



HOCHSCHULE FÜR UNIVERSITY OF
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Summary of Masters Thesis

Masters Degree

International Project Management

In the Building Process Chain

Implementing Lean Construction in Germany: A Case Study

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Introduction

The downturn of the construction sector in the past decade confronted the industry with severe economic problems. Many jobs became redundant as a large number of companies closed down and released their workers. On the other hand, the industry is rated as backwardly oriented and adversarial to innovation (Egan, 1998). In fact, the way most companies reacted in the crises was to decrease the number of employees and increase the amount of subcontracted work. However, there is a broad body of research in how to increase efficiency and effectiveness in the industry. One school of thought is to perceive construction as production by projects adopting tools that were developed for the car industry to construction; this approach is widely known as lean construction (Koskela, 2000). As researchers mostly agree in its theoretical potential, there are few cases that provide empirical evidence of its effectiveness (Salem et al., 2006, Ballard, 2000). While lean construction is well established in the Anglo-Saxon countries, in Scandinavia and South America, however it is hardly known or subsequently implemented in Germany (Johansen and Walter, 2007).

Research Question and Objectives

The scope of this masters thesis is to apply lean practices to a German construction project and to critically evaluate the use of the measures and their further implications for both project delivery and outcome, it aims to evaluate to which extent the lean practices lead to improved processes that in turn produce desirable and measurable outcomes. Hence, the following research question was arrived at:

How does the implementation of lean construction practices affect execution and result of construction projects?

Any evaluation of business processes takes into account measurable outcomes and results. Thus, the research objectives were to critically evaluate the effectiveness and efficiency of the chosen methods. On the other hand the success of a project often is reliant on organisational factors which build the structural setting of the venture and to the same extent it is dependent on the people within and surrounding the project. Thus, the research aimed also to assess “hard” as well as “soft” factors for success.

Literature Review

The term “lean” was introduced by MIT researchers Womack, Jones and Roos (Womack et al., 1990). In their study of industrial competition in the car industry they suggested that the way of producing cars at Toyota was a distinct kind of production. The study was followed by “Lean Thinking” (Womack and Jones, 1996) a book which presented the principles and basic concepts behind the Toyota production system and proposed to extend them to the entire enterprise. Koskela (1992) transfers the

principles of lean production to construction. Mainly the two concepts of total quality control and just-in-time are in focus, but also related concepts are considered e.g. employer involvement, continuous improvement, benchmarking, concurrent engineering, value based management, and visual management. The lean approach differs from traditional production philosophy in terms of its production activities, which are conceived as flow processes of material, information, work and other resources. Continuous improvement of all processes helps eliminate waste and generate value for internal and external customers. Periodical innovation and implementation of new technologies may enhance the efficiency of the flow processes. Table 1 gives an overview on the generic parts of lean construction theory according to Koskela (2003). The practical considerations of how to apply the principles of lean production to specific construction requirements led to the development of a construction control system called “Last Planner” (Ballard, 1994, Ballard, 2000) and the “Lean Project Delivery System” (Ballard and Howell, 2003).

Theory of Lean Construction		
Theory of Production	Peculiarities to Construction	Theory of Management
1. Transformation 2. Flow 3. Value Generation	1. One-of-a-kind Projects 2. Site Production 3. Temporary Multi-Organisations	1. Design of a System 2. Operation 3. Improvement

Table 1: Theory of Lean Construction according to Koskela (2003)

Methodology

As the cause and effect view of the rationalist paradigm seemed too narrow and not reflecting multifaceted construction management settings, interpretivist methods have been applied which are concerned with meaning rather than causalities. Meaning should be created and managed between researcher and practitioner in an iterative process with the identity of the researcher as an integral part of the research. In order to constitute theory under participation of the researcher a case study method (Yin 2003) with an action research approach has been chosen. The strength of this approach lies in its potential to make scientific contributions and deliver important practical results that would not be available through other strategies (Whyte 1989). The data collection strategy of this thesis comprises of three different stages according to the respective phase of the project. In the phase of project inception it was important to get an overview over the topic, thus information was collected through unstructured interviews with participants of a former lean construction project. During

implementation and project execution, information was collected with participant observation and the recording of performance indicators. Towards the end of the project a number of semi-structured interviews were conducted with managers and foremen of the most important subcontractors and with the site manager.

