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Supply Chain Management In Construction Site By Using SPSS Software

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Abstract

Supply chain management (SCM) is a concept that has flourished in manufacturing, originating from Just-In-Time (JIT) production and logistics. Today, SCM represents an autonomous managerial concept, although still largely dominated by logistics. SCM endeavors to observe the entire scope of the supply chain. All issues are viewed and resolved in a supply chain perspective; taking into account the interdependency in the supply chain.SCM offers a methodology to relieve the myopic control in the supply chain that has been reinforcing waste and problems. Construction supply chains are still full of waste and problems caused by myopic control. Comparison of case studies with prior research justifies that waste and problems in construction supply chains are extensively present and persistent, and due to interdependency largely interrelated with causes in other stages of the supply chain. The characteristics of the construction supply chain reinforce the problems in the construction supply chain, and may well hinder the application of SCM to construction. Previous initiatives to advance the construction supply chain have been somewhat partial. The construction industry has been slower than other industries to employ the Supply Chain Management (SCM) concept and develop models that support the decision-making and planning.

Keywords: Supply Chain Management, Construction Site, decision making, SPSS Software

1.INTRODUCTION

Despite the lack of a universally agreed supply chain terminology, it can be widely contended that the notion of Construction Supply Chain (CSC) refers to the business processes and organizations involved in construction projects, while Construction Supply Chain Management (CSCM) refers to the management of information, materials and capital flows and the integration of key construction business processes. Originated in the manufacturing industry, Supply Chain Management (SCM) dominates the field of Operations Management and aims to improve customer service and production efficiency, reduce costs along the supply chain, improve communication and coordination among stakeholders, etc.

Practitioners in the construction industry and researchers on construction management have long time been reporting several problems on the performance of construction and have been scrutinizing the CSC for possible improvements actions, especially after the Second World War. Many studies indicate the shift from a traditional project-based to a supply-based approach of construction management.

Statistical figures show that main contractors are purchasing more labor and material than previously. For instance, in 1994, in Dutch construction industry (i.e. residential, commercial and industrial building), the main contractors' share in the total national turnover had decreased to 24%. Thus, suppliers and subcontractors represented about 75% of turnover. Currently, this is expected to be more. As a consequence, main contractors become more and more reliant on other actors in the construction supply chain (e.g., suppliers and subcontractors). Therefore, they need to revise their supply strategies and trading relations with subcontractors and suppliers. Thus, the goal of this paper is to clarify the roles and possibilities of SCM in construction. Starting from the lessons learnt and methodological development of SCM in manufacturing, present supply chains in construction are observed, and recommendations for SCM in construction are presented. The focus of this paper is on the supply chain of a main contractor. It has to be noted that in construction, real estate owners also may drive supply chain development.

1.1 Supply Chain Management

'Supply chain' is the term used to describe the linkage of companies that turns a series of basic materials, products or services into a finished product for the client. All construction companies, be they client, main contractor, designer, surveyor, sub-contractor, or supplier are therefore part of a supply chain. Because of the project based nature of construction and the way that procurement normally operates, they are usually members of different supply chains on different projects. Each company in the chain has a client – the organisation to which the services are provided – but an integrated supply chain will have the objective of understanding and working wholly in the interests of the 'project client'.

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

The benefits for end-users and project clients include a more responsive industry delivering facilities that better meet user needs, delivered to time and cost with minimum defects. This in turn creates higher customer satisfaction levels and an improved reputation for the industry.

1.2 Origin Of Supply Chain Management

SCM is a concept that has originated and flourished in the manufacturing industry. The first signs of SCM were perceptible in the JIT delivery system as part of the Toyota Production System (Shingo 1988). This system aimed to regulate supplies to the Toyota motor factory just in the right - small - amount, just on the right time. The main goal was to decrease inventory drastically, and to regulate the suppliers' interaction with the production line more effectively.After its emergence in the Japanese automotive industry as part of a production system, the conceptual evolution of SCM has resulted in an autonomous status of the concept in industrial management theory, and a distinct subject of scientific research, as discussed in literature on SCM (e.g., Bechtel and Yayaram 1997, Cooper et al. 1997). Along with original SCM approaches, other management concepts (e.g., value chain, extended enterprise) have been influencing the conceptual evolution towards the present understanding of SCM.

There are also other illuminating typologies of SCM. First, there are development issues of SCM, including order information transparency, reduction in variability, synchronising of material owes, management of critical resources and configuration of the supply chain. Second, there are strategies for SCM including establishment of stable partnerships, modular outsourcing of components, design for suitability for manufacture, manufacturing technologies, evolution of the supply chain with the product life cycle, and information acquisition and sharing. Third, there are levels of SCM that can be distinguished. Including initial partnership.

2. METHODOLOGY

In the literature on SCM, many supply chain methods have been proposed. Most methods address logistical issues of the supply chain, e.g., quality rates, inventory, lead-time and production cost. The methods of pipeline mapping, supply chain modeling and logistics performance measurement analyze stock levels across the supply chain. The LOGI method studies time buffers and controllability problems of the delivery process. Supply chain costing focuses on cost buildup along the supply chain. Integral methods like value stream mapping and process performance measurement offer a "toolbox" to analyze various issues including lead time and quality defects.(Table.1)

A descriptive research method was adopted in this research by using a well-structured questionnaire for data collection. It was designed to find the solution to the existing problems in the aspect of logistics and supply chain in the cement manufacturing industry in India. The questionnaire consisted of four sections:

- Section 1: provided the demographic details about the respondents.
- Section 2: addressed the organisational information of the cement manufacturing industries.
- Section 3: is focused on questions about the collaborative work in the cement manufacturing industry with regard to logistics and supply chain management.
- Section 4: addressed the effectiveness, performance and information distribution in the logistics environment.

The collected data was analysed using statistical analysis software package (SPSS) and also, Microsoft Excel Ranking function was used to compute the rank of mean scores of responses. This was based on the percentage responses to the 5-point Likert-type scale. The ranking enabled the importance of individual statements, problems, parameters and key performance indicators to be evaluated relative to each other.

