

# **NEW SUPPLY CHAIN NETWORK IN BRAZIL'S HOUSE CONSTRUCTION INDUSTRY**

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## **ABSTRACT**

Brazil's house construction industry is currently undergoing changes in its structure due to the new competitive environment. In São Paulo, among other states, production is passing from an in-house type to a subcontracted type. Finding an effective way to manage the supply chain is crucial for the success of this new situation.

With the main focus on the Brazilian supply management in this industry, this paper seeks to identify and discuss the principal key factors the supply chain management has to be aware of in order to facilitate the implementation of lean production in construction projects in this country.

From a brief review of literature that exists on supply chain management, four key factors can be identified to improve supply chain performance: lean designs, system reliability, supplier co-ordination and supplier development. Based on a description of the supply chain and current management procedures in this country, the relevance given to these key factors is discussed.

## **KEY WORDS**

Supply chain management, lean construction, lean design, reliability, supplier coordination, supplier development.

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## **INTRODUCTION**

Lean construction is a new philosophy which has appeared over the last decade, and presents a new, non traditional way of thinking about production management. It relies on five principles: value, value stream, flow, pull and perfection (Garnet et al. 1998). As opposed to traditional project management it conceives a project as a system and not as a sum of isolated activities (Howell and Ballard 1998).

It is this holistic approach that differentiates it from current practice, which relies on a conversion view, whilst lean thinking models the process on a flow view, which includes conversion, inspection, moving and waiting and, in addition, incorporates a value generation view.

The fact that this new philosophy brings a non traditional perspective and that it has been taken from manufacturing, makes it difficult to accept and implement in the construction industry. Moreover, implementation will strongly depend on the participation and enrolment of all the members of the supply chain, which include: materials suppliers, design suppliers, and subcontractors.

London et al. (1998) affirm that the potential benefits from supply chain management include: faster response times, less waste, reduce inventory holdings, more effective information, etc.

With the main focus on the Brazilian supply management in this industry, this paper seeks to identify and discuss the key factors the supply chain management has to be aware of in order to facilitate the implementation of lean production in construction projects in this country.

To help this analysis, there is a brief review of literature that exists on supply chain management; then, based on a description of the supply chain and current management procedures in this country, we will discuss the relevance that these key factors are given.

## **LITERATURE REVIEW**

The importance of a detailed analysis of the supply chain in the construction industry has been recognised by academics relatively recently. Moreover, Hines (1996), writing about manufacturing, affirms that it was not until the 80's that the true strategic value of buyer-supplier relationships was being discuss in any depth. Nowadays, practitioners are also beginning to perceive the importance of this.

According to Christopher (1992) "supply chain is 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 consumer".

In the house construction industry, the supply chain is typically formed by designers, material suppliers, and subcontractors. All these organisations are brought together to achieve one main objective, to build a particular project. Therefore, it is essential that all these agents be working as one with the aim of satisfying the final customer.

If we divide a traditional project into two phases, design and construction, we will find that the agents that normally work together in the first phase are the designers and the owner

and, in the second phase, material suppliers, subcontractors, designers (with a very passive role) and the construction firm. This traditional arrangement makes a clear break between these two phases and normally the designer only specifies what is to be built. How to build it is left for the constructor and all the agents involved in production (Howell et al. 1996). This has caused numerous problems during construction.

Fortunately, this traditional practice is beginning to be questioned and the design phase is beginning to acquire a new perspective. Melhado (1994) states that the design is responsible for the development, organisation, registration and transmission, of the physical and technological features of a project. The importance of this phase relies on this definition. Without designs that fulfil these features, problems downstream (construction) like re-works, delays, etc. are likely to appear. It is important to note that this definition is not only describing product designs but also process designs. The design must not only be limited to what to build but also to how to build it. This author also affirms that it is essential during the design phase for constructors and other agents to be called to participate in order to increase value in projects. This also emphasises that the participation of designers does not end at the design phase but continues during construction. In other words, there is not a break between these phases, they support each other until the projects ends.

It is also important that the team have effective means of communication that permit them to exchange information in order to achieve a product (design) compatible among all the disciplines involved (architecture, structures, etc.) and without gaps left to be solved in the next phase.

The next phase, construction, will be constantly threaten by uncertainty. Davis (1993) affirms that uncertainty is one of the principal factors that make supply chain difficult to be managed. One way to protect against it is creating buffers or inventories. In Japan, it is believed that buffers hide problems, for them stocks are synonymous of waste (Christopher 1992). For this reason, it is important to make the process more reliable. Howell and Ballard (1998) have recognised this aspect as a key factor to the improvement of system performance.

