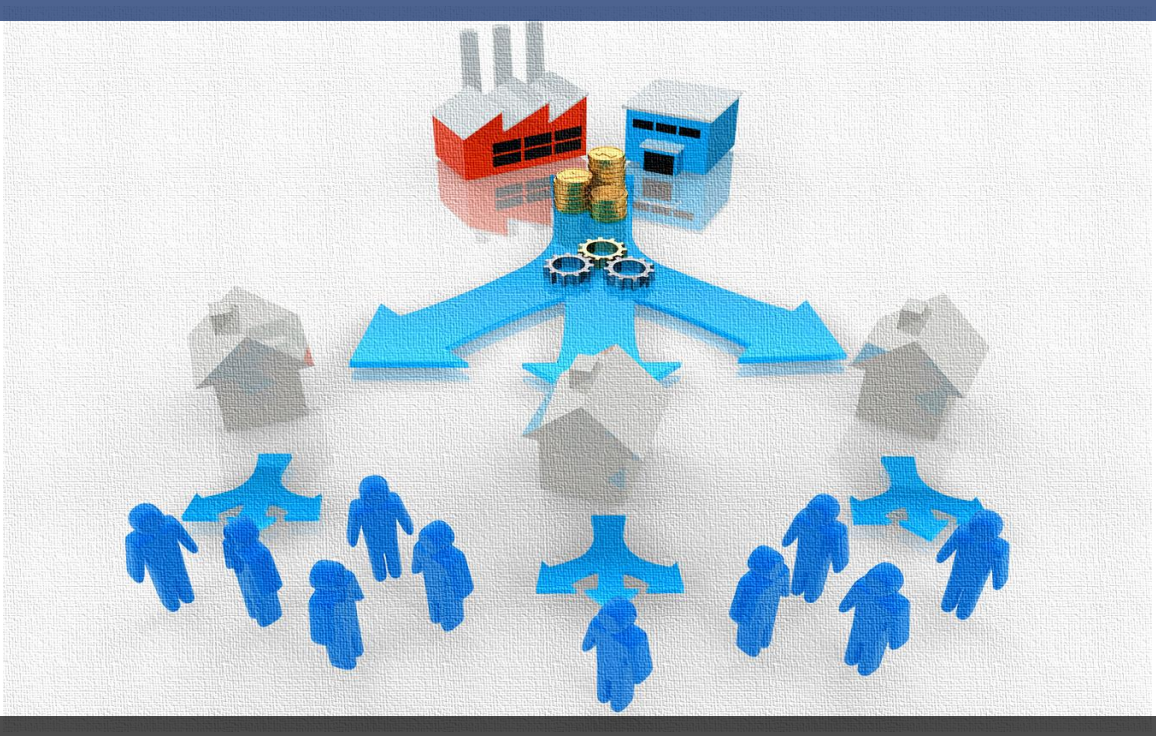


MAX Profit Construction Supply Chains Management

Adriana Mendero and Raju K Mazumdar

This document contains the assessment and Redesign of the current performance of Max Profit Construction supply chains, As well as, detailed strategies and recommendations to improve its current results.

2012

Executive Summary

Max Profit Construction (MPC) has been operating in the construction industry for twenty-five years. Even though, the company was recognized as a leader due to its expertise in traditional construction methods, a fluctuating industry is requiring that MPC improves its current processes, and implements new strategies in order to stay in the market and keep growing.

The goal of this report is to assess the current situation of Max Profit Construction (MPC) supply chain, in order to propose a supply network strategy and consequently improve the overall performance of MP Constructions as well as delivering superior customer value.

Through an assessment of the present Supply Chain structure, potential areas of improvement were identified.

Potential Areas of Improvement	Recommendations
1. Inefficient Communication flow between MPC and Consultants /Lack of integration among key actors and the MPC offices in the different regions	• Implementation of a new ICT technology system in order to communicate • Establish a standardized communication process
2. Buildability problems	Early involvement of key suppliers and MPC in design stage
3. Traditional construction leads to reworks and Quality Problems	Introduce prefabricated elements and standardization of process in order to transfer process off-site
4. Adversarial Relationships/ *No time for innovation/* Charing Risk and Rewards	Implementing strategic alliance with clients, subcontractors and suppliers
5. Waste and problems in MPC Supply Chain	Implementing Just in time Approach (JIT)
6. Problems in make-to-order supply chains	Implement a new cost analysis (break down of costs) Avoid short lead times and panic orders

1. Table of Contents

1. Introduction

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 customer". (Christopher, 1998 p15). The process of managing this Supply Chain is called Supply Chain Management SCM, and it has been best defined as the integration of key business processes from end user through original suppliers that provides products, services, and information that add value for customers and other stakeholders." (Lambert et al, 1998, p.1)

In the last twenty years, the interest and popularity of SCM has gradually increased. Global organizations have understood that in order to face challenges such as risk mitigation, fragmentation, over-costs and disruptions in the supply chain, it is imperative to manage both, their own organization and the relationships between the other members of the same supply chain (Croxton et al. 2001). Likewise, the concept of competition is changing from individual to supply chain success through strategic alliances.

This report aims to improve the performance of Max Profit Construction by implementing the Supply Chain Management strategy into its internal process. This proposal considers: i) assessment of the current supply network, ii) redesign the areas that need to be improved, iii) Controlling and monitoring the supply Chains, and iv) implementing continuous improvement.

Source: Vrijhoef&Koskela, 2000

2. General Overview

The interest in SCM applied in the construction Industry, started from the manufacturing success in resolving industry performance problems. However, the highest difficulty with the practical application was the complex structure of this industry. Projects involve assembling materials and components designed and produced by a multitude of suppliers, working in a diversity of disciplines and technologies in order to produce a product for particular client, (Vrijhoef, R. and Koskela, L. 2000).

One of the general current perceptions of the construction industry is the lack of cohesion and coordination among these firms, as well as the temporary project organization agreements. These have leaded the industry to become highly fragmented. Numerous actors such as specialized contractors, subcontractors, suppliers, distributors, manufacturers, and a variety of construction services integrate the construction network, which in the current scenery of MP Construction; they are separated from one project to another.

