

SUPPLY CHAIN MANAGEMENT IN CONSTRUCTION: DIAGNOSIS AND APPLICATION ISSUES

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ABSTRACT

A research project has been carried out with the general objective of proposing a generic application methodology of supply chain management (SCM) to the construction sector by adapting the manufacturing SCM experience and development to the particular characteristics of construction. As part of this research, a survey was carried out to more than 50 companies that participate in the construction sector. The purpose of this survey was to obtain a diagnosis about the current situation of the supply chain in the Chilean construction industry. The paper presents the main results of the survey and highlights the problems and restrictions that exist in the local construction supply chains as well as their main causes. Also, a set of solutions is suggested to address the identified problems and improve the supply chain performance. By using the data obtained from the survey and the knowledge available in the literature, the paper proposes a framework for implementing the concepts and principles of supply chain management in construction companies and, in this way, to take advantage of the benefits that SCM can provide. One of the principal conclusions of the paper is that the application of SCM in the local construction sector will require the introduction of several changes in the way that participants of the supply chain interact currently. Some of these changes are analyzed and discussed.

Keywords: Supply Chain Management (SCM), construction, diagnosis, application.

INTRODUCTION

Management of materials and information flows are key strategic priorities for construction companies. A good performance in these areas can provide them with significant benefits and allow the adding of greater value for clients.

Supply Chain Management (SCM) can be a very useful approach for construction companies on this regard. This is especially attractive if we consider that the construction activity is a process characterized by high levels of fragmentation and where the effective integration, coordination and management of the chain, from suppliers to final clients, is a necessary condition to obtain good results.

This paper presents the main results of a diagnostic study about the relationships between the participants of the supply of construction in Chile. It also provides a general

methodology for the application of SCM in construction. Finally, it discusses about its main application problems and their causes, its benefits and the requirements for its effective application in this sector.

SUPPLY CHAIN MANAGEMENT IN CONSTRUCTION

The supply chain is a network of organizations involved, from the supplier of the supplier until the client of the client, on the different processes and activities that produce value in the form of products and services for the final client. Its major components are the suppliers' network, the transformation unit and the clients' network. The effective management of the supply chain is necessary for successful competition in today's global markets.

SCM is a philosophy that describes how organizations should manage their supply chains to achieve strategic advantages. Its goal is to synchronize the client requirements with the materials and information flows along the supply chain, until reaching a balance between the client satisfaction and the cost. It refers then to the coordination of the activities of all that participate in the supply chain, to knowing the production requirements with the purpose of satisfying the client, to delivering of products of higher value and to reducing the costs of the organization that apply these principles.

The application of the SCM, mainly in the manufacturing industry, has been successful and has achieved the expected benefits [Roth and Martin, (2000), Proverbs and Holt, (2000), Landry, (1998), Christopher, (1992)]. Some of these benefits are: cost reduction, competitive advantages, productivity improvement, value creation and better relationships between parties. This can be achieved by four proposed critical factors that were determined after an analysis of the SCM literature: information integration of the whole company, operational coordination and collaboration, focus on the client and development of general strategies in the whole chain [Ross, (1998), La Londe, (1998), Lee and Whang (2001), Roth and Martin, (2000)]. These four factors are shown in figure 1.

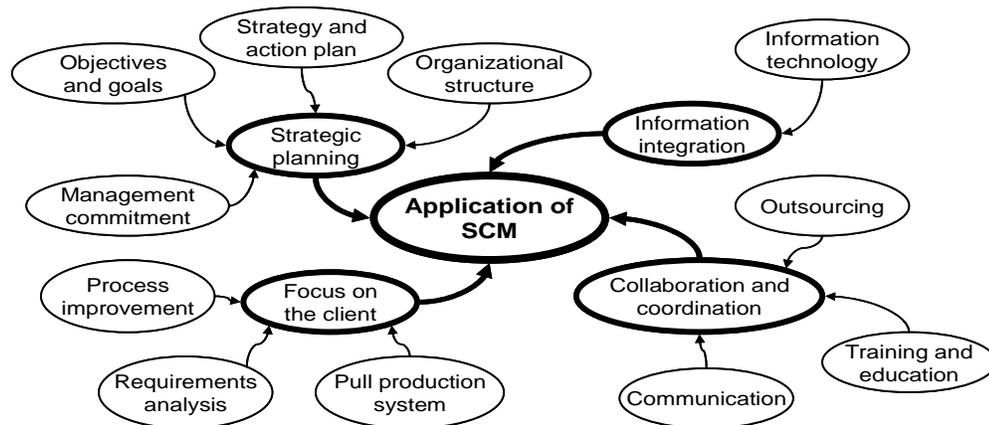


Fig. 1 Proposed critical factors for SCM application

To apply SCM in construction it is necessary to distinguish some characteristics of the construction production system, as follows:

- The construction product is for a single client most of the times.
- The product changes for each project.
- The place, equipment and methods of production change for each project.
- Construction personnel have a high rotation index during the construction time and between projects.
- Not all the parts and materials can be stored at site.
- It is not easy to take advantage from economies of scale and learning.

Although the construction process is different, SCM can be useful and effective in construction [O'Brien, (1999)]. Besides, construction is a process with strong fragmentation evidenced by the lack of integration of its supply chain, a fact that makes SCM a very appealing approach to achieve integration between internal and external suppliers, designers, contractors, subcontractors and internal and external clients. Figure 2 presents a conceptual representation of the construction supply chain and the way that all of its participants interact.

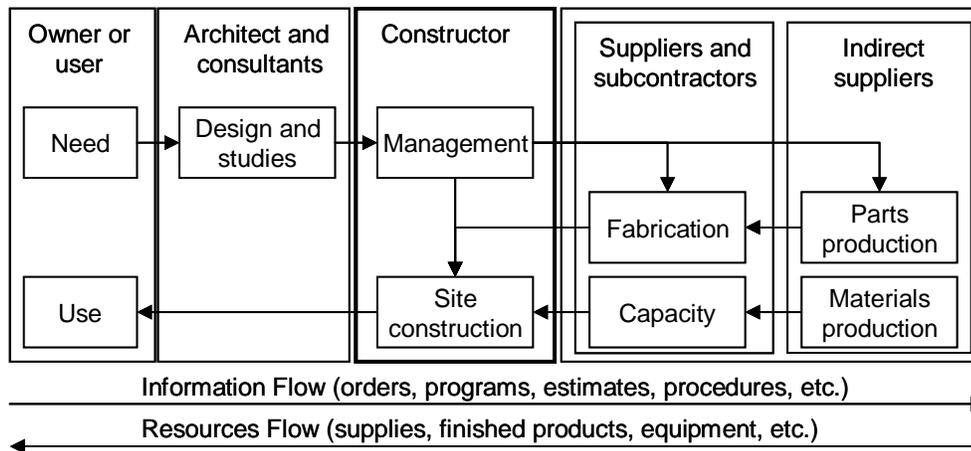


Fig. 2 General model of the supply chain in construction (adapted from Vrijhoef y Koskela, 1999)

Given this configuration of the construction supply chain, a construction company has as many supply chains as it has construction projects, because for each project the client's needs and the project's characteristics might be different. As shown in figure 2, the supply chain in construction represents a system of multiple supplier – client relationships that are needed to complete the project. Besides, every supply activity (i.e., purchase, storing, transportation, inventory management, etc.) ends at the site, where the construction is carried out. Another particularity is the number of clients. Compared to the manufacturing supply chain, the number of clients in construction is very limited and, besides the housing sector, generally is only one.

The construction supply chain is affected by many problems as has been reported by several authors [Vrijhoef and Koskela, (1999), Vrijhoef, (1998), Hong-Minh et al., (2000); Akintoye et al., (2000), O'Brien, (1999), Ofori, (2000)]. Most of these problems are not generated in the conversion process but in the different interfaces that exist within the supply chain. Some of the general problems are as follows:

- Lack of coordination, collaboration and commitment between suppliers and clients within the supply chain.
- Design problems (many changes and inconsistent information).
- Poor quality of materials and components.
- Deficient communication and information transfer.
- Inadequate management within the supply chain, mainly poor planning and control.
- Poor training of contractor's suppliers, subcontractors and workers.
- Lack of effective methods for measuring the performance of the different parties within the supply chain.

