

ADDING PRODUCTION VALUE THROUGH APPLICATION OF VALUE BASED SCHEDULING

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ABSTRACT

Customer value is a key goal in the Lean philosophy, essentially only actions that adds value should be conducted. In a transformation view, the basic lean approach is to remove waste, which indirectly increases value (or withstand value lose). Lean Construction acknowledges two different types of value views. Product value, as stated above and value in relation to cooperation in the construction process. Process values are important when it comes to the comfort (physical and mental wellbeing) of the craftsmen cooperating aligned around the same goal of a smooth process and a great end product. By increasing the comfort of the craftsmen their productivity could increase. Furthermore, shared process values decrease the needs of managerial standards, structures, and systems. By means of a questionnaire survey this study investigates the connection between scheduling and the comfort achieved through process values of both engineers and foremen on site. The questionnaire identifies relevant process values, and these are compared to values observed in the scheduling process at three construction cases. The aim is to minimize time usage in the scheduling processes and to increase robustness of the schedule by securing an adherence of the schedule. The results show a lack of focus of the scheduling process' surrounding atmosphere. Process values such as sympathy, kindness, helpfulness, and equality had only minimal attention. In order to foster these "soft" values it was found that hierarchy should be minimized and management should seek towards democratic leadership.

Keywords: Last Planner System, Lean, Scheduling, Values, Waste.

INTRODUCTION

Ohno (1988), one of the fathers to Lean, stated that the total capacity of a production system equals the sum of work and waste. Therefore, in order to increase the work and streamline the production Lean has a partisan focus on removing waste. Lean emphasizes the production as a flow of materials where raw materials are undergoing moving, waiting, inspections, and transformations before it reach the intended shape and function as the final product or construction (Koskela 2000; Koskela 1992). Only transformations add value to the product. All other activities are only expenditures in cost and time and can be regarded as waste. The concept is then to eliminate or

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minimize waste by eliminating the non value-adding activities and streamlining the value-adding activities (Lindhard and Wandhal 2012; Koskela 1992). In order to remove waste you need to know and eliminate the root causes. In Lean theory 7 different sources to waste are identified: 1) Waste of overproduction, 2) Waste of stock on hand, 3) Waste of transportation, 4) Waste of making defective products, 5) Waste of processing itself, 6) Waste of movement, and 7) Waste of time on hand.

Lean, which includes Lean Construction, only focuses on the hard and direct observable waste. In relation to Ohne's definition a production system consists of work and waste. Work is often considered to be only the transformation, because it is the output. But as an input, in order to complete the transformation, human production factors are needed. The motivation and skill of the employees are having a huge impact on the output both regarding quality and quantity. Thus humans can affect the capacity of the production system. This is especially the case in construction which is considered a labor intensive industry.

Improved human skills are expanding the capacity of the production system since new knowledge is added. Opposite does improved motivation not add anything to the existing system. Therefore, improving motivation is an exploitation of capabilities already in the production system and a known approach to minimize waste. Capabilities and utilization is also important in relation to the machines in the production system. Therefore, the phrase can be generalized to: Waste is not to fully utilize of the capabilities and possibilities in the production system.

As mentioned, Lean's primary focus is on removing waste to maximize the value creation. In fact the production outcome is the same, but value loss is evaded by reduced resource usage. Thus removal of waste does not extend the existing value creation in the production system. Extending the value creation can only be achieved by improving the work to increase the customer satisfaction, cf. Ohne's rule.

Creating value is a fulfillment of the customer demand and requirements. Johnson and Kaplan (1987) defined value this way: "value of any commodity, service, or condition, utilized in production, passed over into the object or product for which the original item was expended and attaches to the result, giving it its value." Creation of value in any production system is achieved by producing what the customers want to fulfill the customers' demands and requirements. In construction this value creation has two customers: the next trade and the end customer (Wandahl 2004a). Value creation is measured in relation to cost which includes the consumption of both time and resources. Moreover, value is determined in relation to achieved benefits and compared to value and cost of substituting and competing products.