Due to the expected development of MPC this year, and the new market requirements, it is imperative that the company introduces SCM practice into its internal process. This Methodology will contribute to understand and solve the current problems in the existing construction supply network. However, The practical solutions offered by SCM, have to be developed in the construction practice, by a highly engaged teamwork.

MPC is based in Brisbane, Melbourne and Sydney. Each company is operating independently without interaction. MPC is currently involved in twenty-fiveprojects both commercial and residential, totalling $2 million dollars. The company's supply chain is integrated by 500 -540 Subcontractors, Distributors and Manufacturers who in turn are formed by large and small firms.

3. Assessing the company's process

3.1 Traditional procurement method

The *traditional procurement* method used by MPC has important features, (Fig 1). Firstly, the main contractor and Consultants are chosen by the client through a competitive tender process and secondly, the design must be fully completed before the construction phase starts.

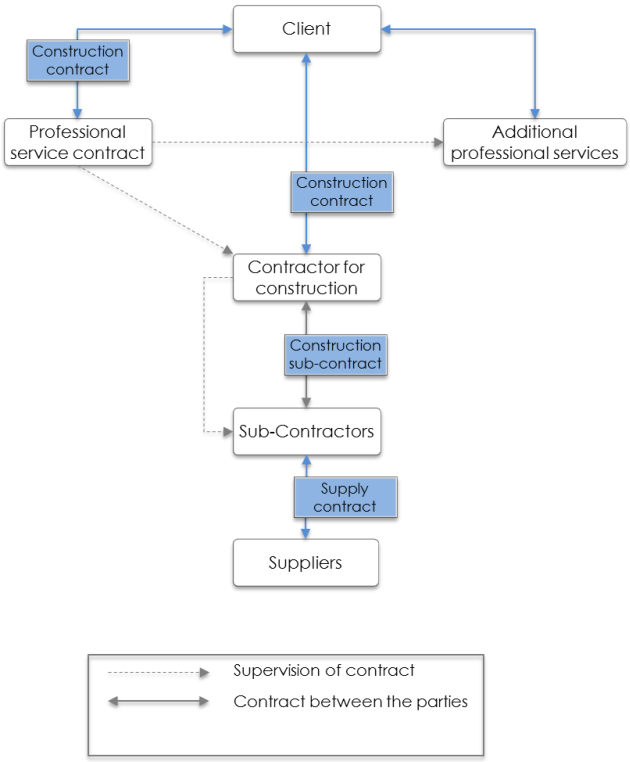


Figure 1 Traditional Procurement Process
Source: Greenhalgh, Brian; Squires, Graham (2011)

3.2 Separation between design and production

The main disadvantage of this procurement method is that the design is quite separated from production, hence neither MPC nor Suppliers, are involved during the design and planning stage. (Morledge, R. 2013).

This could cause poor project definition. According to Keith Potts (2008), the lack of involvement of the contractor during the design stage could result in an unclear scope, unrealistic targets, inefficient risk assessment, ineffective leadership, poor communication, ineffective stakeholder management and reworks during the construction stage.

3.2.1Communication flow between MPC and Consultants

Another drawback is the lack of communication between consultants main contractor, Suppliers and consultants. According to Morledge, R., the success in this procurement method mainly depends on the design professional's skills at administering the contract, consequently if that skill fails, the Main contractor cannot do too much to improve the project results.

3.2.2Buildability problems

MPC has found serious buildability problems during the construction stage, as the design mistakes have to be solved during the construction phase, which is time consuming and costly. Changes in the design, when the construction stage is already started, have strong impacts in the project results and efficiency. Schwarzkopf W, and McNamara J, (2001), points out that the effect of these changes on labor productivity means a **30 percent loss.**

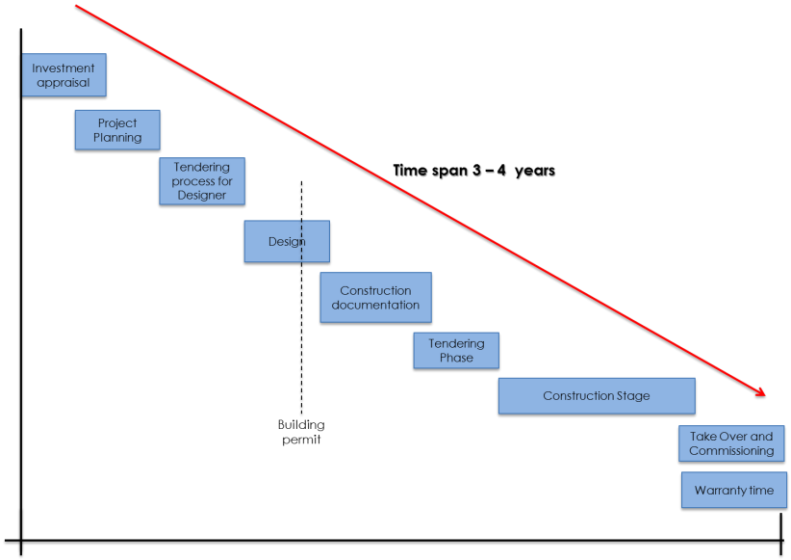


Figure 2. Time Span / traditional procurement method.

3.2 Competitive tendering

This method is broadly used in government and privet organisations. Its main objective is to force suppliers to compete and therefore, the client will obtain superior "value for money". However, it does not happen in real life.

One of the main bottlenecks detected in the supply chain map is the selection process of suppliers and subcontractor. According to Murray B (2011), there are many disadvantages of using Competitive tendering method. The most important are:

3.2.1 Lack of integration between suppliers and MPC:
As they are employed on a project –by –project basis, the uncertainty in obtaining continues work is always present, as suppliers are changed from one project to another.

3.2.2Limited communication: Limited communication between client and suppliers during the tendering process.

3.2.3Possibility that not always the leading suppliers tender: The client can only evaluate bids from firms who do tender. Consequently, if leading suppliers do not tender, client could end up buying an inferior service and product.

3.2.4The pressure to keep costs down to get the profit margin could lead to use cheap and poor quality materials or labor.

A case of study explained by Vrijhoef, L (2000), shows the extra costs compared to the market price and purchase price. It resulted that many low prices have an extra costs from **around 40%.**Figure 3 shows an example in 'material 27' where the total **price increased around 50%** due to manually transportation and waiting time.