Table 1: Characteristic differences between traditional ways of managing the supply chain and SCM

Element	Traditional management	Supply chain management
Inventory management approach	Independent efforts	Joint reduction of channel inventories
Total cost approach	Minimize firm costs	Channel-wide cost efficiencies
Time horizon	Short term	Long term
Amount of information sharing and monitoring	Limited to needs of current transaction	As required for planning and monitoring processes
Amount of coordination of multiple levels in the channel	Single contact for the transaction between channel pairs	Multiple contacts between levels in firms and levels of channel
Joint planning	Transaction-based	Ongoing
Compatibility of corporate philosophies	Not relevant	Compatibility at least for key relationships
Breadth of supplier base	Large to increase competition and spread risks	Small to increase coordination
Channel leadership	Not needed	Needed for coordination focus
Amount of sharing risks and rewards	Each on its own	Risks and rewards shared over the long term
Speed of operations, information and inventory levels	"Warehouse" orientation (storage, safety stock) interrupted by barriers to flows; localized to channel pairs	"Distribution center" orientation (inventory velocity) interconnecting flows; JIT, quick response across the channel

Besides assessing and improving the supply chain, other elements are essential to the methodology of SCM. A generic methodology of SCM can be deduced combining and generalizing the commonalities of different SCM methods. In a way, the SCM methodology bears resemblance to the Deming Cycle. Generically, the methodology of SCM consists of four main elements: (1) Supply chain assessment, (2) Supply chain redesign, (3) Supply chain control, and (4) Continuous supply chain improvement.

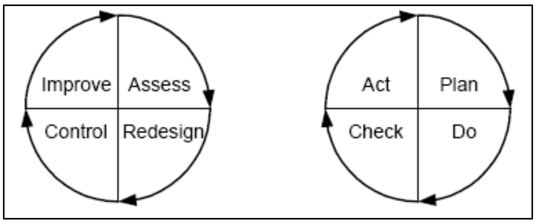

Figure. 1 Generic SCM methodology compared to the Deming Cycle

The first step is to assess the current process across the supply chain in order to detect actual waste and problems. The issue here is to find the causality between the waste and problems, and locate their root causes. Once the causality is understood, and having found out about the root causes, the next step is to redesign the supply chain in order to introduce structural resolution of the problems. This includes redistribution of roles, tasks and responsibilities among the actors in the supply chain, and a review of procedures. The next step is to control the supply chain according to its new configuration. An important part of the control is the installation of a monitoring mechanism to continuously assess how the supply chain operates. This includes systems to measure and estimate waste across the supply chain process, and feedback systems to discuss and evaluate underlying problems. The objective is to continuously identify new opportunities, and find new initiatives to develop the supply chain. In fact, this continuous improvement implies the ongoing evaluation of the supply chain process, and the recurring deployment of the previous three steps: assessment, redesign and control.(Figure.1)

2.1 Conceptual Models

A remarkable percentage of the model-based literature on CSCM pertains to conceptual or symbolic or process models.Most of them focus on information flows and aim to improve the communication and coordination between supply chain members. In this context, there are CSC models that propound an e-business infrastructure, information technologies, enhanced communication, collaboration, learning, total quality management, strategic partnerships, third-party logistics, information management platforms, information and communication hubs, information technology-based lean ideas and open information channels. The conceptual model of circumscribes the adoption of Building Information Modeling (BIM) in CSC which offers great potentials of information exchange and collaboration. In the literature we may also find models that assess the progression of SCM in construction, adopting principles of the so-called maturity models in manufacturing and aerospace. Reference presents a CSC maturity model which describes the maturity stages of CSC business processes with respect to the level of functional, multi-project and multi-firm integration achieved. Another maturity model defines assessment criteria and procedures to measure qualitatively the maturity level of CSC relationships which range for traditional adversary to fully collaborative.

2.2 Optimization Models

As far as optimization modeling of CSC is concerned, the research is also heterogeneous, but more limited. Although optimization studies make up a major and sizable share of the general SCM research (in manufacturing, automotive and chemical industries), there are a few cases for CSCM (see Table II), by means of either mathematical programming or simulation-based optimization. The two-level programming model of for collaborative scheduling in CSCM provides a compromising schedule to different supply chain partners with regard to profit maximization at two hierarchical stages. The bi-level (or two level) programming decision model of is a client-led negotiation process with the contractor which finds the optimal selection of the revenue incentive intensity and achieves a time-cost equilibrium with regard to optimization of net revenue. In a model for CSC design and behavior analysis is created using the SCOR process model and simulation software, including also optimization of the procurement behavior with metaheuristics methods.

It is likely to be impractical to establish long-term relationships with all members of the supply chain. So you should start by establishing relationships with those suppliers and sub-contractors who are critical to your delivery to the market of better products at lower cost and higher quality. These are your strategic supply chain partners or 'first tier suppliers'. It is vital that you take time and care to establish which companies fulfil the criteria that you set (or have the potential to do so) and that they have similar interests to you in developing long term relations. A successful supply chain of first tier suppliers is a manageable objective. In time you may plan for each of your suppliers to have similar chains, but don't try to conquer the world in one go.

Evaluate and compare potential first tier suppliers' strengths and capabilities in the following areas:

- The strength of the existing relationship
- Technical capability and reputation
- design capability and innovation record

- Size and market position
- Management style

Remember you are seeking partners capable of reliably supplying you with products and services at competitive prices. Success will deliver mutual commercial benefit through greater success in the market, based on increasingly satisfied clients. All parties in the supply chain must be committed to working for the long term on the basis of continuous improvement and innovation. If anyone is inclined to quit when the going gets tough, the supply chain will fail.

Involving the designer in the supply chain is essential to long-term success.

For a whole project supply chain, there may be a number of professional design teams (architect, structural engineer, services engineer) that need to be involved. On the other hand, where the supply chain is established to deliver a component, the designer may be embedded within one of the supply chain partners. Either way, the designer's role is central to delivering:

- Optional functionality
- Lowest cost of ownership through a value for money focus on lowest through-life cost
- Safe construction using least amount labour and minimum waste.