The purpose of incorporating the principles of SCM to construction can be stated as: obtaining competitive and comparative advantages through value generation, cost reduction and the integration of all the parties that intervene in project management and construction processes, with the goal of satisfying both the internal and the external clients.

RESEARCH METHODOLOGY

The methodology used for carrying out the diagnostic of the construction supply chain in Chile, consisted in the application of a survey to more than 300 organizations that involved construction companies, suppliers, subcontractors and clients [Heredia, (2003)]. The population analyzed was all the companies that belong to the construction sector that develop their activities in Santiago, the capital of Chile. A total of 50 valid surveys were obtained during the study. The composition of the sample is shown in table 1.

Table 1 Composition of the sample

Type of organization	Required number of answers	Current number of answers
Construction companies	29	31
Suppliers	13	11
Subcontractors	5	6
Clients	3	2
Total	50	50

In addition to the answering instructions, the survey was structured in four sections with the following objectives:

- To obtain general information about the respondent companies, including type of company, area of work, annual operational volume and number of employees.
- To understand the relationships between companies and their suppliers.
- To understand the relationships between companies and their clients.

- To identify and understand the more relevant aspects of the relationships between construction companies internal clients and suppliers especially between construction sites and the main office.

The survey was answered mainly by companies' general or area managers that have a direct relationship with their clients and suppliers.

SUMMARY OF THE DIAGNOSTIC FINDINGS

In the next sections, concise summaries of the major findings of the diagnostic of the supply chain are presented.

RELATIONSHIPS WITH SUPPLIERS

Regarding the criteria for suppliers' selection, price ranked as the most important factor taking into account when choosing a supplier by an 84% of the respondents, followed by quality (78%) and efficiency and effectiveness of delivery (37%).

Concerning problems in the relationships with suppliers, the major categories were: not conforming to agreed delivery time (72.6%) followed by non conformance with quality requirements (52.2%), lack of adequate communication (34.8%) and lack of suppliers' capacity or availability (30.4%).

When asked about causes of these problems with suppliers, the most mentioned by the answerers were: lack of planning of own company (38.3%), lack of planning by suppliers (34%), lack of control by suppliers (34%), insufficient communication (34%) and lack of training and competence of suppliers' personnel (34%). Design changes were also mentioned as a cause but only by 27.7% of the respondents.

Respondents also referred to the main barriers in the relationships with suppliers: differences in objectives and goals were mentioned by 52.8% of respondents; also the same percentage indicated the lack of management skills of suppliers, 43.2% referred to the inadequate organizational structure of suppliers and 36% to the inability of suppliers to consider long-range benefits.

Regarding the benefits of keeping good relationships with suppliers, the major benefits were: better quality (67.4% of answerers), better productivity (57.2%), cost reduction (44.9%) and lower inventories (32.6%).

Finally, when asked about the ways used of measuring suppliers' performance, cost was mentioned as the most important factor by an 86% of them, quality (82%), timing (58%) and service (40%).

RELATIONSHIPS WITH CLIENTS

Respondents indicated that the main problems with clients are as follows: design problems (86.7% of respondents), quality requirements (49.2%), and communication problems (46.9%) and contracts problems (46.9%). Regarding the causes of these problems, they indicated that changes in requirements is by far the most important cause marked by 65.7% of the respondents, followed by the participation of third parties (inspection, engineering firms, etc) mentioned by 39% of the respondents and insufficient communication (35%).

When asked about barriers to good relationships with clients, respondents indicated the following: deficient communication channels (90.6%), insufficient management skills of their own company (46.9%) and inappropriate organizational structure of their own company (46.9%).

Regarding the mechanisms to identify and understand clients' requirements, periodic conversations were mentioned by 94.9% of respondents, previous projects information (76.9%), surveys and interviews (51.3%) and market studies (46.1%). They also mentioned the following benefits of keeping good relationships with clients: better quality (57.5%), higher profits (55.5%), more competitiveness (53.3%) and cost reduction (39%).

INTERNAL RELATIONSHIPS BETWEEN MAIN OFFICES AND CONSTRUCTION SITES

Contractors and subcontractors were asked about issues related to the relationship between their main offices and construction sites. The main difficulties mentioned by respondents were: problems with design information (96.4%), communication problems (53.6%), quality failures of supplied items (53.6%) and lack of knowledge of requirements (39.3%). According to the respondents, the main causes of these problems were: lack of planning (83.3%), lack of control (62.5%) and insufficient communication (58.3%).