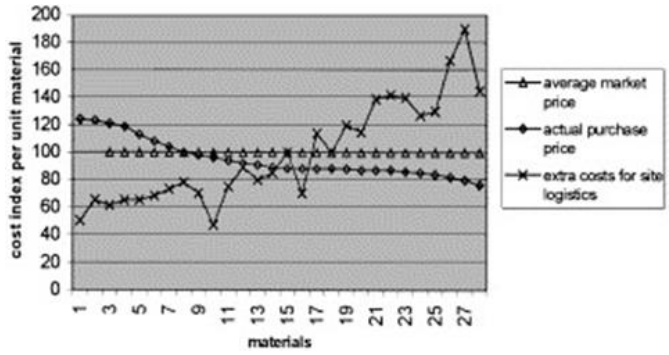


Figure 3 Cost and Price analysis of building materials
Source R.Vrijhoef. L. Koskela (2000) pg 174

3.2.5No time for Innovation: Deficient profit margin which could be invested in research for innovation, product development, and peak technology. This difficulty is also related to the fragmentation of the supply chain (See supply chain assessment) in which the efforts and innovation initiatives are segregated among the complex organizational structure, resulted in a lack of time for 'continuous improvement'.

3.3 Traditional construction method

Traditional construction process, involves on site fabrication which means that we are occupying large on site spaces and materials. The company also have reported serious quality issues after the delivery of the project which has caused substantial lost.
On site manufacturing is hard to be controlled as they are not standardized and mainly depends on labor skills. This resulted in the need of an exhaustive quality control system, which could be time consuming and in some cases ineffective.

4. Current Supply Chain Assessment

Figure 4, is the visual representation of the main actors involved in the current supply chain structure and their interaction in terms of materials, information, processes, and money flows, both upstream and downstream

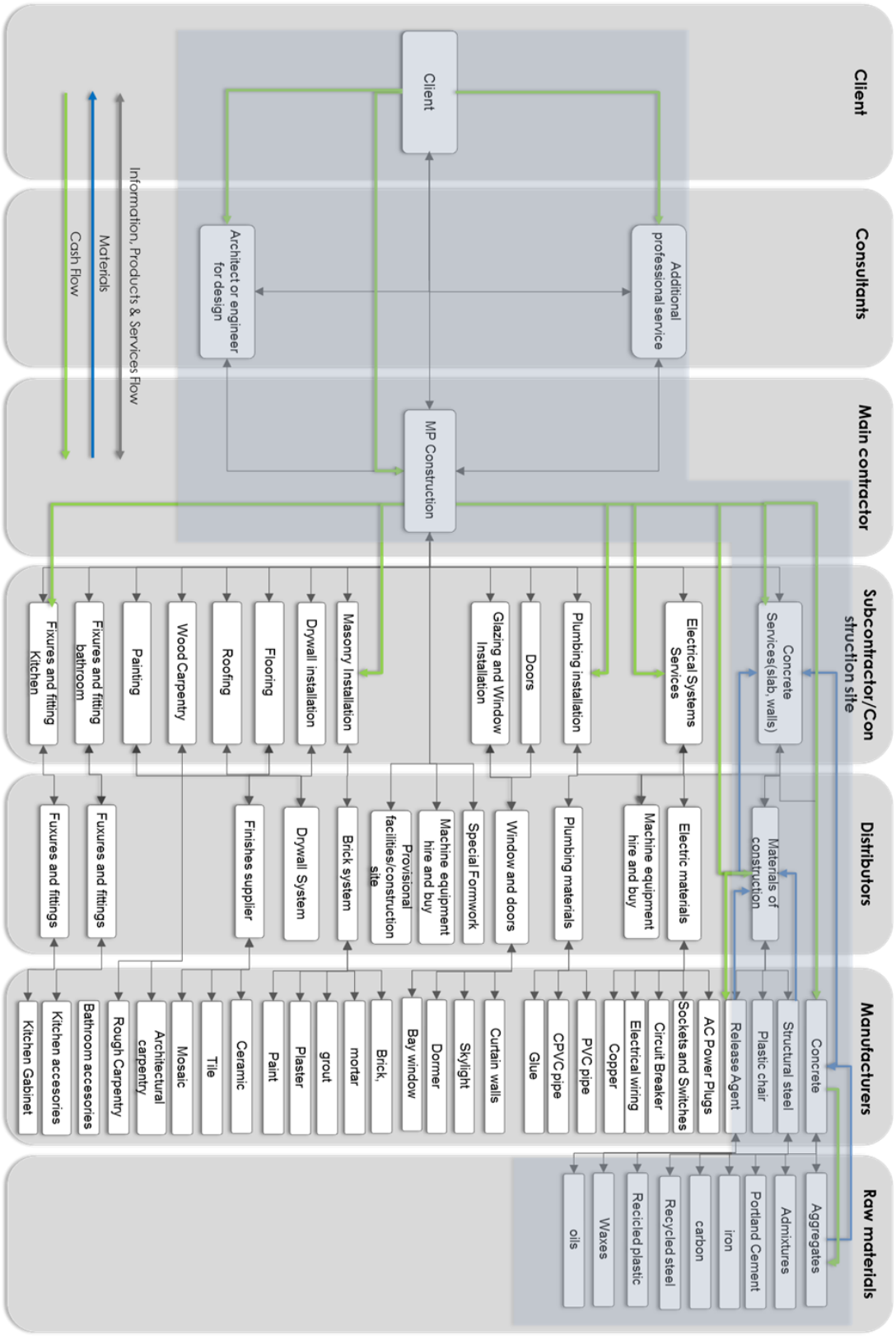


Figure 4 Current supply chain map

4.1 Detailed Supply Chain – Steel

Figure 5;explains the main nodes through the supply chains. Firstly, It shows the lack of communication between the MPC offices, which leads to a lack of information sharing and consequently lack of feedback. Secondly, the separation between construction and design results in communication and buildability problems. Finally, it has found that each office has at least three subcontractors and more than six suppliers from the same speciality; some of them are medium and solid firms who have the proper installed capacity to acquire bigger contracts.

