**

| | Component |
|---|---|
| | 1 |
| CA1 | .385 |
| CA2 | .907 |
| CA3 | .835 |
| CA4 | .845 |
| CA5 | .590 |

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

**Table 3: Rotated Component Matrix for Competitive Advantage**

**Rotated Component Matrix[a]**

a. Only one component was extracted. The solution cannot be rotated.

Table 3 showing Rotated Component Matrix for Competitive Advantage was used for finding out different factors. Based on the analysis only factor 1 was extracted, grouping of questions had taken place and after that reliability test was conducted to find reliable factors.

#### 5.2.1.2 Factor Analysis of Organizational Performance:

**KMO and Bartlett's Test**

| | | |
|---|---|---|
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy. | | .782 |
| Bartlett's Test of Sphericity | Approx. Chi-Square | 471.848 |
| | df | 120 |
| | Sig. | .000 |

As per Table 4: KMO and Bartlett's Test, it was found out that our data was reliable which could be further used for factor analysis of Organizational Performance (KMO value is greater than 0.5).

**Table 4: KMO and Bartlett's Test for Organizational Performance**

Table 5 showing Rotated Component Matrix for Organizational Performance was used for finding out different factors. Based on the maximum values in factor 1,2,3 grouping of questions had taken place and after that reliability test was conducted to find reliable factors.

**Rotated Component Matrix[a]**

| | Component | | |
|---|---|---|---|
| | 1 | 2 | 3 |
| OP1 | .885 | .204 | .239 |
| OP2 | .755 | .461 | .158 |
| OP3 | .434 | .433 | .652 |
| OP4 | .690 | .198 | .353 |
| OP5 | .255 | .281 | .870 |
| OP6 | .605 | .455 | .431 |
| OP7 | .196 | .249 | .906 |
| OP8 | .695 | .518 | .111 |
| OP9 | .752 | .264 | .464 |
| OP10 | .790 | .287 | .136 |
| OP11 | .550 | .661 | .157 |
| OP12 | .169 | .861 | .289 |
| OP13 | .320 | .817 | .272 |
| OP14 | .364 | .717 | .367 |
| OP15 | .427 | .548 | .396 |
| OP16 | .667 | .238 | .455 |

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 7 iterations.

**Table 5: Rotated Component Matrix for Organizational Performance**

#### 5.2.2 Reliability Analysis:

Reliability is the measure of the degree that it supplies consistent results. Reliabilityis a necessary contributor to validity. It is concerned with estimates of the degree to which a measurement isfree of random or unstable error.

The reliabilities of CSCM practice, competitive advantage, and organizational

performance will be assessed with Cronbach's Alpha. We will calculate means, standard deviations, correlations, and reliability values for each of constructs. After which the reliability values for all constructs will be compared with greater than certain value, which will be considered acceptable.

| | Factor loading | Percent variance explained | Cronbach's alpha |
|---|---|---|---|
| Factor 1: Competitive Advantage | | 54.589 | 0.755 |
| CA1 | 0.148 | | |
| CA2 | 0.822 | | |
| CA3 | 0.697 | | |
| CA4 | 0.715 | | |
| CA5 | 0.348 | | |

**Table 6: Factor analysis for Competitive Advantage**

Table 6 showing Factor analysis for Competitive Advantage depicts the combined factor loading of communalities, percent variance explained from total variance explained and Cronbach's alpha value from reliability test. I have to consider only those factors whose Cronbach`s alpha value is greater than 0.7 i.e. Factor 1.

| | Factor loading | Percent variance explained | Cronbach`s alpha |
|---|---|---|---|
| Factor 1: Market/ Financial/ HSE/Waste Mngt. Performance | | 64.311 | 0.944 |
| OP1 | 0.881 | | |
| OP2 | 0.808 | | |
| OP4 | 0.640 | | |
| OP6 | 0.759 | | |
| OP8 | 0.765 | | |
| OP9 | 0.850 | | |
| OP10 | 0.725 | | |
| OP16 | 0.709 | | |
| Factor 2: Financial Performance | | 8.092 | 0.915 |
| OP11 | 0.765 | | |
| OP12 | 0.854 | | |
| OP13 | 0.843 | | |
| OP14 | 0.781 | | |
| OP15 | 0.639 | | |
| Factor 3: Market/Waste Mngt. Performance | | 6.613 | 0.918 |
| OP3 | 0.801 | | |
| OP5 | 0.901 | | |
| OP7 | 0.921 | | |

**Table 7: Factor analysis for Organizational Performance**

Table 7 showing Factor analysis for Organizational Performance depicts the combined factor loading of communalities, percent variance explained from total variance explained and Cronbach's alpha value from reliability test. We have to consider only those

factors whose Cronbach`s alpha value is greater than 0.7. i.e. Factor 1, 3 and 4.