Regarding the main barriers to keep good internal relationships between main offices and construction sites, the answers were as follows: lack of appropriate communication channels (100%), inappropriate organizational structure (71.2%), lack of knowledge of information technologies (55.9%) and inadequate management skills (55.9%). They also mentioned the following benefits of keeping good internal relationships: cost reduction (75.9%), better quality (75.9%), productivity increase (41.3%) and greater profits (34.5%).

APPLICABILITY OF SCM IN THE CHILEAN CONSTRUCTION INDUSTRY

The brief review of the answers obtained from the survey is an evidence of the many problems that exist in the supply chain at the local construction industry and demonstrates that many of these problems should be solved before SCM may be effectively applied. Deficiencies of integration and coordination, price-based supply decisions and different short-term goals are critical issues that should be addressed before implementing SCM. One of the manifestations of this inadequate attitude of the parties is the fact that most of

the companies assign the responsibility of supply problems to their suppliers without looking at their own internal deficiencies, like the lack of planning and control, changes of their supplying needs, inadequate communication and so on. No intention of creating long-term relationships and promoting integration and collaboration with suppliers was clearly proposed by most of the companies.

Construction clients also have an important role in improving the specific relationships with their contractors, with especial emphasis on three issues: to provide clear requirements, to avoid continuous changes of designs and supplies needs and to create adequate communication channels to improve the critical conversations with their suppliers.

In general, it can be said that there is a poor understanding of the way each of the parties participates in the supply chain. It adds to this, the insufficient application of sound management principles and methodologies for managing their respective companies. This is also an issue that should be addressed if it is hoped to be successful in the application of SCM in the local construction industry. The effective application of SCM would provide many benefits that should act as incentives for all the parties as it is recognized by most of the answerers of the survey.

A PROPOSED METHODOLOGY FOR APPLYING SCM IN CONSTRUCTION

Knowing the current situation of the local construction supply chain, a generic methodology is proposed to implement SCM, taking into account the problems previously identified. This methodology is addressed mainly to construction companies. However it can also be applied by the other parties of the supply chain.

The methodology is based on the cycle known as the Deming cycle, also known as the PDCA cycle (plan – do – check – act). The fundamentals of this cycle and its application to every activity or process of the organization are essential to achieve a continuous improvement of its supply chains. The main steps of the implementation methodology are shown in figure 3.

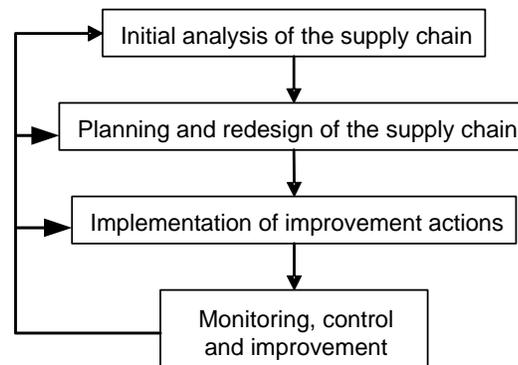


Fig. 3 Main steps of the SCM implementation methodology

The methodology is focused on strengthening four aspects: strategic planning, coordination and effective collaboration, focus on the client and information integration as shown previously in figure 1. These four aspects should be considered and measured by construction companies to reach the potential benefits of keeping good relationships with suppliers and clients.

INITIAL ANALYSIS OF THE SUPPLY CHAIN

The objective of this stage is to define the supply chain of the organization and to know the problems that are present as well as their causes. With this analysis, a wide vision of what is going on with clients-suppliers relationships within the chain can be obtained. The actions and expected results of this stage are summarized in figure 4.