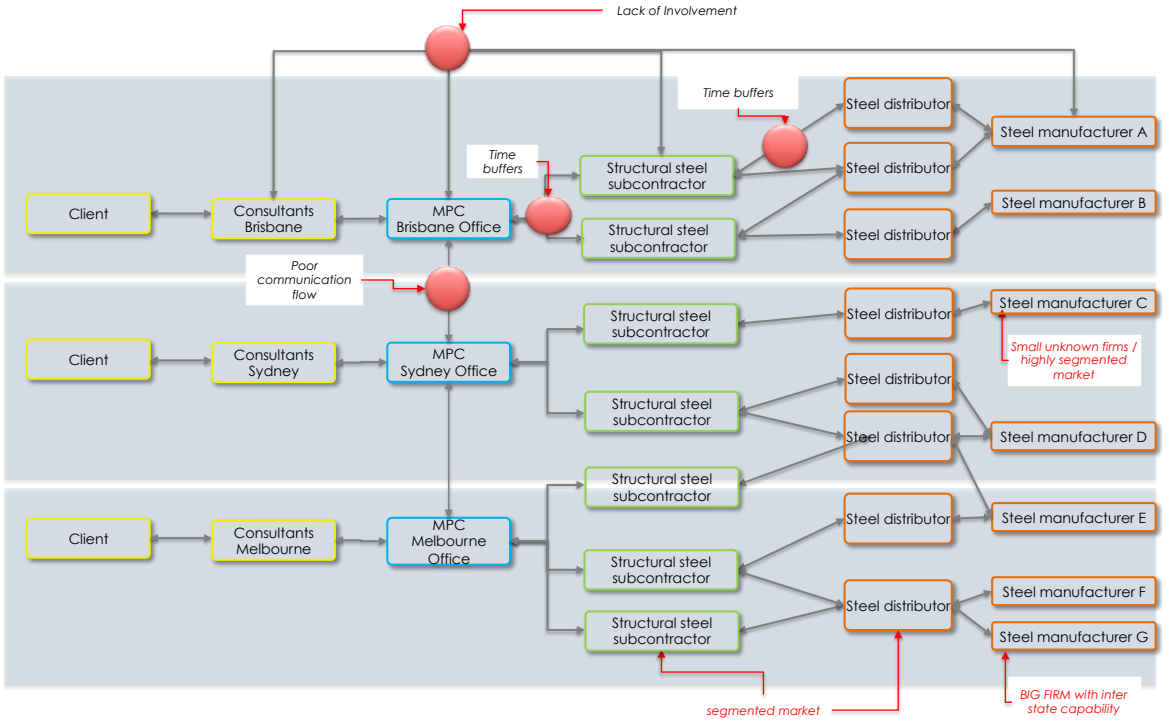


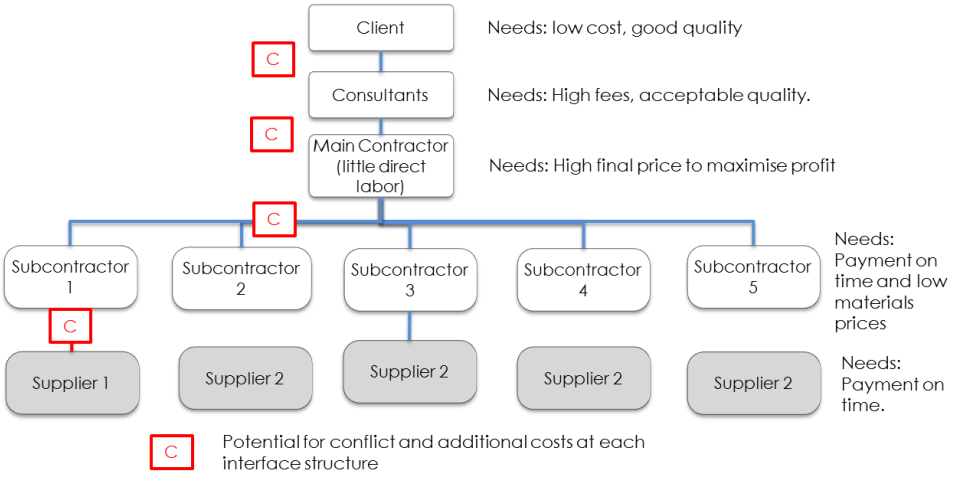
Figure 5 Detailed Supply chain map – Hydraulic System

4.2Fragmentation of the supply chain

An important problem detected, is the extensively large use of subcontracting composed by small firms with not much vertical integration. Additionally, each subcontractor uses different Supplierssegregated in Sydney, Melbourne and Brisbane, which helps to fragment even more the current supply chain. According to Pryke, S. (2009), the later fact causes significant transaction volumes of operations, but uncertain value of money resulted in each transaction.

4.3Adversarial Relationships

As a result of a fragmented supply chain, there is a lack of communication among the main actors, which could result in lack of confidence.Pryke, Sargues that each actor has his own goals and objectives, which result in several points of tension and conflict. This could cause a reduction of efficiency of the entire network.



Souce Pryke S, 2009 from the source Cox and Townsend (1998, p. 33).

Figure 6 Adversarial Relationships

4.4Amount of Charing Risk and Rewards

Without a SCM, each Risk and Rewards throughout the Supply chain is visualized separately, (Pryke S, 2009). This means that each actor tries to maximize their ownbenefitswithout taking any risk. Hence, mutual gains negotiations approaches are hindered by the approach of passing risk down to the next level in the supply chain.

One of the main consequences of not Charing the risk across the supply chain is to gain a bad reputation not only for subcontractors and suppliers but also for MPC.

4.5Wasteand problems in MPC Supply Chain

The lack of coordination as a result of a poor communication has resulted in various interfaces across the supply chain. These have caused tension and conflict, which eventually leads to increase cost and reduce efficiency particularly due to delays.

Vrijhoef, L. (2000), shows a case of study mainly focused on the performance of a construction supply chains in terms of waste of resources.