Discussion

The main goals were to achieve improvement of site operations and logistics, reduction of mutual constraints between the subcontracting firms, and improvement of quality and schedule adherence. As a part of the visual management, several plans were designed for each floor dividing the floor space into managerial units. These floor plans were displayed at the entrance hall of each floor; hence the workers could easily find the particular work place. The process of work levelling was executed using a so-called Heijunka-box, a tool widely used in production planning. The work assignments were determined during weekly meetings with the representatives of the firms and the site manager. The next week's work was discussed, constraints, connections and dependencies were assessed and finally "Kanban" cards with all relevant information were put in place at the box. With this system it was possible to control whether the work was done at the end of the day, and it allowed collecting information on how reliable a firm worked regarding schedule and quality. The results were discussed at the beginning of the weekly meetings and displayed in charts at a bulletin board in the meeting room where they were visible for everybody. The actual measures were as follows.

- **Pull Driven Management**

A main issue of lean construction is the utilisation of flow principles. The basic means to achieve flow is to pull resources when they are requested. The most important tool to facilitate the pull principle was the Heijunka-box. With the box it was possible to determine the work assignments in the right sequence with the right timing. Daily work packages were determined and the dependencies between these packages were visualised. To pull means bringing the right part in the right amount in the right time to the right place, thus the pull principle is prerequisite for any just-in-time management. Yet it is not limited to the work-flow, it also takes into consideration the allocation of any other resource e.g. information or materials.

- **Weekly Meetings and Communication**

Part of the initiative was a routine of weekly meetings with all relevant persons where the work packages were determined, all other issues were addressed and solutions for problems were to be sought. The interactive nature of the meetings was accentuated by the fact that there were no chairs in the room, thus all participants were standing.

One reason to organise the meetings that way, was that the active participation underpinned the firms' commitment to the agreed tasks. Not only the awareness for the issues of the other firms was in focus, it was the communication on the site that needed to be supported. The experiences from this case study suggest that lean construction aims not to replace communication, rather communication is an integral part of lean construction.

- **Visual Management**

To achieve better productivity, the flow principle is dependent on a steady and reliable performance. It is not decisive to strive for the highest output at any time; rather it is important to improve output reliability. It is equally important to measure and document the output performance, using the collected comparable data as basis for further improvement. In the underlying case the practical application of this principle employed the Kanban-cards and the Heijunka-box. Concerning the measurement of output performance the cards were used to collect information of quality and reliability of the executed work assignments. From the information it was possible to identify problems at an early stage, to analyse and avoid them in future. Equally important was the intention that no error should pass into the next process where the effort for rework would have been higher and subsequently the work-flow would have been interrupted.

Conclusion

Construction is a wasteful business. Most construction sites are stuffed with material, machines and garbage. And the construction processes are full of waste too. Lean construction aims to reduce all kinds of waste, and therefore helps to achieve better results. The applied techniques in general proved to be effective for a complex construction project. Despite of major disruptions the project was finished on time, on budget and to the demanded quality. The weekly meetings turned out to be effective to improve communication on site and helped to raise the level of commitment to fulfil the assigned tasks. Together with the pull driven scheduling, the meetings accounted for the reliable planning of the work assignments. Lean construction is a method that relies to the greatest extent on comprehension and communication between all involved parties. Main area for improvement and a field for further research is the contractual basis for lean construction. The transactional nature of the contracts proved to be a main barrier for lean processes. Also the legal consequences of lean construction regarding the German Civil Code (BGB) and the German Building Code (VOB) need to be researched. The necessity to improve construction processes is unquestioned. To achieve improvement by the consequent reduction of waste seems a viable solution.

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