Davis (1993), referring to manufacturing, distinguish three different sources of uncertainty: suppliers, manufacturing and customers, which can be analogous in construction. It is important to find key metrics for each of these sources that can help us identify and understand the reasons for these uncertainties in order to protect the system against them or be prepared to deal with them.

In lean construction, a tool call WorkPlan based on the last planner methodology has been developed (Choo et al.1998). This software permits weekly planning on-site and it also tracks the main reasons for planning failures in order to prevent them from happening again. It differs from current practice because production management is not based on the productivity of isolated activities but on the reliability of the project as a whole.

Other key factors necessary to achieve a lean supplier network are: supplier coordination and supplier development (Hines 1996, London et al. 1998). It has been pointed out that Japanese firms have succeeded in this area developing partnering among their suppliers (Mc Millan 1990, Hines 1996). It is interesting to note that for partnering really develop its potential benefits it has to be inserted in an appropriate management context (Howell et al.

1996). According to these authors, a prototype process approach would be appropriate for partnering to develop its real potential.

According to Hines (1996), supplier co-ordination refers “to the activities made by a customer in order to mould their suppliers into a common way of working, so competitive advantage can be gained by removing inter-company waste. This type of co-ordination would involve such areas as: working to common quality standards, using the same paperwork system, shared transport and employing inter-communication company communication methods such as EDI”. While supplier development refers “to the activities made by a customer to help improve the strategy tools and techniques employed by suppliers to improve their competitive advantage, particularly, by removing intra-company waste”.

Christopher (1992) suggests that if suppliers are involved in the product development process at an early stage, innovative solutions can be achieved.

Given that JIT philosophy strongly depends on good relationship and co-ordination with the suppliers, these last key factors are very important in order to implement it.

Finally, it is important to take into consideration that in order to achieve harmony among all the agents involved in a project, there must be an equilibrium among all these participants. Efficiency will be achieved in the project when the lowest cost for the entire system of firms is achieved (O’Brien et al. 1995). This is a different way of understanding what the optimum solution is. It is not looking for the reduction of costs in one of the firms, it is the best arrangement for all of them.

## **BRAZILIAN SUPPLY CHAIN**

From the literature review four main key factors for the effective management of the supply chain were identified: lean designs, system reliability, supplier co-ordination, and supplier development.

In this item we characterise the Brazilian supply chain and current management practices in order to discuss how these factors are taken into consideration.

## **DESCRIPTION**

Over the last ten years, the house construction industry in Brazil has undergone several changes in its structure. This is in response to changes in local environment: the increase of competitors in the industry, the increasing demand of quality and price of the customers, the creation of Consumer’s defense code, among others (Cardoso 1996). All these factors have changed the rules of competition. Whilst in the past, the price was calculated as a result of the sum of the total costs and the profit the firm wanted to gain, at present, the price is determined by the market and the profit is a result of the cost; the higher the total cost the lower the profit becomes. As a consequence, house construction firms are looking for new ways to reduce their costs, especially their production costs.

The described panorama, together with the inability of firms to manage their production and the necessity to reduce fixed costs are pushing these firms towards subcontracting. Vertically integrated production is being replaced by increased use of subcontracting, similar to what happened in U.S. and Japan manufacturing industry (Mc Millan 1990).

In São Paulo, one of the most developed states of Brazil, a great number of small firms specialised in specific construction works, like: foundations, forms, masonry, steel implementation, etc., have appeared during the last years. Years ago all these services were carried out in-house.

Besides this factor, most construction firms in São Paulo only have a few workers registered, and the rest of them are subcontracted per project. This has led to the appearance of many small companies formed by ex-workers. The principal problem with this new kind of suppliers is that they do not have qualified personnel to carry out the services.

Given these circumstances, construction firms are beginning to work with a high number of "companies" per project. These subcontractor companies are heterogeneous in nature. While some are well organised firms with many years in the market, others are new *firms*, with a non traditional organisational structure formed by few workers that sometimes get together in order to carry out a determined service.

Other kinds of suppliers that also have been facing changes in their structure are the design suppliers. Years ago, there were only product designers in this industry. The most common were: architectural, structural, electrical and hydraulic. Now that many construction firms are getting involved in different management programmes to rationalise their production, such as TQM, more firms are realising the importance of not only product designs (what to build) but also process design (how to build) before the production stage. This new design includes both the product design and process design. With this new demand, new suppliers, specialised in process design have appeared.