The results of the first research, shows that time buffers seemed to be mostly situated at the beginning and end of each sup-process. This was mostlydue to an imprecise and insufficient pre-planning coordination and inter-organizational difficulties (Figure 7). Almost every actor across the supply chain considers a time buffer to itsprogram;this action increases the total time of the project. (Vrokjpef, 2000)

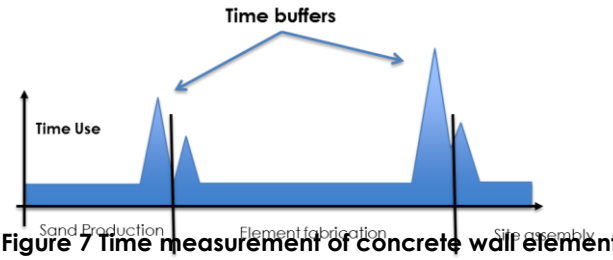


Figure 7 Time measurement of concrete wall elements

Source: R. Vrijhoef, L. Koskela European Jornal of Purchasing & Supply Management (200)pg 174

Figure 8 shows that the value-added time is just **0.3%-0.6%** of the total flow time; this consequently has a strong impact in final cost.

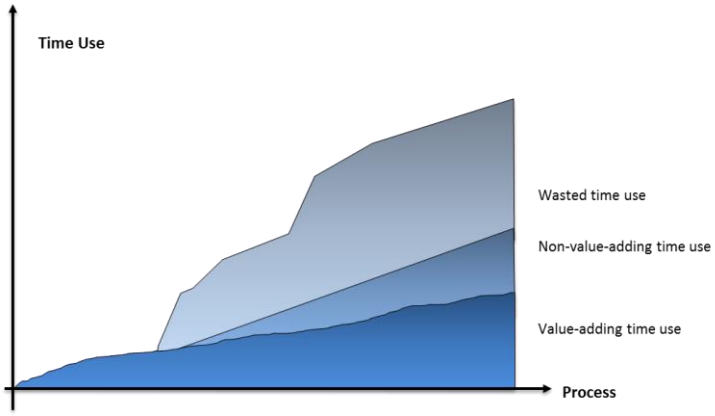


Figure 8 Time measurement of concrete wall elements

Source: R. Vrijhoef, L. Koskela European Jornal of Purchasing & Supply Management (200)pg 174

4.6Problems in make-to-order supply chains

A research carried out Koskela and Leikas (1997), shows that the incidence in which important information is missing during communication flows such as incomplete design data and confusing design specifications.

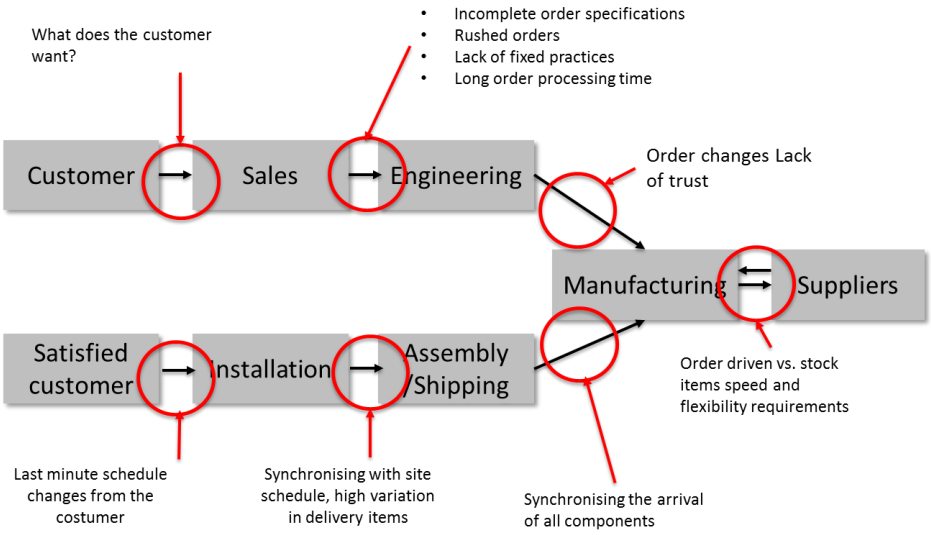
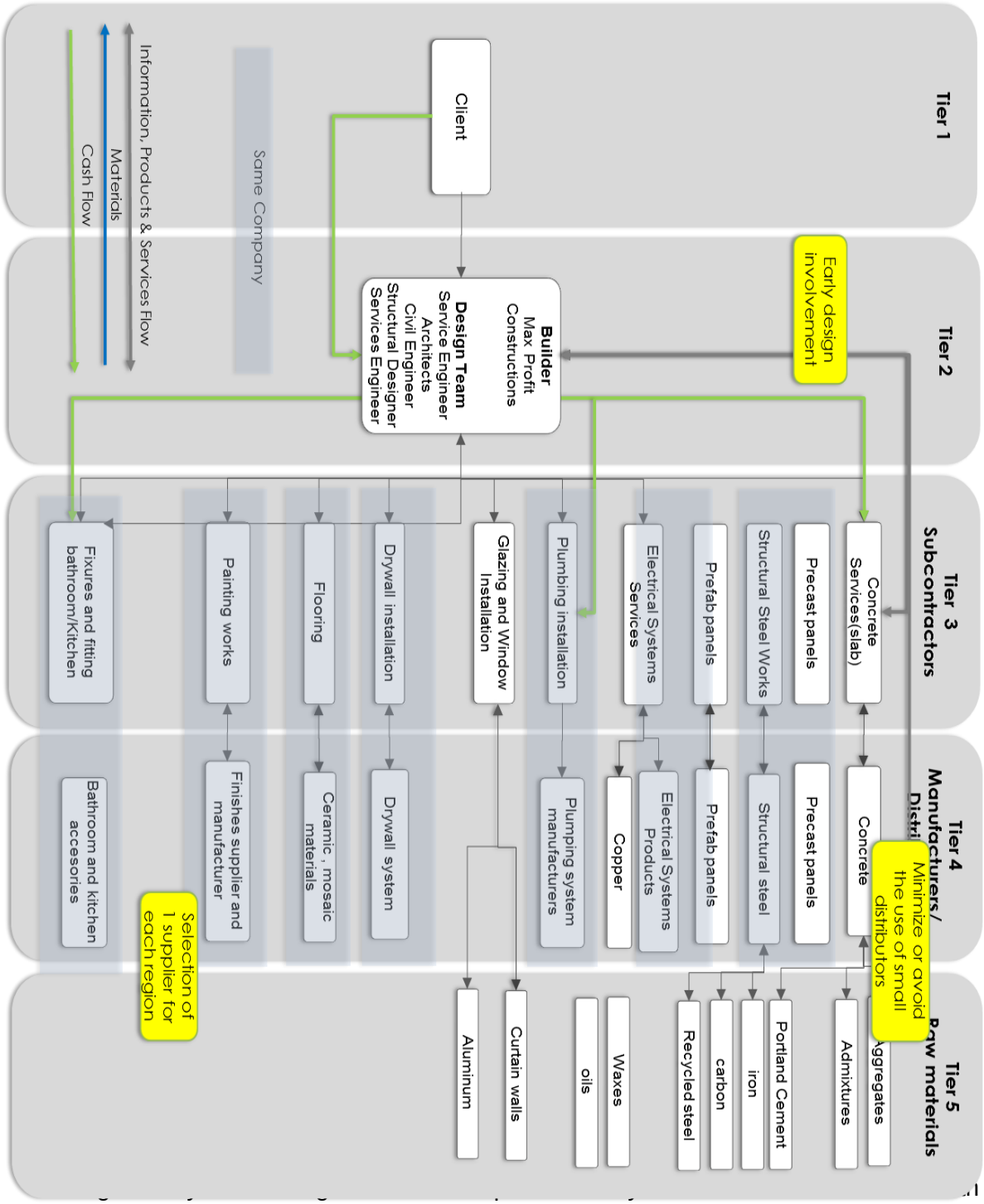


