

Lean Construction in Denmark – a brief overview

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Background

The Danish construction industry is characterized by the same problems as construction industries in most countries: low productivity, errors, overruns in cost and schedule, bad reputation and a high accident rate.

Since the mid 80es a number of initiatives have been taken by the government and the industry to better this situation and a number of white papers have been prepared on the problems and possible solutions (Bertelsen and Nielsen, 1999).

In the beginning of the 1990'es a series of experiments was undertaken using a just in time pull logistic in supply of materials to the construction sites. The methods developed for this were strikingly similar to the Last Planner being developed independently by Glenn Ballard et al at the same time. (Bertelsen and Nielsen, 1997)

However, it was not until 1999 under the governmental program: *Project House* that the Danish construction sector became aware of the work within the Lean Construction network.

Again a strikingly similarity was found as the Project House program was setting the challenge to industry to produce double value for half the cost over the next ten years, an objective quite close to the objective set in Lean Construction by Lauri Koskela (2000): Maximize value and minimize waste.

Trimmed Building

The term Trimmed Building has been used for the Danish implementation of the lean principles in a new building process inspired by the above challenge. The building process is named the Seven-Cs model¹ because of the initial letter of the names of its phases and actions. The model takes off by defining the value in the first phase, then converting the value parameters into a conceptual design in the second phase, and finally converting the concept into the constructed artifact in the third phase.

The process is thus:

¹ In Danish 7K

Cause²: In the first phase the client's reason to build and his value parameters are laid down and analyzed. This is recognizing the multi perspective, which the client has to observe as caretaker of the interests of the owner, the users and society, in three time perspectives: during construction, after completion and in the longer run. In total nine perspectives.

As we are dealing with value, we are also dealing with potentially conflicting points of view, and the approach in this phase is therefore to work in workshops bringing as many of the stakeholders into the process as practically possible. Often as many as fifty or more participants are found in these sessions.

Based on the outcome, Contact is made to the team of professionals who shall undertake the design and construction processes. Often Design-Build teams are preferred. However, the price is not fixed at this point in time, and a partnering like agreement is entered into for the next phase.

The second phase is **Concept**. In this the value parameters are transformed into a conceptual design with a firm budget. The process is one that deals with a number of wicked problems, and the form of work is still the workshops, now with a participation of the professionals and the contractors as well.

At the end of the concept phase, a binding **Contract** is entered, and the project proceeds into its third phase: **Construction**.

In this phase a detailed design is prepared and the site work is executed. In this the **Last Planner** is an important tool along with the process management. Also the **Value management** established from the outset of the concept phase is continued during the construction phase, taking hand not least of the process values.

The construction phase ends up with the **Commissioning**.

Over the whole process, the client establishes a project **Control**.

This process is described in detail in a Client's guide to the new construction process (Bertelsen et al 2002) and the management principles are dealt with in Bertelsen and Koskela (2002).

Trimmed Building and the Lean Construction Theories

The tools and methods used in Trimmed Building are quite firmly based upon the prevailing theories for construction as outlined in the figure (Koskela, 2000; Bertelsen, 2002).

Six ways of understanding construction are theoretical bases: Transformation, Flow, Value generation, One-of-a-kind production, Complex system and Cooperation. Seven theories/strategies are then used as bases for the tools: Operations vs Process (Shingo, 1988), Stable workflow (Ballard, 2000), Wicked

² In Danish: Krav, the exact translation of which is requirement.

Problems, Value vs Waste (Shingo, 1988), Chaos Theories, Constrains (Ballard, 2000), and Action Learning.

These ideas give rise to the methods: Workshop Design, Value Management, Chaos Control, Last Planner, Logistics, and Process Management.