### 5.2.3 Regression Analysis:

Specifically, a dimension level analysis will be performed using regression analysis which was instrumental in indicating whether the independent variables-CSCM practices significantly predict the dependent variable organization performance.

Regression model- $Y=a + b1x1 + b2x2 + b3x3 + b4x4 + b5x5 + b6x6 + b7x7$ (5.1)

where Y = Organization performance; a= the y intercept when x is zero; b1, b2, b3, b4, b5, b6,b7 are regression coefficients of the following variables respectively; x1- Strategic supplier management; x2- Customer relationship management; x3-Information sharing; x4- Quality of information sharing; x5- Outsourcing; x6- Lean practices; x7- Postponement.

Through these analysis of the relationship between construction supply chain management practices and organization performance, the study will aim to demonstrate that the CSCM practices may directly impact organization performance. The findings will be presented after collection of full sets of data.

The model specification is as follows

$Y=\beta0+\beta1x1+\beta2x2+\beta3x3+\beta4x4+\beta5x5+\beta6x6+\beta7x7+\beta8x8+\varepsilon$ (5.2)

Where;
β0= constant
β1, β2, β3, β4, β5, β6, β7, β8=coefficient
x1= Strategic supplier partnership
x2= Customer relationship
x3= Information sharing
x4= Information quality
x5= Outsourcing
x6= Lean practices
x7= Postponement
ε= error term

| Various Models | R Square |
|---|---|
| Model 1: CA=*f*(CSCM) | 0.677 |
| Model 2: OP=*f* (CA, CSCM) | 0.867 |
| Model 3: OP=*f* (CSCM) | 0.803 |

**Table 8: Various Models for Regression Analysis**

From Table 8, Various Models for Regression Analysis it is evident that Model 2: OP=f (CA, CSCM) is having maximum R Square value and the coefficients will be selected from this model.

Table 9 showing Coefficients for Competitive Advantage and Construction Supply Chain Management, it is evident that the two independent variables of CSCM i.e. strategic supplier management (SSP) and customer relationship (CR) & Competitive Advantage (CA) significantly impact organization performance (OP). However, rest five independent variables of CSCM i.e. level of information sharing (IS), level of information quality (IQ), extent of outsourcing(O), lean practices (LP) and

postponement (P) has no significant impact on organization performance (OP). The findings of this research thus point the importance of construction supply chain management and competitive advantage towards positive enhancement of organizations performance in construction projects.

**Coefficients[a]**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | | |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | t | Sig. |
| 1 | (Constant) | .394 | .379 | | 1.040 | .310 |
| | CA | .508 | .160 | .445 | 3.174 | .005 |
| | SSP | -.125 | .120 | -.170 | -1.041 | .310 |
| | CR | .015 | .101 | .019 | .147 | .884 |
| | IS | .132 | .090 | .201 | 1.471 | .156 |
| | IQ | .206 | .113 | .257 | 1.818 | .083 |
| | O | .219 | .115 | .297 | 1.910 | .070 |
| | LP | -.064 | .136 | -.079 | -.472 | .641 |
| | P | .062 | .117 | .086 | .533 | .600 |

a. Dependent Variable: OP

**Table 9: Coefficients for Competitive Advantage and Construction Supply Chain Management**

## 6. CONCLUSION

This paper provides explanation for the framework designed as shown that recognizes seven key dimensions of CSCM practices and describes the interrelationship among CSCM practices, competitive advantage, and organizational performance. The Research inspects the evidences for the following models:

Model 1: CA=*f*(CSCM)

Model 2: OP=*f* (CA, CSCM)

Model 3: OP=*f* (CSCM)

It is conducted factor and reliability analysis of the collected data; this has given us various factors which are reliable. After which I have conducted regression analysis on the three models developed using the factors which are reliable. The result of regression on these three models have predicts Model 2 as the most appropriate one having value of $R^2$ as 0.867.

Although some of Construction organizations have realized the importance of implementing CSCM, they often do not know what constitutes a comprehensive set of SCM practices. Through the analysis of the relationship of CSCM practice and competitive advantage with organization performance. It was demonstrated that CSCM practice such as Strategic supplier management (SSP) and Customer relationship (CR) & Competitive advantage (CA) may directly impact Organizational Performance (OP).

Recommendation is given to bungalow case study organization for improvement of factors like Inventory Control, Rework Minimization, Waste Management, Subcontractor Development. This further concludes that the scenario for competition among organization is moving towards supply chains. More and more projects are adopting effective CSCM practices in the expectation of reducing costs, waste and securing topmost position by gaining competitive advantage in the industry

The study concludes that most of the construction organizations and projects have adopted various supply chain management practices and these practices have assisted the organizations to enhance their performance as a whole. This is reinforcing from the results of the regression analysis conducted, which clearly indicates that there is a strong relationship between construction supply chain management practices (CSCM), competitive advantage (CA) and organizational performance (OP).

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