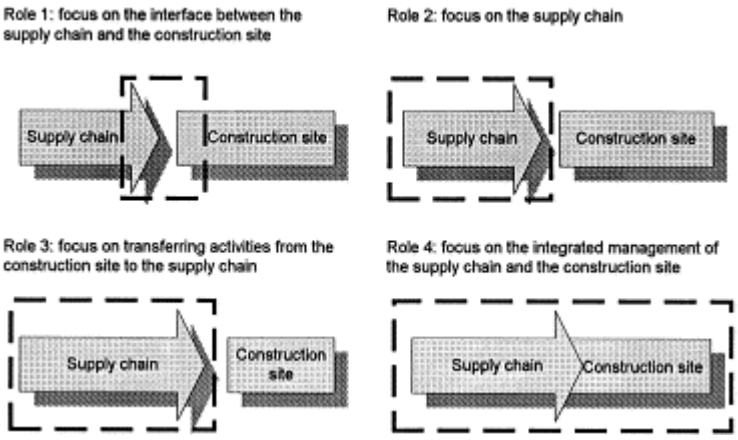
Figure 9 Summary of common issues in make-to order Supply chains Source (Luhtala et al., 1994).

5. Redesign and proposed solutions

In order to minimize and eventually eliminate the potential areas of improvements described above, it is important to manage effectively our supply chains. This includes, redesign and integrate the current supply network, review and redesign procedures, and redistribute roles, tasks or/and responsibilities among the main actors. The implementation of this process needs to be started and leaded by MPC who would be the coordination actor between suppliers and client.



the aim to involve each part of the process.



5.2 Role 1. Focus on the interface between the supply chain and the construction site

This first role aims to solve issues of the supply chain that impact on site activities. This means to be aware and mitigate the potential situations that can delay the project, caused by the materials supply or labor.

5.2.1 Purchasing Process Reorganization

Integrated Costs: This means to consider variables such as handling costs, quality waste and loss into the material price.As we discuss previously, one of the main problems with competitive tendering is the pressure to keep costs down without considering important logistic variables. MPC needs to adopt a more integrated processes across the supply chain (see alliances 5.5.2)

Material Flow Planning: Avoid short lead times and panic orders. According to Horstaann, 75% of the total value of a construction project is subcontractors and materials. If the company guarantee coordinated planningbetween suppliers and subcontractors this will result in significant cost reductions.

Break down of costs: Implement a new cost analysis considering two factors, the factory costs (fixed price) and “other” cost incurred outside the factory. (case study Skanska and Rockwool)

According to a case of study conducted by a company called Skanska and Rockwool, this concept was successfully implemented. By clarifying the logistic costs, they could systematically reduce them through better coordination with their key suppliers.

5.2.2 Implementing Just in time Approach (JIT)

Just in time is Programing the adequate materials in the right time at the right place. (Low and Chan, 1997).This could be reached by synchronise subcontractors, design, production and construction, having the right communication and focus on the critical path activities.

The JIT framework in off-site prefabrication, was developed by Low and Chan (1997). The same framework was adopted in construction in order to achieve uninterrupted on site processes.

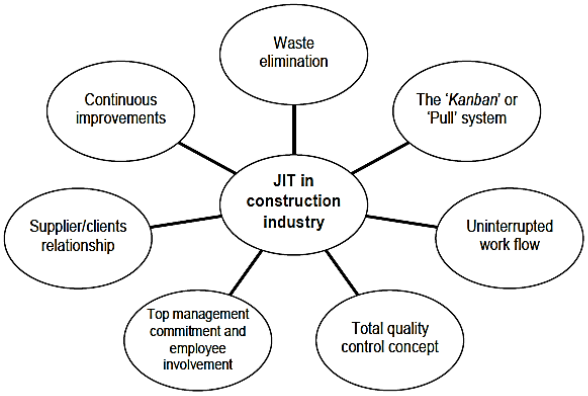


Figure 10 JIT Framework for the Prefabrication Industry
Source :Pheng, L.S. and Shang, G. (2011)

A case of study carried out by Jarnbring (1994) shows that the interface between the contractor and suppliers has a **cost reduction potential of 10%** (regarding materials and costs). This could happen through the improvement of logistical procedures.

Benefits
Terminal 5 The Case Study shows substantial benefits by applying JIT

- Reducing space for inventory or / over inventory
- Productivity levels increased from **55-60% to 80-85%**
- Reducing waste
- Reducing transport

Barriers

- Some of the barriers showed by Pheng, L.S. and Shang, G. (2011) were:
- Cost of implementation
- Cost of technology investment and maintenance
- Market conditions
- Culture.