Creation of value comes through process, but the values in the process are important for maximizing the human input. Production process values are important when it comes to the comfort and motivation of the individual craftsman on site (Bejder et al. 2008). By increasing comfort and motivation of the craftsmen their dedication and accountability will increase resulting in increased productivity (Singh 1996; Olomolaiye 1988). Accountability is important in the scheduling process where the schedule is founded on commitment which needs to be obeyed. Due to interactions and interdependencies between the subcontractors, the flow of work is dependent on fulfillment of these commitments.

The production process values are a part of the corporate culture which dominates the construction site (Van den Steen 2010). Culture is the social and normative glue that

holds the, in construction, temporary organization together (Siehl and Martin 1990). The main organization in construction is a joint of smaller organizations from the participating subcontractors. Thus, there is a hierarchy of culture where the individual subcontractor has its own subculture (Hunter and Tan 2006).

Culture is by Triandis (1972) defined as: “an individual’s characteristic way of perceiving the man-made parts of one’s environment. It involves the perception of rules, norms, roles, and values, is influenced by various levels of culture such as language, gender, race, religion, place of residence, and occupation, and it influences interpersonal behavior.” According to Kroeber and Kluckholm (1952), culture is affecting behavior by determining patterned ways of thinking, feeling and reacting. Therefore, since behavior is determined by culture, culture needs to be managed. In construction the overall culture changes since organizations change. Every project consists of its unique composition of organizations and employees which together forms the projects culture. Thus, management of culture is important for ensuring optimal capacity utilization, i.e. optimal output of the production system.

Value Based Scheduling (VBS) is introduced in an attempt to affect behavior through changed culture. The concept is focusing on leadership and the connected process values. The objective is to increase motivation, collaboration, and output by establishing comfort and trust between individual craftsmen. An improved involvement when making commitments in the schedule makes the schedule more realistic. Together with increased accountability and dedication the likelihood for observing the schedule is increased. As mentioned every construction project consists of its own unique culture. Therefore, the values should be determined at project basis to fit the present project. Cultural changes are difficult to accomplish, hence it is important to ensure everyone’s support in this change process. It is therefore critical that everyone is consulted and have a voice when the values are determined. This ensures alignment and observance of values from top management to each craftsman, on site.

VBS is a parallel to Value Based Management, where values constitute a supplementary scheduling, planning and management tool (Wandahl 2004b). VBS is a proactive approach to avoid or limit problems related to scheduling. The values form an ethical guideline supporting on site behavior and support and reduce the demands to the existing scheduling system, which at a Lean construction company would be Last Planner System (LPS). VBS increases the reliability of the schedule, because commitments increasingly are kept. Values affect behavior by increasing motivation, dedication and accountability, resulting in an increased probability of schedule observance. Thus the robustness of the schedule is increased.

It is important that the scheduling system supports the determined values. Therefore, the purpose of this research is to determine which values in general are preferred in such a system. Moreover, this research suggests which values a scheduling system is expected to deliver. By fulfilling the identified values and needs the scheduling processes can be improved. Identification of the values is achieved through the following research question:

Which values could be combined with existing scheduling procedures of onsite construction and how can these values support Last Planner System?

RESEARCH METHODOLOGY

To investigate which values that are preferred in a scheduling process an electronic survey was conducted. The samples in this survey were A) the members of leanconstruction.dk, comprising 16 contractors representing a large proportion of contractors in Denmark B) former students at the MSc in construction management programme at Aalborg University, who present is employed as contractors. The two samples were chosen because respondents, to a greater extent, were expected to know about and have experiences with Lean and LPS. Usage of LPS is important since it is based on Lean thoughts. This increases the quality of the replies and the validity of the survey. In total 192 persons were included in the survey. The questionnaire was completed by: 14 project managers, 17 construction managers, 16 site managers, and 7 foremen. The respondents represent varying opinions and contribute with different experience to scheduling. This secures an unbiased and valid survey.