2.3 Evaluating The Model-Based Cscm Literature

The most adopted modeling approach in CSCM is by far conceptual followed by mathematical modeling. Mathematical models are mostly simulation studies and the optimization paradigms are quite limited. In conceptual and simulation models, there are some studies trying to transfer and transform SCM models from manufacturing to construction. For example, exploits similarities of house building industry, a subset of construction industry, with manufacturing and base their model on IOBPCS developed in manufacturing. Reference adapts the SCOR model to the characteristics of construction, while develops a construction oriented model based on maturity models of other industries. It could be argued that especially the field of CSC optimization needs not just adaptations but ad-hoc analytical models capturing the intrinsic construction problems. Accordingly, the application of mathematical programming which is perfectly suited to the support of resource allocation decisions and is widely used is SCM, has been very limited in the case of the construction industry most publications on CSC optimization have appeared during the last five years.

All the optimization models presented are single-period or do not incorporate a time dimension at all, which does not allow for a long-term evaluation of decision making. Conceptual models for CSCM are mostly descriptive and,except for few instances, are not specific enough to be tested by means of case studies and pilot projects neither can be easily expressed from a quantitative point of view. Even if some conceptual models are evaluated by means of expert interviews and simple case studies, their authors refer to standard comprehensive assessment methods for sound validation and future research.For such a fragmented industry, it is important to develop models that either are reusable or integrate flows of construction processes across several projects and periods of time. So far, quantitative CSC models show limited or none reusability and neither are designed in the direction of establishing as many continuous flows as possible within a wider supply network. Added to this, simulation models, which are common in the CSC literature, are modeling approaches that usually do not stress reusability because they are not developed to find solution to a problem, but to describe a system under investigation and gain insights into its internal mechanism.

It is also remarkable that the final product to be delivered to the client through the CSC is not well defined in the proposed models. Some models are restricted to the products manufactured for use in the construction industry. The perception that the construction project is the "final product" to be delivered is not always present in CSC models, despite the fact that most CSCM problems should be managed in this context and not in a sub-product level. Despite the fact that construction production is primarily a site production combining fabrication and assembly, many researchers also refer to an off-site production which evolves upstream in the supply chain by prefabrication, modularization and preassembly.

Thus, it would be appropriate to clarify whether models pertain to construction or manufacturing of construction materials. Through the lens of Operations Research, mathematical models of CSCM fall under the hard OR domain, but we cannot accordingly relate any model with soft OR. The optimization and simulation approaches of problem-solving are based on analytical thinking and are indicative of the so called hard OR methodology. The essential feature of hard OR is the construction of mathematical models that objectively and quantitatively represent the problems under study. Soft OR includes qualitative and systems thinking-based models for structuring messy problems and supporting group decision making with conflicting goals.

3. SUPPLY CHAIN MANAGEMENT

3.1 Supply Chain Management

Supply chain' is the term used to describe the linkage of companies that turns a series of basic materials, products or services into a finished product for the client. All construction companies, be they client, main contractor, designer, surveyor, sub-contractor, or supplier are therefore part of a supply chain. Because of the project

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3.2 Origin Of Supply Chain Management

SCM is a concept that originated and flourished in the manufacturing industry. The "rst visible signs of SCM were in the JIT delivery system, as part of the Toyota Production System. This system aimed to regulate supplies to the Toyota motor factory just in the right*small*amount, just in the right time. The main goal of this system was to drastically decrease inventories, and to e!ectively regulate the suppliers' interaction with the production line. Another stimulus for SCM originated in the "eld of quality control. As early as 1950, in an address to Japanese industrial leaders, Deming suggested that working with the supplier as a partner in a long-term relationship of loyalty and trust would improve the quality and decrease the costs of production.
After its emergence in the Japanese automotive industry as part of a production system, the conceptual evolution of SCM has resulted in an autonomous status of the concept in industrial management theory, and a distinct subject of scientific research, as discussed in literature on SCM. In addition to the Japanese influence, Western scholars like Burbridge and Forrester provided early contributions to the understanding of supply chains. Along with original SCM approaches, other management concepts (e.g. value chain, extended enterprise) have influenced its conceptual evolution,which has led to the present understanding of SCM.(Figure.2)

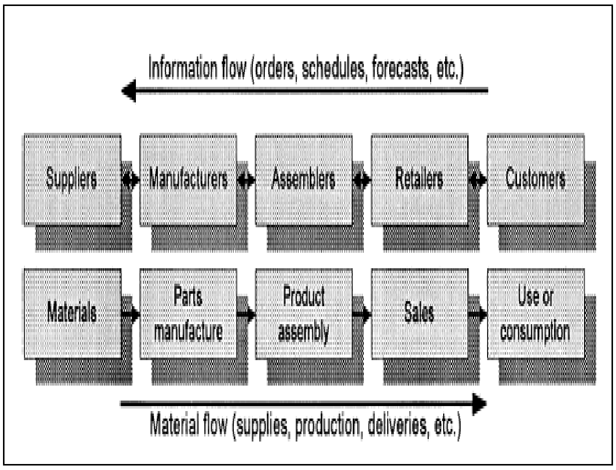


Figure. 2 Generic configuration of a supply chain in manufacturing

3.3 Concept Of Supply Chain Management

The supply chain has been defined as `the network of organisations 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.SCM views the entire supply chain, rather than just the next part or level, and aims to increase transparency and alignment of the supply chain's co-ordination and configuration, regardless of functional or corporate boundaries. The basic idea of SCM is to recognize the interdependency in the supply chain, and thereby improve its configuration and control based on such factors as integration of business processes.

3.4 The Roles Of Supply Chain Management In Construction

3.4.1 Characteristics Of Construction Supply Chains

In terms of structure and function, the construction supply chain is characterised by the following elements:

- It is a converging supply chain directing all materials to the construction site where the object is assembled from incoming materials. The `construction factory is set up around the single product, in contrast to manufacturing systems where multiple products pass through the factory, and are distributed to many customers.
- It is, apart from rare exceptions, a temporary supply chain producing one-o! construction projects through repeated reconfiguration of project organisations. As a result, the construction supply chain is typified by instability, fragmentation, and especially by the separation between the design and the construction of the built object.
- It is a typical make-to-order supply chain, with every project creating a new product or prototype. There is little repetition, again with minor exceptions. The

process can be very similar, however, for projects of a particular kind.