5.3 Role 2. Focus on enhance and develop a specific supply chain

Develop our strategic suppliers by understanding what they could offer and how we can make the best of it. Vrijhoef, R, and Koskela, L, (2000), explains that it is important to analyse in depth cost and time of an specific supply chain, in order to find potential areas of improvement.

For instance, the supply chain of reinforcement steel,which was assessed previously, shows that MPC needs to identify the suppliers and subcontractors based on their capability to provide multiple products and/or service. Doing these, MPC will be able to categorize its key suppliers and subcontractors in order to know what supplier

could satisfy our need and make more profitable negotiations from both the supplier and MPC.

In a case study carried out by Casas GEO a housing developing company (2007). The director of the purchasing department started implementing SCM for specific products. One of which was the expanded polystyrene (see appendix 1), this product was used as a roof and external walls. The company realized that the current suppliers were formed by around 20 firms, both big and small. However, just three of them had inter-states capabilities and were able to develop more interesting products for casas GEO. The company developed this specific supply chain, and the general savings were**10% of direct cost reduction**and **15% indirect cost reduction.** (H4 Consultants, 2007)

5.4 Role 3. Relocate activities from the construction site to the earliest stage

This means to integrate prefabricated elements or industrialization approach into our current construction methods.

5.4.1 Product Standardization

Davies (2009), argued the importance of setting out standardized process in order to improve the project results. Even though every product has different features, processes can be standardized in order to improve its performance. This replication needs the use of learning from previous experiences.

Standardization depends on what extent activities can be simplified and repeated and must be implemented during the design stage by designers and builders.

5.4.2Offsite pre-fabrication

During the construction of Heathrow Airport Terminal 5, the offsite prefabrication was a significant success factor. One of its key suppliers assembled 60% of the services offsite, using modular systems, Pryke S, (2009).
Benefits obtained

- The components in efficient and safe factories
- Quality improvement
- 5% of waste reduction
- 50% of Labor Reduction
- The company could deliver the project six months earlier.

5.5 Role 4Focus on the whole supply chain in order to generate an overall improvement.

This rolesuggests to firstly understand the client's needs, and secondly to propose better solutions by integrating the knowledge and technology of each member of the supply chain.

5.5.1 Early involvement of key suppliers in design stage

The early involvement means to involve people with broad construction knowledge in the early design stage. Iansiti (1995), explains that Clients, designers and general contractors must leverage their experience by inviting sub-contractors and suppliers

to participate in a 'design-assist' role. It means that highly professionals of selected specialities are invited to participate in early design meetings.

This design build team will help suggesting alternative design solution, comment on the buildability of the existing project, and propose strategies to save costs. Participation in these meetings also gives the chance to know the team that will be working with MPC during the construction stage.

By implementing this strategy the communication between main consultants and builders is improved and buildabilty problems produced during design stage will be avoided. This strategy will also encourage suppliers to work together in order to come up with innovation and cost saving strategies.

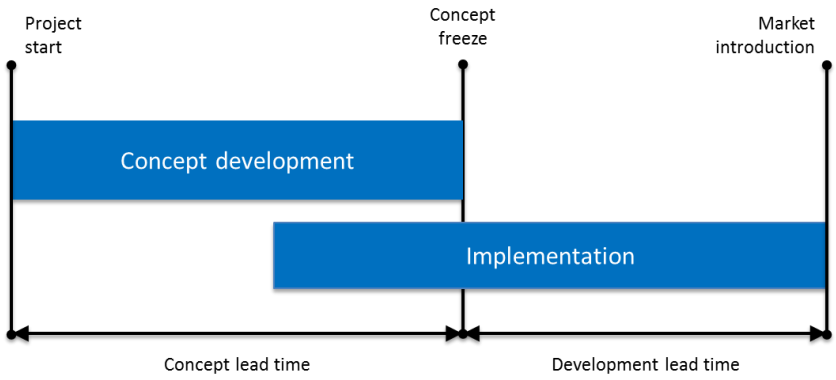


Figure 11 Model of effective Product Development
Source: Iansiti 1995

5.5.2 Strategic alliances& Partnership

According to Lambert et al. (1998), Integration of our supply chain aims to improve our process efficiency across main actors of the company's supply chain. Strategically speaking, it means to share resources, benefits and risks. This approach requires a high level of collaboration between the members of the different firms, acting as one big entity.

Firstly, it is important that MPC evaluates subcontractors and suppliers based on:

- Previous performance
- financial stability
- Installed capacity
- Reliability
- Years that have been working with MPC

Once we have identified our key suppliers the next step is to establish strategic alliances with them.

A Key factor of strategic alliances is to have an **efficient communication** across the network. The information that must be communicated is: Plans, specification, orders, process, Knowledge, performance, feedback, invoices, tender documentation contractual terms and construction information.

In order to improve the communication flow it is imperative that MPC undertake the following actions:

- Set out a standardized communication plan and process
- Establish communication protocols

- Investment on IT platform shared among companies

Case Study
The Skanska's and Rockwool's partnership agreement was based on trust. All information including costs, process and knowledge had to be revealed in order to enhance efficiency and diminish costs.

An important action implemented by them was Skanska's committed one of its employees to work with Rockwool with the aim to find potential areas of improvements in their operation.

One of its main results that helped to reduce the fragmentation of the supply chain was:

- Retailers before Partnership: 1000
- Retailers expected after Partnership: 70-80

A Best practice showed In the Heathrow Airport Terminal 5 (T5) project, was called 'buy club'. They identified the main three Mechanical and Electrical contractors and sourced all specialisations on one supplier. This ensured the quality of the project and guaranteed an excellent value solution.

Main Benefits

- **10%-30% Cost Savings**
- Early involvement of the suppliers in the design stage
- Issues founded before construction stage
- Reduce accidents on site
- Simplify the supply chain
- The Tender evaluation mark 5% for environmental problems

Another Best practice implemented by British Airport Authorities during the construction of T5 was the creation of "teamwork, trust and commitment" this tactic created an atmosphere of equality, as well as, a culture of innovation, which resulted in cost reduction and increased productivity.