The questionnaire process takes its outset in the strategy presented in Akintoye and MacLeod (1997). First, an initial invitation was sent out to every participant and after two weeks a reminder was sent out to those who had not yet completed the survey. In total 51 persons completed the survey resulting in a response rate of 27%. In the questionnaire the respondents were asked to rate a number of values in relation to the importance in the scheduling process. The values in the survey were found by reviewing the values represented at a number of partnering projects.

Additional three construction cases were followed see Table 1. At the construction cases LPS had to be applied. Data collection consisted participation in scheduling meetings and observations to capture the production process values. Onsite observations help capturing the context wherein the scheduling is conducted. Focus was on the atmosphere and values which were characteristic at the meetings.

Table 1 Data collection at the three case-studies.

	Case 1	Case 2	Case 3
Contract form	Turnkey contractor	Turnkey contractor	Prime contractor
Site observations	Once every fortnight in total 5 observations.	1-2 times every fortnight in total 8 observations.	1-3 times every fortnight in total 8 observations
Meetings participated in	Subcontractor, foremen and safety meetings	Subcontractor and LPS meetings	Subcontractor, foremen, emergency and construction meetings
Observation length	10 weeks	10 weeks	10 weeks
Interviews of site-manager	Unstructured and semi-structured	Unstructured and semi-structured	Unstructured and semi-structured

The research presented is a part of an ongoing research project aiming to disclose new parameters to help and support scheduling in construction. The research is explorative and open minded, and is trying through creativity to avoid the limitations of a narrow-minded and traditional way of thinking.

RESULTS

A questionnaire was designed to capture and rate the importance of different values in relation to scheduling processes and the schedule itself. To capture a complete and

nuanced picture project managers, construction managers, site-managers and foremen has been included in the survey. The results from the questionnaire are afterwards compared with case observations from 3 construction sites. Focus has been on how and whether or not the values are supported, encourage, and fostered in LPS.

In the questionnaire the respondents were asked to rate the importance of certain values and to which extend they found it important that the given values would be supported by the scheduling process. The results, which are presented in Table 2, shows a tendency in the construction industry to rate the “hard” values such as responsibility and collaboration higher than the “soft” values such as helpfulness, kindness, and sympathy.

Table 2 “If scheduling should be combined with values to which extend do you think the schedule should encourage [Value]?” When calculating the weighted average: to a very high degree was valued 1000, a high degree 100, some degree 10, lesser degree 1, and not at all 0.

[Value]	Respondents	Weighted average
Responsibility		643
Respect		534
Cooperation (Willing to share)		530
Honesty		518
Trust		514
Equality		392
Helpfulness		255
Kindness		226
Sympathy		199
Total (N=)	51	

Responsibility turns out to be the highest rated value. Thus it is important that the involved contractors’ respect and obey the mutual agreements and, as best as one can, seek to observe the commitments. Therefore, responsibility is a key issue in LPS in the search for increased robustness. Responsibility is together with trust the only values LPS directly seek to foster. In LPS trust lays the foundation to collaboration.

In LPS, responsibility is increased by involving foremen in the Phase scheduling. Participation and joint-responsibility increases the awareness of subcontractors regarding the importance of observing the schedule. Moreover, responsibility and awareness are fostered by the implemented PPC calculation. Basically, PPC is a measure illustrating the percentage of kept commitments, where also trust and honesty comes to a test in relation to the likelihood of commitments being obeyed. Furthermore, joint-responsibility in the scheduling and sequencing does unite the parties and encourages collaboration.

