A CONTINGENCY APPROACH TO THE CO-LOCATION OF DESIGN TEAM MEMBERS

THE CASE OF NCC CONSTRUCTION SWEDEN AB

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Master Thesis Summary

This article summarizes the master thesis written by Söderberg (2015), a case study of a large construction company as the company was in the midst of changing their building design operations. The company had started to use the concept of a ‘Big Room’, a shared space where architects and engineers can sit together and design the building before production starts.

Through a series of project observations and a set of interviews with people from different parts of the organization the current state of the new practice could be understood and qualitatively described.

Contrasted against theory of the Big Room methodology and the concept’s theoretical heritage in Lean Production, the current state within the company could be analyzed before recommendations could be made for the path ahead.

From the analysis, it was concluded that a greater number of the design team members should be encouraged to continuously participate in work conducted in the Big Room. A change in the strategic process and how to manage dependencies between different specialist groups was also suggested.

The Japanese company Toyota is the world’s biggest automobile manufacturer and the philosophy that made the company successful is known as the Toyota Production System. As Toyota set out to develop their hybrid car ‘Prius’, one of the most important discoveries from an organizational design perspective was to use a ‘Big Room’ – a way of integrating design team members by working together in the same space (Liker, 2004).

The NCC Project Studio concept, studied in Söderberg (2015), is based on Toyota’s idea of a Big Room. The Project Studio approach is schematically drawn in Figure 1. The design team, drawing the building before the shovel is put to the ground, and the project customer (owner) gathers in the Project Studio location on a regular basis to align the team members’ work efforts.

The design team consists people from NCC, architects and various specialists, commonly engineers of different kinds. NCC usually holds the main contract of the project meaning that NCC has agreed to deliver the full project scope to the project owner. The engineers are contracted by NCC using so-called sub-contracts, basically a break-down of the main contract (Figure 1).

Thesis study purpose

The purpose of the master thesis study was to describe and analyze the current use of NCC PS, and to propose recommendations for improvements to the design team constellations. Of particular importance were the issues of who to involve in the NCC Project

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Figure 1 – Schematic over the NCC Project Studio concept.
Studio, how, and to what extent, during the design phase.

**Thesis study methodology**

The study was designed to be conducted in phases. After an initial literature review, two data gathering phases were to follow; a longitudinal\(^1\) observational phase followed by a cross-sectional\(^2\) phase with a series of interviews. Analysis of the data was then based upon the full data set, from both phases and the theoretical framework developed throughout the study to build recommendations.

During the first data gathering phase (the longitudinal, observational), one design team was visited for a time period of ten weeks as they met in their Project Studio more or less weekly. Observations were done passively so that the design team studied would act as close to normal as possible. Data was taken through notes. After the observational phase a conference on lean design in Chicago was partaken with professionals from other construction companies working with the same type of change initiatives.

In the second data gathering phase (the cross-sectional interview phase) two more construction project design teams were approached, in addition to the team that had already been observed. The two other project teams were located in other parts of Sweden and were also different in size from the first project studied. Data from the projects studied can be seen in Figure 2.

The four interviews made resulted in more than 40 000 words of interview transcripts. Material that was read and re-read before the most substantial opinions from each interviewee could be highlighted. Finally, extracts could be mapped in a framework named Socio-Technical Systems (STS), taken from contingency theory further described below. The analysis method used closely follows thematic analysis described in Braun and Clarke (2006).

The series of observations, together with the chosen extracts were contrasted against theory of lean construction to arrive at the recommendations.

**Theory**

Two theoretical frameworks were used in the thesis. Firstly, one framework was derived from contingency theory, and it was used to show the study’s perspective on the data that had been gathered. This was referred to as the ‘empirical framework’. The second framework, referred to as the ‘theoretical’ focus on the Big Room concept, and its heritage from Lean Production and the Toyota Production System.

The first of the two frameworks, the empirical, is used mainly due to the criticism raised against the theoretical area of lean construction. For example, Green (1999) means that the theory oversee failed implementation attempts and that the theory is evangelical.

As a response, Söderberg (2015) uses a framework from contingency theory to structure his findings within NCC Project Studio. Contingency within the management literature highlights that there is no ‘one fits all approach’. Data gathered from the organization was systemized with the STS framework, all pieces of information being classified as part of the psychosocial, technical, structural, or goals/values sub-systems of the organization. The STS framework provide the reader with a holistic perspective of the organization and its current practice giving him or her the opportunity to evaluate and analyze the data.

Second, the theoretical framework based on lean construction and the theory of lean production was described.

Toyota can be seen as the role model organization from which lean production theory has been developed. According to the study of TPS made by Liker (2004) the system can be visualized using a pyramid to rank the importance of the basic principles on which the system is built.

This pyramid has been drawn in Figure 3 and it can be seen that a long term philosophy an important foundation for a lean system. Based on the long term employees from different geographies, project sizes hierarchical levels and with different roles within the company.

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1. Longitudinal means that an object is studied for a period of time during which the object develops or changes.
2. Cross-sectional means that data is gathered spanning dimensions other than time. In this case the interviews were with
philosophy, the next step is for the organization to organize itself around processes to be able to develop their employees, suppliers and customers as a third step. Finally, the organization should strive for continuous improvements in a problem solving atmosphere.