- Ways to achieve a successful supply chain management could be the following:
- To manage the resources of supply strategically in order to reduce the total cost of owning materials and services.

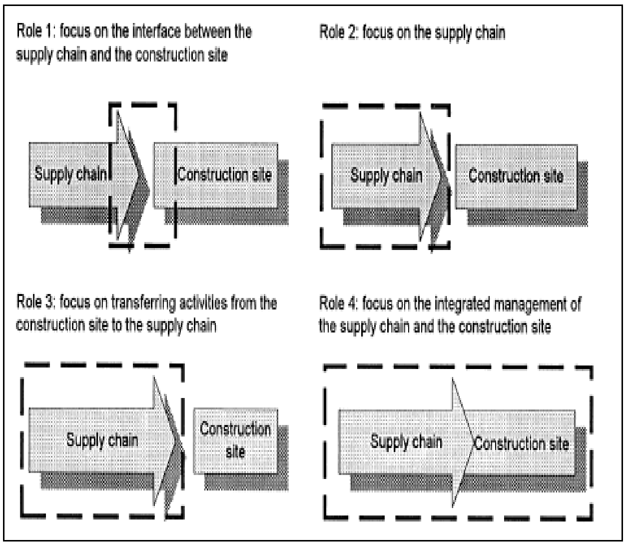


Figure. 3 The four roles of supply chain management in construction.

- To pay attention to market signals and align demand planning accordingly, across the supply chain, ensuring consistent forecasts and optimal resource allocation. Customize the logistics network to the service requirements and profitability of customer segments.
- Segment the customers, based on the service needs of district groups, and adapt the supply chain to serve these segments profitability.
- Adopt channel-spanning performance measures to gauge the collective success in reaching the end user effectively and efficiently.(Figure.3)

Transportation plays an important role in both moving purchased goods from suppliers to the buying organization and moving finished goods to the customers. More so, due to the important role that it plays in the supply chain. It is an obvious fact that products are rarely produced and consumed in the same location, as such; transportation is a significant component of the costs that most supply chains incur. Transport is typically regarded as a non-value adding activity in the supply chain, although the challenges make the assumption that it plays an essential role in the supply chain; and if managed accordingly, it can allow supply chains to work more effectively and efficiently.(Figure.4)

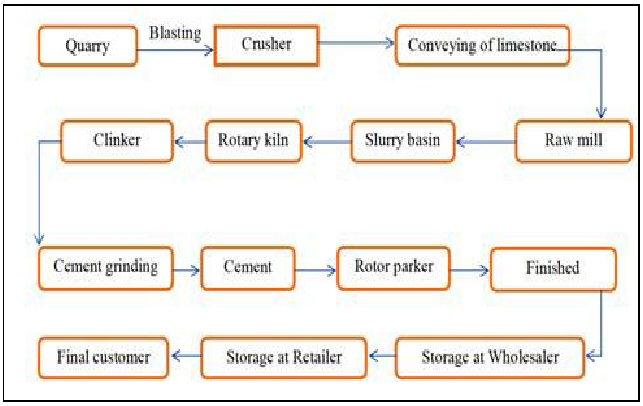


Figure. 4 Supply chain for cement production

3.4.2 Road, Relative Costs And Operating Mode

Although the fixed cost is very low, since the physical transport infrastructure, such as the motorway are in place through public funding, the variable cost is medium in terms of rising cost of fuel, cost of maintenance and the increasing use of road and congestion charges. In respect of operating characteristics, the road as a mode of transport scores favourably on speed, availability, dependability and frequency; but it does not fare so well on capability, due to the limited capacity on weight and volume. Uniquely among transport modes, it can allow direct access to consignor and consignee sites.

3.4.3 Rail, Relative Costs And Operating Mode

The fixed costs of rail system are high; while the variable cost is relatively low. The fixed costs are high, due to the expensive equipment requirements, such as the locomotives, wagons, tracks and facilities, such as freight terminals. On relative operating characteristics, rail is considered good on speed, dependability and especially the capability to move larger quantities of freight.

3.4.4 Air, Relative Costs And Operating Mode

Fixed costs are on the lower side; but there are high variable costs that include fuel, maintenance, security requirements etc. The main advantages of air is speed; but it is however limited in uplift capacity. Similarly, other modes of transport are required to take freight to and from the airports; thus air cannot directly link the individual consignor and consignee.

3.4.5water, Relative Costs As Well As The Operating Mode

The fixed costs of using water as a means of transport system are on the medium side, this includes vessels, handling equipment and terminals. Variable costs are low, due to the economies of scale that can be enjoyed from carrying large volumes of freight. This is the main advantage of the water mode, together with its capability to transport large volumes of freight like air; but it cannot offer consignor-to-consignee connectivity, and vessels are sometimes limited in terms of what ports they can use. It is also quite a slow mode.

3.4.6 Pipeline, Relative Costs And Operating Mode

Fixed costs are high, due to rights of way, construction and installation, but the variable cost is relatively low; and generally, this encompasses routine maintenance and ongoing inspection/security. On operational characteristics,
the dependability is excellent; but this mode can only be used in very limited situations and prone to the danger of bunkering. Figure 5 shows Generic configuration of a traditional supply chain in residential building

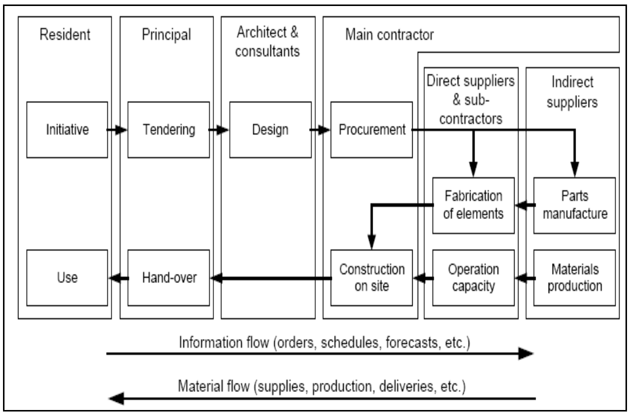


Figure 5 Generic configuration of a traditional supply chain in residential building