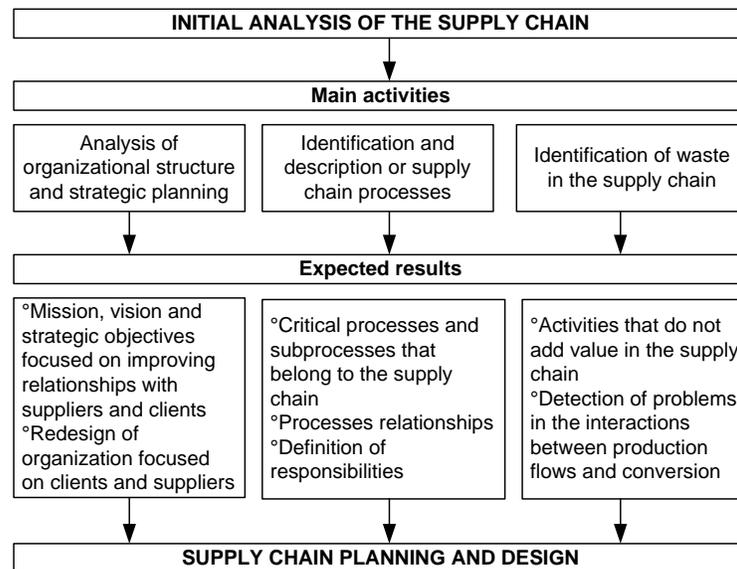


Fig. 4 Activities and results of the initial analysis of the supply chain

PLANNING AND DESIGN OF THE SUPPLY CHAIN

During this second stage, objectives and actions needed to eliminate or reduce the main causes of the problems found during the analysis stage are planned. Also, improvement opportunities are proposed. The activities in this stage are focused on designing a new structure of the supply chain of the organization that will improve competitiveness through value generation for clients and cost reduction through waste elimination. This is shown in figure 5.

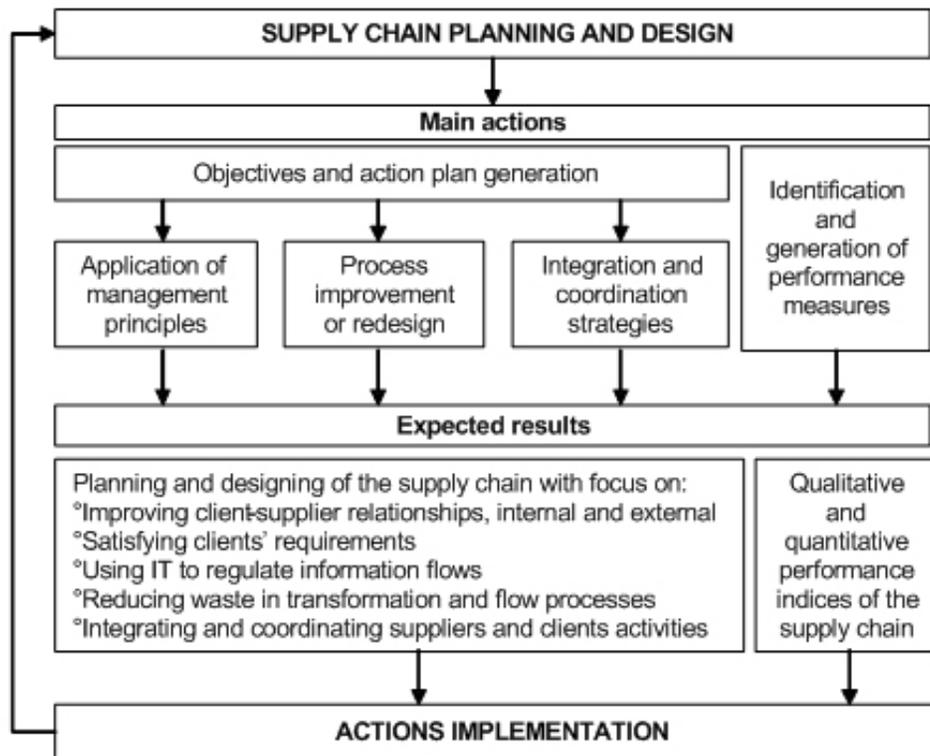


Fig. 5 Activities and results of the planning and design stage

ACTIONS IMPLEMENTATION

In this stage, the purpose is to carry out the activities or strategies defined in the planning stage. It also considers the construction of the necessary capacities related to the use and management of technology, capital, people and resources to assure an effective implementation.

MONITORING, CONTROL AND IMPROVEMENT

In this stage, the obtained results are compared against planned results using performance measurements. If this comparison is not positive, then corrective actions should be taken. If results are okay, then new actions are planned to continue improving the supply chain.