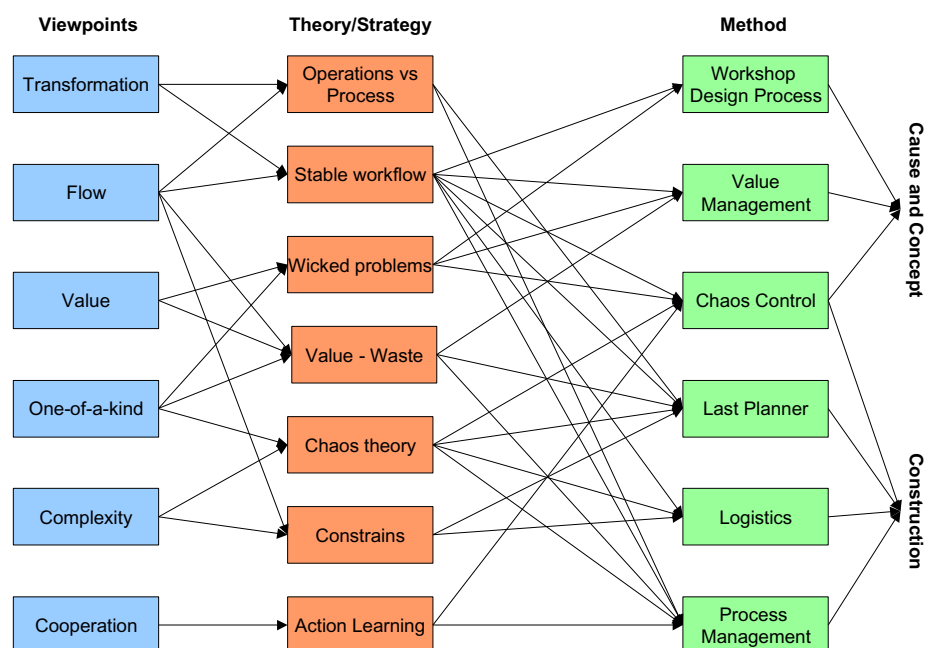
Workshop design is a design process recognizing the wicked nature of the problems to be solved. As many stakeholders as practically possible participates in a series of workshops with the professionals, where value parameters and design solutions are analyzed and agreed upon.

The *Value management* takes over after the workshops keeping track of the fulfillment of the client's value parameters throughout the remaining process until the final customers' survey.

Chaos control is a new method outlined in theory, but demonstrated fully in practice. The background is the assumption that a project may enter a chaotic state as phase transition, which may cause steeply increase of costs and delays. But also that a monitoring of number of parameters may indicate how close the project is to the edge of chaos and how to reduce the risk.

Logistics comprises the principles reported in Bertelsen and Nielsen (1997) for the use of Last Planner methods in controlling the flows of materials towards the construction site.

Process management (Bertelsen and Koskela, 2002) is a management function in parallel with the project management with an aim of managing the construction process as a flow of materials, information and work.



These new methods will be reported upon in separate letters to follow.

Experiences

The methods have been used on app 20 – 30 projects until now. Most of these projects have either used the Workshop/Value management or the Process Management/Last Planner part. However, some of the value-managed projects are now entering the construction phase.

Most of the results are not yet firmly documented, but informal reports tell about much higher customers' satisfaction, increased value and lower costs.

Also zero punch list are reported from a number of the construction jobs along with increased workers earning n piece rates.

One result, which is firmly documented, should indeed be sufficient reason for the whole effort: A dramatic improvement of the workers' safety. The biggest Danish general contractor MT-Hoejgaard has used the principles on all construction jobs, where they execute the project management. A comparison between these sites and their other sites – for the same quarters of 2001 and 2002 – shows a drop in the accident rate by more than fifty percent on the lean sites with process management. (Thomassen, 2002).

Future development

The Government is aware of these results and a recent directive calls for the use of the process management and the Last Planner process control – or similar methods – on all new, government co-financed projects in the housing sector. Also, a new selection procedure in choosing housing associations to manage new projects will put focus on these clients' capabilities in managing the value generation in a better way.

Also the Construction Workers' Union is actively involved in the introduction and use of the lean principles, as they see them as an instrument for a higher professional respect for their members, a route to higher earnings and, not least a means to safer working conditions.

Finally, Lean Construction Institute Denmark has been established in a close co-operation with LCI, US. The launching of the Institute took place in November through a conference and a two-day seminar conducted by Glenn Ballard, who was the conference's key speaker as well. Also Lauri Koskela visited Copenhagen for the event making it possible to get an update on the ongoing research activities and to exchange ideas for future projects.

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