Table 3 Overview of the First Two Case Studies

	Case study 1	Case study 2
Description	This case study refers to time measurement to detect and analyze time buffers in a part of a supply chain process of concrete wall elements including the excavation and delivery of sand, the fabrication and delivery of elements, and the site installation of elements.	Involves problem analysis to identify and locate controllability problems in a part of a chain process of composite façade elements. The observed part included the job preparation, price bargaining, engineering, assembly, and site installation of the elements.
Objective	Analysis of the time use along the process in order to get insight in the time buildup, and the magnitude and location of time buffers.	Analysis of the controllability problems along the process in order to get insight in the occurrence and causality among the problems and their causes.
Method	Decomposition of the process in sub-processes and activities Time measurement of the activities Categorizing time use per activity: wasted, non-value-adding, value-adding Locating and quantifying time buffers Composing the process time buildup	Decomposing the process in sub-processes Uncovering the controllability problems per sub-process Identifying and locating the causes Finding connections between the problems and causes
Results	It appeared that at the beginning and the end of the sub-processes remarkable time buffers occurred. The time buffers were particularly due to inventory and delays. The share of the time buffers compared to the total lead-time was quite large (70-80%). Underlying problems of the time buffers included separate planning. The problems referred to various root causes including inter-organizational barriers.	The controllability problems were numerous. Root causes included non-collaborative working relations between parties, and adversarial bargaining. Most problems that were encountered on an operational and managerial level were caused by strategic and cultural issues. These included lacking common targets, reluctance and opportunism.

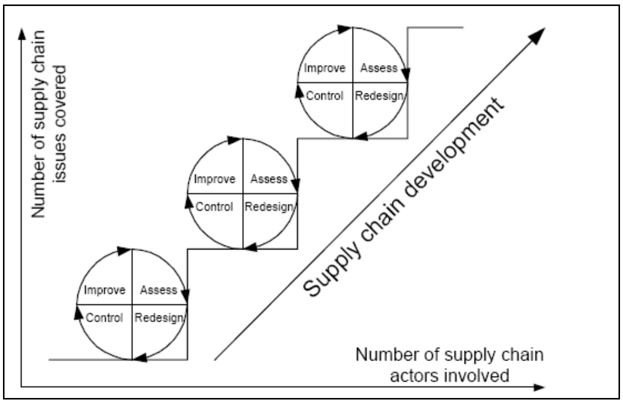


Figure 6: General Approach to Supply Chain Development

3.5 Analysis Of The Present Status Of Construction Supply Chains

The status and characteristics of present construction supply chains have been investigated in three case studies, carried out in India.The supply chains that were observed were randomly chosen and were each representative of a `typical supply chain and make-to-order construction process.
All of the observed supply chains consisted of follows of prefabricated components. Thus, development from the point of view of role 3 (transferring activities from the site to the supply chain) was present in the supply chains studied. In addition, the contractors involved had carried out sporadic improvement initiatives for realising role 1 (interface between the site and the supply chain).
Initially, the case studies analysed the symptoms of deficient site activities (i.e. waste and problems) and the impact of the supply chain on the performance of site activities (referring to role 1 of SCM). Then further analyses sought out the root causes of the symptoms leading to the domain of role 2 (improving the supply chain) as well as roles 3 and 4 of SCM (transferring activities from the site to the supply chain, and integrated management of the supply chain and the site,Table.3 and Figure.6)
Case study 1: Time Buffers: The first case study represented a time measurement of the production and delivery process in a supply chain for concrete fac7ade elements in a housing project. Time buffers appeared to be mainly located in between the sub-processes; separating the sub-processes in order to cope with variability and non-synchronicity on either side of the buffers. The time buffers had a large impact on the build-up of time in the total process.
Case study 2: controllability problems: The second case study represented an analysis of controllability problems in the production and delivery process for composite facade elements preceded by planning, engineering and bargaining activities in a housing project. The

controllability problems appeared to stem often from earlier activities in the chain process performed by prior actors.

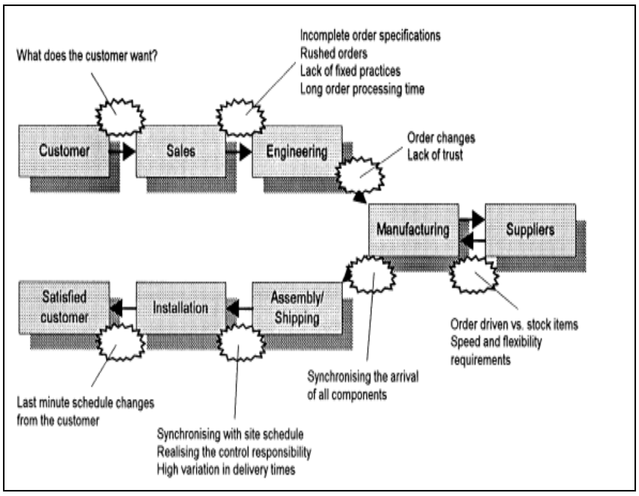


Figure. 7. Summary of the most common problems in make-to-order supply chains

These results concur with the findings made in construction regarding the frequency of problems as well as their origin and causes. The findings from the case studies are in line with the findings in previous research and correlate to typical problems in make-to-order supply chains in manufacturing. This observation largely justifies that many problems existing in construction supply chains have their origin in the deficiencies of obsolete control principles. Therefore, problems encountered in construction supply chains may well be resolved by applying a generic methodology provided by SCM, and developing corresponding control principles and methods.(Figure.7)

4.ABOUT SOFTWARE

SPSS is a widely used program for statistical analysis in social science. It is also used by market researchers, health researchers, survey companies, government, education researchers, marketing organizations, data miners, and others.