It is also interesting to note that the number of engineering suppliers has also increased. Their main activity is the programming, budgeting and scheduling the activities on-site. They act as a type of consultant, and construction firms often demand their services due to the lack of personnel trained to realise these activities.

Finally, materials suppliers have not escaped from this changing environment. Competition is strong for them too. Their clients are now alert of the quality and prices of their products. These kinds of suppliers are often chosen by bidding, but factors such as quality and timely are also taken in consideration. Some material suppliers have improved their delivery service in order to add a new feature that can make the difference between them and other competitors. In other words, suppliers are perceiving the importance of adding value to their products to be more competitive.

The supply chain in the Brazilian house construction industry is now a network formed by a great number of heterogeneous firms working together on the same project. Most of these firms interact with each other during the production stage. With this new structure, new management problems have appeared. Now firms have to be able to manage a great number of companies on-site. Co-ordination and effective communication become crucial in order to achieve quality standards and to cause the cost of production to decrease effectively.

### **CURRENT MANAGEMENT PRACTICE**

In Brazil, the construction of projects is often managed in the traditional way. The construction phase often begins with only a part of the designs complete, and the rest of them are completed during construction. In addition to this, designs are mostly limited to what to build, there is little information about how to build.

Unfortunately, this erroneous way of thinking has resulted in many problems in the construction phase: re-works, constructability problems, delays caused by incomplete design or lack of congruency are daily problems on-site. Moreover, many problems that have appeared post-occupancy have also been a result of weak designs and planning.

This panorama is now beginning to change. Some firms are beginning to perceive the strategic importance of this phase. Nowadays, as firms are looking for ways to reduce their costs, interest in finding new ways to rationalise their process has grown. Management techniques such as those provided by TQM are becoming known in São Paulo's construction industry, and some firms are implementing them in their business.

It is interesting to note that with TQM a new concept, *the internal customer*, has been introduced. This new approach means that each process has a customer to satisfy (the next process). This new concept can help to develop a self-control mechanism if management is based on *pulling* resources rather than *pushing* resources, because when each internal customer pulls the preceding process it will only pull the processes or products that satisfy customer requirements. In this way, the line will be stopped each time a defective item is identified until it is corrected and defective items will not flow through the next process.

This search of quality can even be perceived in public programmes. In the state of São Paulo, a public programme, QUALIHAB, based on TQM, has been created with the objective of achieving quality in public house constructions. The importance of this initiative lies in its impact on the whole the supply chain. It has a chain reaction, the customer (state) demands quality from the construction firms and they demand quality from their suppliers.

In private projects some approaches to improve project quality have also been introduced. For example, some firms have begun by identifying their principal constructability problems during the production phase in order to find solutions in the design phase. This could be a first step for firms that are trying to improve their performance.

For firms that are trying to improve constructability, it is important to make the production team participate, due to the fact that this team is constantly dealing and working with them. After this first stage is complete, these ideas have to be organised and analysed so they can be incorporated into the next designs. The next step would be to choose which designers to work with carefully. Without their collaboration in accepting and incorporating these new ideas to their work it will be very difficult to change anything. It will be best if the designer team is always the same, because a process of continuous improvement can be carried out.

Coordination among designers appears as a key factor in the design phase. Melhado (1994) recommends the naming of a project coordinator, who will be responsible for organising all the agents involved in this phase and make the group work as one. This coordinator needs to have particular characteristics, e.g., knowledge about construction, leadership skills, among others.

The management of the next phase, construction, basically relies on a conversion view and pushing resources attitude rather than a pulling one. Buffers exist in order to protect the system against uncertainty, but there is not any approach to increase reliability of the process. Productivity is seen as an indicator of performance. This traditional practice has not been successful in reducing waste and in managing sites. This situation can get worse given that many firms are moving away from in-house production towards a subcontracted type.

As has already been discussed, in Brazil, especially in São Paulo and other states, the new tendency is towards a intensive use of subcontracting.

Eccles (1981) describes this new organisation form as “a contracting mode intermediate between the rational contracting modes of bilateral governance (obligational contracting) and unified governance (internal organisation) is the preferred mode for construction work given certain conditions. This author named this type of organisation as quasi-firm.

At present, some firms are engaging in this new type of organisation, with the principal objective of reducing waste. They see in subcontracting a way to forget about their production problems and to reduce fixed costs. But not all of them have been successful in achieving this objective, the principal reason being that they have changed from in-house production to subcontracted production without analysing the systemic implications of this choice.