LPS puts only little attention to the atmosphere wherein the scheduling processes proceeds and to the comfort of the individual craftsmen. This was characteristic at the observed cases where no focus was on kindness, helpfulness, sympathy, equality, or respect. It is important to stress that the “soft” values increase comfort. It was therefore, no surprise that one of the three sites was dominated by a harsh tone. This rough behavior was promoted by the site-manager who had a very brutish appearance. Moreover, he used his hierarchical advantage to force through his own agenda and

opinions. His leadership did not at all seek towards equality and did not encourage collaboration, honesty, sympathy, etc. Hierarchy of power was observed at all three construction sites. But in the other two cases the hierarchy was not as direct visible and not used as a management tool.

DISCUSSION

Both the questionnaire and the studies show that scheduling in today's construction only has minimal focus on the values which foster comfort to the individual employee at site, and hence frames an effective working climate. Management should put more effort into ensuring this comfort because it is the breeding ground for motivation and mutual trust. All too often construction sites are plagued by internal competition among the participating trades. In the worst cases this leads the trades to a state of war where the only objective is to maximize own profit, and to sub-optimize in all aspects. Therefore, Lean could be improved by focusing not only on transformations but also at the leadership which guide and support the transformation process to increase comfort and motivations of project participants. The result will be increased efficiency and productivity as well as a more robust schedule.

Production process values should be identified to support the existing schedule system. Values need to be mutual developed and agreed. This will ensure all subcontractors commitment for observance. Common goals and values lay the foundation for the culture at site. It unites and glues the temporary organization together and makes them act as they were one company, cf. Siehl and Martin (1990). Additional long-term cooperation through partnering or joint ventures could form the setting for a united culture. This will improve the scheduling and the encouragement for collaboration will increase. The willingness to share resources to increase utilization and find common solutions will also be expected to rise.

Finally, it is important to minimize hierarchy of power in the scheduling process. Lean should seek towards a flat organizational structure. Here, it is important that all participants should be involved and have an influence in the development of the schedule. This increases the quality of the schedule (Ballard and Howell 1994). Moreover, it increases the motivation by fostering equality, sympathy, and mutual respect.

Construction sites are often dominated by autocratic leadership which, according to Cassel (2008), creates "*ego-centered*" individuals where competition and power drives the motivation. Mutual competition at construction sites is evident and composes a significant problem in today's construction. Mutual competition was observed multiple times during the case studies, and hindered collaboration. Thus is there a need to change this style of leadership. Construction sites should seek to be managed through democratic leadership. According to Cassel (2008) individuals under democratic leadership tend to be social- and group-centered. Moreover the extreme emphasis placed on competition is replaced by courtesy, honesty, and cooperation (Cassel 2008).

FUTURE RESEACH

This research is an initial part of an on-going research that emphasises the human aspect of construction production scheduling. Here, VBS is intended as a support to LPS to increase robustness of the schedule by increased motivation and dedication to the commitments. Additional further research is needed to support the research and to

form guidelines for selection and observance of values and how they can be supported by leadership style. Among others this involves pilot projects to test the theory.

CONCLUSION

Lean does not focus on the importance of humans in the production system and ignores their influence on capacity and quality. Humans do together with machinery and equipment compose the production system. Improving motivation is a utilization of the existing capabilities in the system. In Lean, there is no direct focus on utilization. Here, not fully utilization of the capabilities and possibilities in the production system should be regarded as the 8th source to waste.

If utilization is regarded as waste unnecessary waste could be removed if the motivation and comfort at the employees on site is improved. This can be achieved by focusing on the production process values. Moreover, values form an ethical guideline which influences culture and behavior. By fostering dedication and responsibility the likelihood for observing the commitment in the schedule is increased.

The atmosphere wherein the scheduling process proceeds is important to the comfort of the individual participant. Management should increase their effort of ensuring this comfort because it is the breeding ground for motivation and mutual trust. Therefore, leadership is important. Site management should seek towards democratic leadership because it encourages courtesy, honesty, and cooperation which are key elements in an attempt to improve the current scheduling system. In general Lean should seek towards minimal hierarchy because involvement and influence improves the quality of the schedule and it fosters equality, sympathy, and respect.

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