Statistics included in the base software:

- Descriptive statistics: Cross tabulation, Frequencies, Descriptive, Explore, Descriptive Ratio Statistics
- Bivariate statistics: Means, t-test, ANOVA, Correlation (bivariate, partial, distances), Non parametric tests
- Prediction for numerical outcomes: Linear regression
- Prediction for identifying groups: Factor analysis, cluster analysis (two-step, K-means, hierarchical), Discriminate.

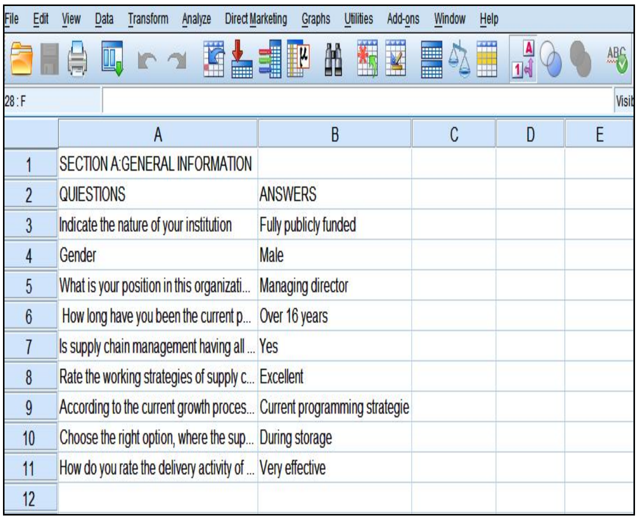
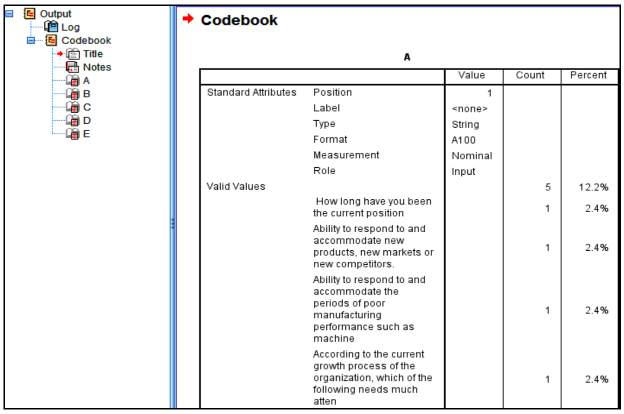
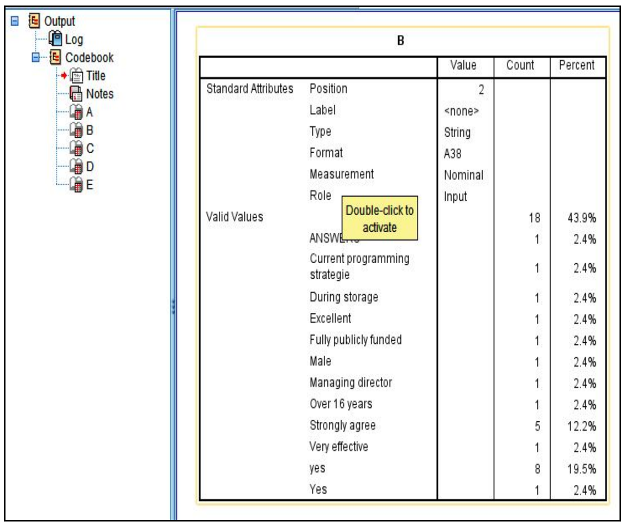
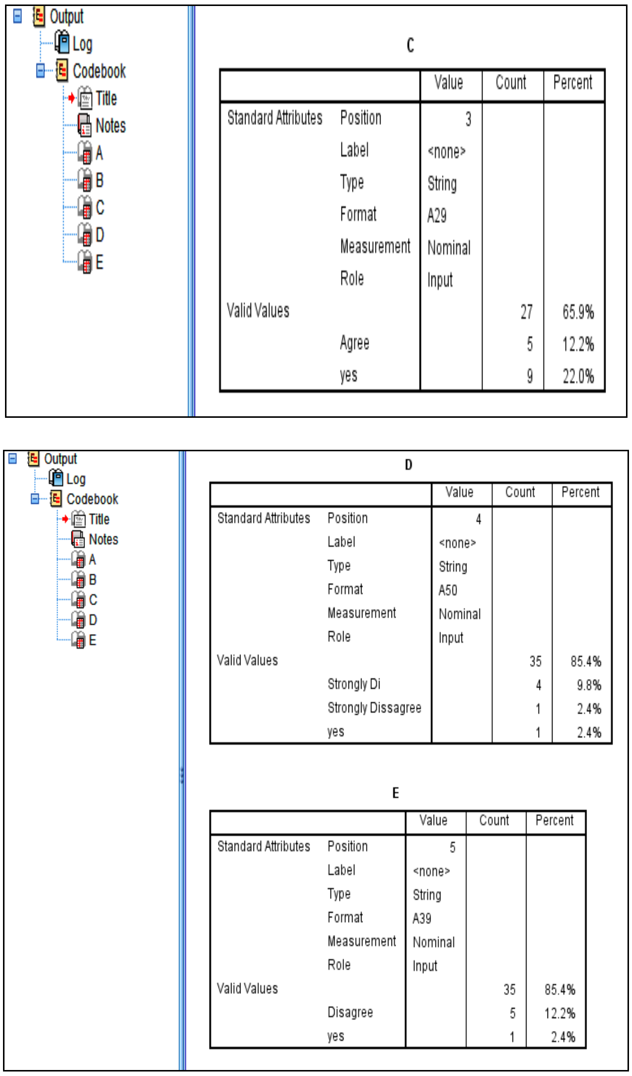


Figure.8 Data Sheet Window In SPSS



Fiure.9 shows Analysis Results Based On Codebook Figure.8 shows Data Sheet Window In SPSS.Fiure.9 shows Analysis Results Based On Codebook. Figure.10 shows Results Related To Attributes Figure.11 shows Summarization Of Data Figure.12. shows Frequencies Table.