Barriers

The barriers that MPC could found could be:

- Lack of trust and understanding between companies
- Lack of credibility
- Communication Barriers
- Lack of openness between main actors
- Different cultures, for instance, alliance between a local and overseas company

6. Control

6.1 Communication Technology

"When performance is measured, performance improves. When performance is measured and reported, the rate of improvement accelerates." Fawcett and Mangan (2004).

MPC must to install a mechanism to assess the performance of the supply chains as well as, to understand the performance of the company. This tool should be able to measure and estimate waste and report useful information to evaluate important problems.

In the Skanska and Rockwool case of study (2003)the implementation of an Electronic Data Interchange (EDI) was critical in order to develop the purchasing process.
They found essential the use of EDI to provide up to date requirements data and to meet the overall schedule

In the Case Study on Heathrow Airport Terminal 5, they used innovative performance software called CALIBRE, which facilitated up-to-date information. It also allowed the managers to check on site performance with productivity indicators.

Barriers

One of the barriers that can be presented could be the high acquisition cost of this platform for MPC, subcontractors and suppliers. This barrier could be overcome by presenting the expected benefits after the implementation.

6.2 Evaluate Key Performance Indicators (KIP)

KPI must reflect the critical success factors of the company and must be measurable. The company has different Key Performance Indicators of Cost, Time and Quality. Three of which are Tender sum versus final account, meet the milestones as per programme,and ensure ISO standards. This Indicators need to be periodically measured, through ongoing evaluations across the supply chain.

In order to collect updated data and evaluate KIP, it is significant to carry out the following activities:

1. Setting out current process in order to identify how information is flowing and the time resources are needed.
2. Identifying and setting out responsibilities between the personal of each firm in order to clarify communication and particular activities
3. Set out periodically workshops between our strategic supply chain, either for specific training, or information sharing.
4. Weekly meetings with key subcontractors
5. Compare actual progress vs. planned progress
6. Daily control boards to measure the work schedule, quality and JIT deliveries and highlight waste and progress.

7. Continuous Improvement

The first step to improve the performance of MPC is to carry out ongoing evaluations. This will allow us to constantly find new initiatives to improve the supply chain.

It is also important to start “interest teams”, in order to review working process and find potential areas of improvements. This group must be carried out by key subcontractors, suppliers and clients through periodic meetings which aim to:

- Focus in a particular problem and find potential solutions
- Share particular experience and knowledge
- Report current performance and improvements

Case Study

The British Airport Authority, during the construction of Heathrow Terminal T5, set up a solution team in order to review current methods that involved the contractor, the client and consultants. The main objective was to work together in order to minimize on-going problems and a no-blame culture. This best practice helped BAA to develop strong relationships resulted in cost reduction and improvement in quality and efficiency.

Training

Once the strategic alliance between main actors starts, MPC must lead the organization of short training course and workshops. Some of them should be prepared by specialist subcontractors to the designers with the aim to avoid common mistakes during design specifications. Others should be given by the suppliers for the subcontractors with the aim to avoid common mistakes during the installation on site.

It is important to identify the needs that the personal of different departments have in order to organize either formal training or workshops to cover those gaps.

8. Conclusions

Supply chains Management is a relatively new topic in construction Industries. In recent years, it has been identified as one of the areas with most potential development in the construction Management field.

Based on the case studies presented in this report, implementing SCM could be the difference between achieving project goals or having important economic losses. For that reason, PCM has been used in manufacture industries for a long time as an everyday process. Contrarily, in construction, which is one of the most risky industries, this field of study is not totally implemented.

In order to have a solid company with a structured growing it is imperative that MPC apply SCM into its process. The supply chain of the construction industry, which in the case of MPC is formed by more than 450 actors, cannot act separately. The only way to improve the productivity and consequently the results is to work with key subcontractors and suppliers in integrated project teams always considering that everybody needs must be addressed to achieve the project goal in time, cost and quality.

There are some barriers that MPC will find by implementing SCM; however, these changes will be outweighed by the expected benefits.

9. References

Christopher, M, 1992, *Logistics and Supply Chain Management: Strategies for Reducing Costs and Improving Service,* Pitman Publishing, London, UK.

Deming, W.E. (1994). *The New Economics for Industry, Government, Education, 2nd Ed*., Cambridge: M.I.T. Center for Advanced Engineering Study.

Greenhalgh, Brian, Squires, Graham, 2011, *Introduction to Building Procurement* ,Taylor and Francis, New York.
H4 Consultants, (2007), Case Study CASAS GEO, Supply Chain Management, Mexico DF, www.casasgeo.com
Contact Names: Ing. Javier Zuñiga Conde Tel 52 55 5480 5000, Arq. Ana Maria Navia Tel 52 55 5480 5247

Iansiti, M. (1995) "Shooting the Rapids: Managing Product Development in Turbulent Environment" *California Management Review*, 38 (1) 37-58

Jarnbrig, J., 1994. Byggarbetsplatsens Materialflodeskostnader (Material Flow Costs on the Building Site) Lunds Tekniska Hogskola, Lund

Lambert, D, 2008, *An executive summary of Supply Chain Management: Process, Partnerships, Performance,* Jacksonville: The Hartley Press, Inc.
Low, S.P. and Chan, Y.M. (1997). *Managing Productivity in Construction JIT Operations and Measurements.* Brookfield,

Morledge, R, 2013, Building Procurement, Published Chicester Wiley.

Pheng, L.S. and Shang, G. (2011) The application of the Just-in-time philosophy in the Chinese construction industry, Journal of Construction in Developing Countries, 16(1), 91-111.

Pryke S, 2009, Construction Supply Chain Management, Wiley
Robert Crawford (2013) Seminar Notes of the class Supply chain management.

Schwarzkopf W, and McNamara J, 2001,*Calculating construction Damages, Second Edition,* Aspen Law & Business.

Stock, J, and Boyer, S, 2009, Developing a consensus definition of supply chain management: a qualitative study. *International Journal of Physical Distribution & Logistics Management,* 39, (8), 690-711.

Vrijhoef, R, 2011, *Supply chain integration in the building industry: the emergence of integrated and repetitive strategies in a fragmented and project-driven industry*, Amsterdam:IOS pressVt: Ashgate Publishing Co.

Vrijhoef, R, and Koskela, L, 2000, The four roles of supply chain management in construction. *European Journal of Purchasing & Supply Management 6*169-178.