This new situation demands a different way of managing the site, and there are new requirements to fulfil:

- firms need mechanisms to measure properly the costs of the services they will subcontract. It is important to clarify that the cost is not only the direct cost but that it also includes the costs that can be saved or added in other processes due to some special features of the product that is subcontracted. This means that the firm should be able to identify this cost in order to make a good choice. It is recommended that in-house production should always be an alternative.
- firms need to understand and be familiar with all the production process to contract and control the suppliers' work. It is essential for the main firm to clearly specify the service contracted, not leaving points that could be misunderstood by the supplier. All these specifications should be detailed in the contract. The main firm should also have control procedures and people responsible for carrying out this control.
- firms need to be prepared to co-ordinate all these companies. This is one of the most difficult and important challenges because despite the fact that there are a number of heterogeneous firms working together on the same project, it is crucial to homogenise their way of working and make them work as one so that value can smoothly flow through all of them at the pull of the customer.

If we try to find some answers in the manufacturing industry we will see that in Japan this situation was managed working with a few suppliers with a long term relationship. Most of the firms developed partnerships with suppliers (Mc Millan 1990, Hines 1996). This position enables the main firm to effectively mould their suppliers into a common way of working.

When a supplier works on several projects for the same company during long terms it is more likely that a process of continuous improvement can be developed. The main firm can get to know the way the supplier works and the points where it is weak and strong. In the same way, the supplier can get to know what the firm expects from him. In this way, both can benefit if the relationship is developed on good terms and not only with advantages for one of these agents. This practise increases reliability of the whole project.

In the Brazilian case, where the supply chain gathers numerous companies that vary between very well organised firms to others with a very unstable organisational structure,

supplier development becomes crucial especially for the most “undeveloped” companies. This factor has been realised by some firms that have begun by implementing training programmes for the subcontracted labour.

Similar to what happened in the manufacturing industry, it is also important that the main firm to participate in the development of its suppliers and call them to participate at early stages of the project. In this way, suppliers will be informed of the scope of the project and can give their opinion in order to improve the constructability of the project.

### **ANALYSIS OF THE SUPPLY CHAIN MANAGEMENT**

From the literature review four main key factors in order to effectively manage the supply chain were identified:

- lean designs,
- system reliability,
- supplier co-ordination,
- supplier development.

It is interesting to note that for these factors develop their potential benefits they have to be inserted in an appropriate management practice. Moreover, these points were taken from manufacturing industry, which was basically based in TQM and JIT management practices. Working with them as only isolated approaches to improve construction performance will limit their advantages.

Analysing the Brazilian supply chain management in this industry, we find that it is basically based on a traditional approach but it is in a transition phase. Lean design is beginning to be considered in current practise as a way of obtaining competitive advantage or at least surviving in this competitive environment. In spite of the fact that its implementation is at an initial stage, it has brought about some changes in the structure industry as a result of the appearance of process designers. Some firms are beginning to implement it but they are having some problems because it not only depends on them but also on the designers to change their conception of their work and to be ready to acquire more responsibility than they used to have. Of course, this will involve an increase in the cost of the design, but it is worth if subsequent construction problems are reduced.

The next point system reliability, is a factor that is not touched in current management practise. Moreover, it will be very difficult to be achieved if sites are still managed in the traditional way, focusing on activity performance and not on system performance. A reliable process is crucial for supply chain management success, so it is time that firms began to take this requirement into consideration if they want to improve performance on-site.

Finally, the next items, supplier co-ordination and supplier development, are beginning to be considered by some firms but in a very superficial way and without a context that really favours its implementation. Current management practices normally choose their suppliers by bidding. This makes supplier co-ordination difficult to achieve and in this context supplier development is seen as a cost rather than benefit. However, some firms are beginning to see

importance of other parameters such as quality and punctuality but always within the current management practice that limits the potential of these factors.

## **FINAL COMMENTS**

As has already been mentioned, the Brazilian house construction industry is going through a transformation phase and is trying to find its place in this new competitive environment. A great number of firms are passing from an in-house production to a subcontracted type with the aim of optimising processes and decreasing costs. To effectively achieve this goal, firms will have to prepare themselves to a new conception of management.

Four main key factors have been suggested in order to achieve a lean supply chain: lean designs, system reliability, supplier co-ordination and supplier development. Despite the fact that the Brazilian construction industry still manages its construction in a traditional way and that the full potential of these points have not been explored (indeed, some of them have not been explored at all,) there is some evidence that current management practise is beginning to be questioned.

The fact that some firms are beginning to have a leaner concept of design is proof that there is beginning to be a change of mentality in the industry. Unfortunately a change of paradigms always takes time, but at least the process has already begun and we believe it will bring with it other improvement processes.

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