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		Value	Count	Percent
Standard Attributes	Position	3		
	Label	<none>		
	Type	String		
	Format	A29		
	Measurement	Nominal		
	Role	Input		
Valid Values			27	65.9%
	Agree		5	12.2%
	yes		9	22.0%

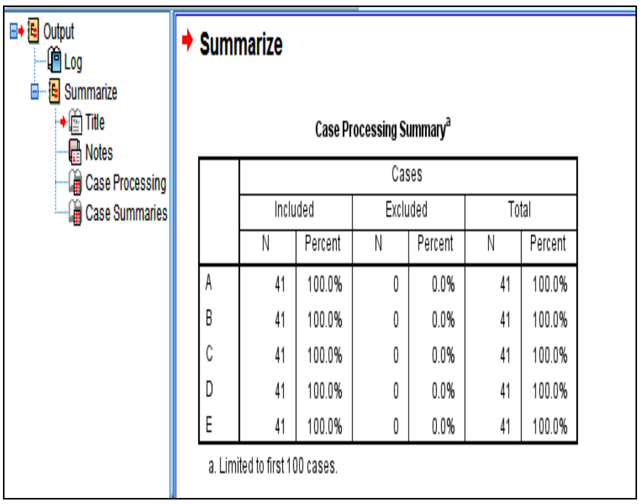
D

		Value	Count	Percent
Standard Attributes	Position	4		
	Label	<none>		
	Type	String		
	Format	A50		
	Measurement	Nominal		
	Role	Input		
Valid Values			35	85.4%
	Strongly Di		4	9.8%
	Strongly Dissagree		1	2.4%
	yes		1	2.4%

E

		Value	Count	Percent
Standard Attributes	Position	5		
	Label	<none>		
	Type	String		
	Format	A39		
	Measurement	Nominal		
	Role	Input		
Valid Values			35	85.4%
	Disagree		5	12.2%
	yes		1	2.4%

Figure.10 Results Related To Attributes

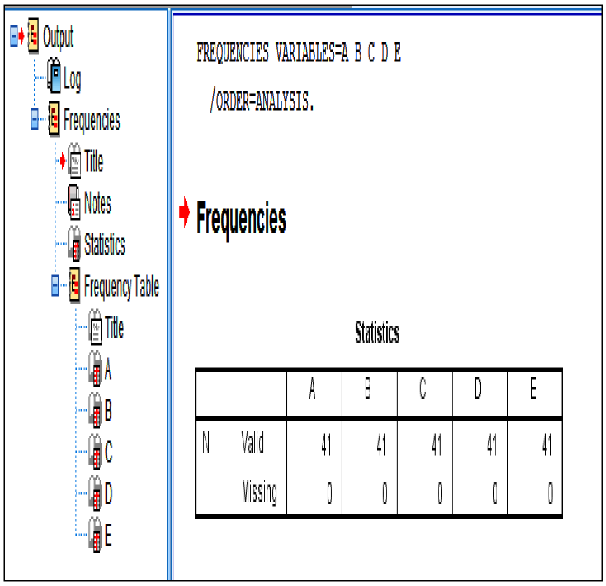


Case Processing Summary[a]

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
A	41	100.0%	0	0.0%	41	100.0%
B	41	100.0%	0	0.0%	41	100.0%
C	41	100.0%	0	0.0%	41	100.0%
D	41	100.0%	0	0.0%	41	100.0%
E	41	100.0%	0	0.0%	41	100.0%

a. Limited to first 100 cases.

Figure.11 Summarization Of Data



Statistics

		A	B	C	D	E
N	Valid	41	41	41	41	41
	Missing	0	0	0	0	0

Figure.12 Frequencies Table

SPSS Statistics is a software package used for statistical analysis. Long produced by SPSS Inc., it was acquired by IBM in 2009. The current versions (2015) are officially named IBM SPSS Statistics. Companion products in the same family are used for survey authoring and deployment (IBM SPSS Data Collection), data mining (IBM SPSS Modeler), text analytics, and collaboration and deployment (batch and automated scoring services).The software name originally stood for Statistical Package for the Social Sciences (SPSS), reflecting the original market, although the software is now popular in other fields as well, including the health sciences and marketing.

5.RESULTS AND DISCUSSION

Based on the empirical analyses and the generic body of knowledge concerning SCM, subjective and objective limitations in each of the roles of SCM can now be perceived. Subjective limitations are due to a deficiency in conceptualisation; objective limitations are caused by the characteristics of the environment of the problem addressed or peculiarities of construction in general. It can be assumed that these limitations have thwarted progress in developing construction supply chains.

Role 1. Improving the interface between site activities and the supply chain. It is a subjective limitation that the logistics initiatives have stressed (average) costs particularly, and thus failed to address the impact of supply chain variability on site assembly. In this regard, the last planner method provides an appropriate augmentation. In addition, there is an objective limitation due to the narrow focus of this role in relation to the whole supply chain. For instance, it is quite possible to improve the dependability of the deliveries of a supply chain through buffering, without addressing the whole supply chain, but the improvement of the dependability of the total supply chain would be a more efficient and effective solution.

Role 2. Improving the supply chain Regarding this role, the erratic and undisciplined nature of customer activities causes objective limitations. There are problems at both ends of the delivery process. At the beginning, the product definition is incomplete or capricious, and at the end, the delivery date often changes and the installation conditions are chaotic. As far as possible, the supply chain should be shielded from these problems or made robust in relation to them.

Role 3. Transferring activities from the site to the supply chain Transferring activities of site yields objective limitations. In industrialisation, the structure and behaviour of the total process changes: the process is longer, the amount of design required more substantial, the error correction cycle longer, and requirements for dimensional accuracy usually higher. Thus the total process of industrialised construction tends to become complex and vulnerable to variability, even if the part of the process located on site becomes less complex. The inevitable penalties for variability may grow on account of this. Indeed, if activities are transferred o! site, the complexity that results in the supply chain must be managed well and be improved in order to profit from the intended benefits.