TOOLS AND METHODS

The application of the methodology should be supported by several tools and methods. Figure 6 presents some of these tools and methods that may be complemented with additional ones.

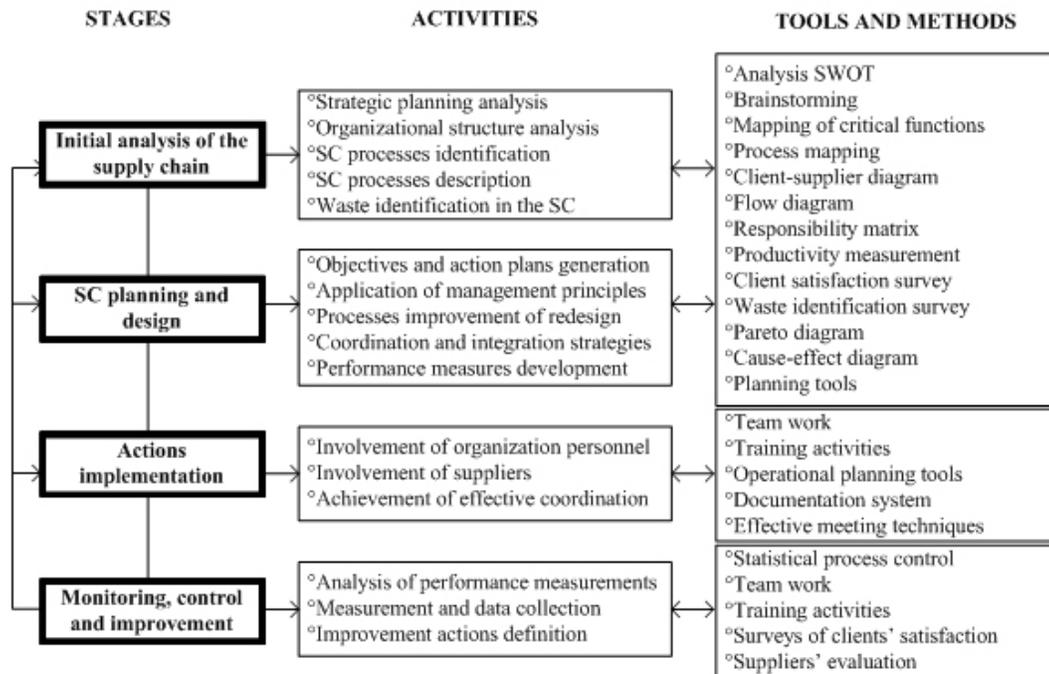


Fig. 6 Tools and methods for the proposed methodology

CONCLUSIONS

Construction is a productive process that presents a high degree of fragmentation between participants. This fact gives rise to many problems originated mainly by the lack of coordination of these participants. SCM provides many principles to address this fragmentation and reduce it. However, those principles were developed in the manufacturing environment, which presents conditions that are much more favourable for its application.

The analysis presented in this paper suggests that the principles of SCM can be applied to the Chilean construction industry despite of the existence of several inadequate conditions currently in the industry, as shown by the survey's results. Some of this adverse conditions are: the short-term approach of management decisions in the construction sector, the lack of managers' commitment with the required changes, the absence of sound communication channels between construction participants and the lack of management' training, between others. Therefore, it is proposed that to achieve the benefits of SCM it is necessary to apply a very systematic but flexible approach and with a long-term planning horizon so that many of these conditions can be changed effectively.

Some of the major benefits that construction organizations can achieve by means of applying SCM principles are: (i) the development of internal capacities to carry out their processes in a more effective and efficient way than that of their competitors; (ii) the development of strategies that will allow them to deliver better products and services to their targeted market segments and (iii) the effective organization and handling of the information and resources flows needed to improve the performance of their suppliers.

Organizations would become more competitive in terms of production costs reduction and by increasing the value for their clients.

A better supplier-client relationship requires the availability of an integrated information and communication system shared by both organizations. This system will help to strengthen the relationship, to facilitate the required understanding between them and to make their objectives more compatible. It will also provide timely information about the performance of the relationship, easing the rapid adoption of improvement actions and motivating a greater commitment in both organizations.

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