A common way for a construction company to start their ‘lean journey’ is by the implementation of the Last Planner system of production control (Koskela et al., 2002). The system, a result of the dissertation Ballard (2000), is a tool to better use the resources that a team possesses based on the current and future needs. The team utilizes a rolling scheduling window and iteratively reassesses what can be done in the given time window. Commitments made during the scheduling sessions are thereby shielded from risks and should be more reliable. Reliability for a complex network working with a joint mission is found to be crucial for success.

Another central feature of a project being delivered lean is early validation of goals. Traditionally, a project owner (a customer, e.g. a construction development company, see Figure 1 – Schematic over the NCC Project Studio concept.) specifies a set of criteria, sending them to a set of construction companies and let the companies compete for the cheapest way of reaching the criteria. When using a lean project delivery method, the project owner needs to validate the project’s ‘business case’ before the project can begin by inviting the project team early in the process. The business case is formulated according to the owner’s four fundamental questions. (1) What do I want? (2) What is it worth? (3) What am I able to pay? (4) How much will it cost?

Only when the owner knows what he or she is looking to satisfy and if the cost for this will likely be covered, only then the business case can be validated and the project begin.

Empirical findings

In the empirical studies, NCC Project Studio sessions generally functioned as a set number of days a week (1-3 in the projects studied) when meetings were held. Commonly, the same people returned for the meetings on a weekly rolling schedule. All the studied projects had in common that the whole design team didn’t partake the studio work, but only one or two responsible for each discipline were invited to function as a link between the project team and their respective ‘home offices’.

‘We wouldn’t host the whole design team but most of them have rather large organizations at home who perform the actual drawing work. Then there is someone from each discipline who are here, one responsible, so to speak’

All the studied teams made use of similar scheduling methodologies commonly named ‘visual planning’. In the visual planning sessions post-it notes of activities were put in sequence to clarify each team member’s dependence on one another. Usually, the scheduling began by forcing as many activities possible to start as early as possible despite the fact that often times earlier commitments had not been delivered in accordance to plan. Activities were thereby continuously pushed to a later point in time.

True for all the projects studied was also that at least one point in time as the design was being developed, the owner sat his foot down exclaiming that the team was not going to meet his budgetary constraints. The team thereby had to revise often times large scopes of the design and for a number of weeks iterate the reasoning behind the decisions made up to that point.

Results

After current practice had been contrasted against the theory developed in the subject area, three major lines of recommendations were given to NCC.

Firstly, the company was recommended to involve and empower ‘another layer’ of design team members. These are the people sitting at the home offices and that only get exposed to the team’s joint goals through their Project Studio representative. The people referred to are commonly known as ‘detailers’ and these are more or less seen to function as fullfillers of the decisions made at the meetings within the studio.

Instead of all detailers sitting at their home offices, being fed with information from their respective ‘administrator’, the detailers should be invited to the everyday work in the NCC Project Studio to fully enjoy the positive effects that the co-

Figure 3 – The Toyota Production System (TPS)
location of design team participants can give as it will be easier for each team member to find his or her part of the overall project mission and facilitate new, informal links of communications between diverse team members. The recommendation of a new organization structural setup has been schematically drawn in Figure 4.

Secondly, a new design process, based on transparent customer criteria (including budgetary constraints) from day one is to make the system work in line with the lean concepts. The design team will have to validate the owner’s business case before design work can begin. Through this validation, the customer will have the possibility to notice when team members are working for their own good instead of the goal of the project.

This recommendation aims to minimize the risk of disrupting the ongoing design work at some point in time, basically facing the task of reviewing all the design decisions made up to that point in time.

The only way that this recommendation will be fulfilled is through the buy in from NCC’s customers, the project owners. When asked to reveal the project budget before the design has even started the owner will naturally be intimidated and wonder how this would result in a fair – market based – project delivery. However, as earlier mentioned, the project team can work towards a shared target only if the target is known. And an important part of this target (if not the most important) is the financial target.

Thirdly, in order to make the team member interdependencies clear and to make planning of the everyday design work more reliable, the team would be encouraged to use the feed forwarding and feedback loops built into the Last Planner System better.

Feed forwarding commemorates the updating of future commitments given new information of this commitment. Say, for example, that the structural engineer is waiting for a specialist’s calculation of snow loads on the roof. The structural engineer also knows that this one specialist is out sick for the coming week when the calculation was due. Utilizing feed forwarding would be to update the schedule information with this information. Given the new information, the team can then jointly decide if they need to find a new expert on the area of snow load calculations.

Feedback is the phenomenon of evaluating the results of prior commitment and to use the evaluation for future commitments. For example, if the Architect did not deliver the plan drawings in accordance to last week’s commitment, he or she might also know that a major reason for this would be that the material that he or she imported from the mechanical engineer was in the wrong system of coordinates, why much time had to be spent transferring from one system to another. Feedback would then be to let the team know of this problem, that this was his or her reason for delay and to use the team resources to minimize the risk for this to happen again. Maybe the plumbing engineer could easily shift coordinates within his or her model.

Recommendations for future research

To complement the study made, large scale studies to justify the appropriateness of the recommendations are encouraged. One important example of this, is a quantitative study on the willingness of remote design team members to be part of the Project Studio sessions. This study would aim to find reasons why this is not currently the case and to highlight aspects of such a change from the ‘detailer’s’ perspective.


SÖDERBERG, A. 2015. A contingency approach to the co-location of design team members, The case of NCC Construction Sweden AB. MSc., Lund University, Faculty of Engineering, LTH.