Role 4 Integration of site and supply chain. Here again objective limitations can be discerned in many initiatives, related to the nature of constructed objects. The logic of many existing initiatives is based on the idea that SCM is more e!ective with stable supply chains and with standardised (even if customized) products. However both features, stable chains and standardised products, are restrictive to some extent in respect of market opportunities and the broad spectrum of demand for construction. Studies show that the benefits of design-build, even if statistically observable, are minor. The most plausible reason for this is that the control and improvement of design-build processes have been poor. Presumably, it had been thought that mere improvement of the organisational structure would. A response rate of 25% was achieved in this study. The results showed that most of the respondents were highly educated; 6.7% held a diploma, 60% held a bachelor's degree and 33.3% had postgraduate qualifications. The responses from different departments were impressive, and those who had knowledge about the logistics issue answered the questionnaires. It was found that the respondents were 26 years and above in age. Women participated well in answering the questionnaires. At least 73.3% were married people, and the remaining 26.7% were single and divorced. Permanent staff played an active role in answering the questionnaires, 80% of them responded. Finally, 73.3% preferred to speak or communicate in English rather than the local languages.

Through the telephone conversation with a logistics manager in it was revealed that using trucks alone as a means of logistics reduces their rate of delivery of large quantities to their customers at long distances, so they were seriously finding alternative ways of getting to their customers with larger consignments within the shortest possible time period. It was mentioned that trucks were limited in the loads they can carry. Most of the members of staff of companies that responded said that their company produced cement was a percentage of 66.7% while 26.7% produced cement and aggregate. Most of these cement factories were situated in the Western part of TamilnNdu due to proximity to the source of raw material, so their logistics links were crucial to
transport their product to other parts of the country. Some of the companies (60%) were owned by individuals and 33.3% were multinationally owned. Dry process of cement production took the highest percentage lead with 93.3% because it is a fast method of production and more cost effective. Customers purchased their products from depots, factories and wholesalers. The percentage of customers who usually buy their products directly from the factory was 53.3%, followed by depot purchases at 40%, and wholesale plus those who had no idea where their products were purchased at 6.7%. Respondents who preferred using road to other means of logistics added up to 73.3%, and they confirmed that they had no intention of changing to another means of logistics for various reasons stated. Only 26.7% of the respondents were willing to change to another logistics system. Respondents emphasized that logistics and supply chain management were extremely important in their various organisations.

Modularization quality was excellent and many agreed that poor use of modularization led to negative outcomes in the company. 78% of the respondents confirmed that collaborative working arrangements in logistics influenced customers and improved customer satisfaction, therefore being extremely influential. They found that the level of commitment by the workers in different departments was excellent. Finally, about three quarters of the customers came back for the product because of an excellent logistics system. The respondents strongly agreed that their company had enough partners with appropriate collaborative skills to effective logistics and supply chain systems. In terms of knowledge sharing and transfer within the working environment, 78% felt this was strongly achievable. There was strong agreement that collaboration procurement methods promote innovation and improvement on major projects.

This was caused by a lack of infrastructure in other logistics systems in Tamilnadu. Timeouts delivery using trucks was regarded as Excellent by 90% of the respondents while for the railway logistics system, it was 10% because it had not operated for some decades. Cost effectiveness in delivery by truck was regarded as Excellent, but this is due to the fact that the rail logistics had not been put into operation, it was therefore rated Poor. Customer satisfaction was rated Excellent for using road logistics because the product got to the end user at the appropriate time.

5.1 Comparative Analysis

The effective planning and management of a logistics and supply chain infrastructure is a challenge for most countries. However, a nation that is operating under only one kind of logistic system is an under-developed country. Most researchers have not deeply discussed a situation where it is suggested to the logistics and supply chain practitioners to implement another means of logistics different from the existing one. The practitioners of logistics infrastructure should always be ready to listen to external advice in order to enhance the quality of logistics operation and to ensure that the logistics system does generate benefits and contribute immensely to the economic growth of the nation. From the comparative discussion that was presented in this section, it is highly advisable to encourage most of the cement companies to use other means of logistics transportation system which are cheaper and more efficient. Maintaining such a system like the railway transportation system will enhance effective delivery, on time delivery and increase the overall turnover.

6.CONCLUSION

This paper contains three contributions to knowledge. Firstly, various existing initiatives towards construction supply chain development are explicitly related to a generic SCM methodology. In this context, four roles of SCM have been identified. Previous research has often been partial, focusing solely on one role at a time.Secondly, the present status of construction is empirically assessed from a supply chain viewpoint. The result of this investigation is revealed to be compatible both with previous observations in construction and in make-to order supply chains. The result provides a new, empirically founded understanding of construction supply chains and shows that great potential exists for their improvement. The majority of the causes of waste and problems are related to traditional management of the supply chain, and thus new principles and methods of modern SCM should provide a solution. Cement is a binder, a substance that sets and hardens independently, and it can also bind other materials together. It is a combination of different materials such as red alluvium, shale, limestone and gypsum in some cases, to produce cement. It is used in the construction of roads, bridges and also in building houses and towers. The effectiveness of the logistics system in the cement industry is of importance to the sustainability and execution of many building projects. The main target of this research was to find out why only trucks were used as the major means of transportation in the cement industry in TamilNadu and also to use the findings of this research to minimize or eliminate the likely hazards that may occur when using trucks alone as a logistics system. Hazards such as, high accident rate on the road, product wastages, and traffic congestion on the highways are common in TamilNadu. According to the survey questionnaire sent to different cement companies in TamilNadu; it was found that 73.3% of the respondents still preferred to use the road link logistics system. The reason was that, though there is a railway infrastructure from one point to another, even from the factory to some towns far and near, the rail system logistics could not be used due to the obsolete infrastructure of the railway. To bring this back into operation, new infrastructures would have to be put in place. Furthermore, there are some works to be done concerning the logistics system which included collaboration with the government and to have the knowledge of how the modern rail logistics system is very significant in the world today. The use of only trucks for logistics in Tamilnadu is not only applicable to the cement factory alone but to other factories and companies like the sugar companies, breweries and petroleum companies. Proper orientation and information about the logistics and supply chain should be given to people in order to improve the logistics and the supply chain activities.

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