Looking into Not-Completed Activities by Applying the 5 WHYs Method

Lindhard, Søren Munch; Jensen, Kim Nørgaard; Larsen, Jesper Kranker

Published in:
Proceedings of the 2016 International Conference on Construction and Real Estate Management (ICCREM)

Publication date:
2017

Document Version
Accepted author manuscript, peer reviewed version

This is a pre-published version
Lindhard, S., Jensen, K.N., Larsen, J.K. 2017 "Looking for Improvement in Last Planner System: Defining Selection Criteria", Proceedings of the 2016 International Conference on Construction and Real Estate Management (ICCREM). American Society of Civil Engineers https://doi.org/10.1061/9780784480274.040

Looking into Not-Completed Activities by Applying the 5 WHYs Method

Søren Munch Lindhard, Ph.D.[1]; Kim Noergaard Jensen, Ph.D.[2]; and Jesper Kranker Larsen[3]

[1]Barslund A/S, Kvistgård, Denmark. E-mail: Sml@barslund.as
[2]Dept. of Mechanical and Manufacturing Engineering, Aalborg East, Denmark. E-mail: Knj@m-tech.aau.dk
[3]Postdoctoral, Dept. of Mechanical and Manufacturing Engineering, Aalborg East, Denmark. E-mail: Jkl@m-tech.aau.dk

ABSTRACT

Construction projects are tormented by activities not able to start and to finish on time. To reduce the number of activities not completed on time, the causes and risks that the individual activity is carrying should be analyzed and understood. This despite, there in construction has been a focus on treating the effect of the delay rather than eliminating the cause. In the Lean toolbox, there is a learning tool called the 5 Whys method, and the 5 Whys method is developed in an attempt to avoid repetitions of problems by identifying and eliminating the root cause. In the presented research study, the 5 Whys method has been applied at one construction project. In total, 11 activities, not completed on time, have been registered and investigated. By applying the 5 Whys method, the underlying causes have been identified, and even though asking Why is not a complicated task, it seems to be a useable technique of gaining business and project insight as the technique used in the analyze phase can lead to potentially solutions to the root causes. Based on the findings from the 5 Whys method, a practical approach to analyze the data is presented.

INTRODUCTION

Delayed activities are common in on-site construction. Love et al. (2005) did in a research study looking into the time overruns in 161 Australian construction project and found the average time overruns to be 20.7%. Time overruns are costly, in addition Love et al. (2005), for the 161 projects, found the average cost overrun to be 12.6%.

One reason to the constant and dominant delay in on-site construction is the industries lacking focus on improvement and learning. Lindhard and Wandahl (2014) supported this as they found that the learning instruments from the Lean Construction toolbox were only rarely applied.

Two central elements in Lean Construction to foster improvement and learning are the PPC calculation and the 5 WHYs method. The PPC calculation is the measurement of the percentage of activities completed on time, and is indicating the quality of the schedules (Hamzeh et al. 2012). Additionally the PPC calculation gives feedback about project performance by highlighting the number of activities not completed on time (Lindhard and Wandahl 2013).

Based on the PPC measurement, root causes to the not completed work tasks can be identified by applying the five WHYs (Lindhard 2014). The 5 WHY's is a technique where five WHYs are asked to reveal the root cause by systematically uncovering the layers to the identified problem (Lindhard 2014; Simonsson and Emborg 2009). Afterwards the root causes and triggers are sought eliminated in order to prevent the problem in reoccurring (Simonsson and Emborg 2009).

The 5 WHYs method help the site-manager to understand the triggers behind the experienced problems. Lindhard (2014) did in a case study look into the triggers and found that even minor miscommunications, minor carelessness, or minor misjudgments under the wrong circumstances

This is a pre-published version
Lindhard, S., Jensen, K.N., Larsen, J.K. 2017 "Looking for Improvement in Last Planner System: Defining Selection Criteria", Proceedings of the 2016 International Conference on Construction and Real Estate Management (ICCREM). American Society of Civil Engineers https://doi.org/10.1061/9780784480274.040

can be triggers to the delay (Lindhard 2014). Even though the 5 WHYs increase learning can improve early problem identification, the method is only rarely applied in on-site construction (Tsao et al. 2000). According to Tsao et al. (2000), the key reason is that the root-cause is often difficult to identify.
In the presented research study, data from the 5 WHYs method are analyzed by applying problem chains to reveal similarities and patterns in how the problems are evolving. The 5 WHYs method has been applied at one construction project covering in total 11 activities that are not completed on time. The reason to only one project is included in this research is because this research study is a byproduct of a larger project cooperation with the construction company in question.
Practically the 5 WHYs technique is applied by the site-manager, who after the weekly work scheduling, for every not completed activity, should identify the responsible person and ask why the activity was not completed on time. The site-manager should continue to follow the track until the root cause is revealed.

METHODS

The research conducted as a qualitative case study research and the research design takes outset in guidelines of Eisenhardt (1989) for case study research, which included the following three steps:
Getting started, which includes definition of research focus and research question. In the (1)presented study, focus was on identifying the root causes to, why activities were not completed on time. To identify the root causes the 5 WHYs technique was applied.
Selecting cases. One construction case was selected through an industry contact. As a (2)requirement, the activities not completed on time had to be registered. A short introduction to the construction case, including contract form, contract value etc. (see Table 1).
Choosing research methods and crafting instruments. Data was collected by applying the (3)5 WHYs technique, and to every problem the responsible person was identified and a WHY was asked. Based on the response the cause and the responsible person once again were identified and a WHY was again asked. This procedure by identifying the responsible person and asking WHY continued until revealing the root-cause.

Table 1. Data Collected from the Case Study.

Item	The case
Short description	Refurbishment of a top floor section in a functioning hospital
Contract form	General contractor
Contract value	US $ 5.5 million
Construction period	7 months
Project followed	6 weeks
Root-cause identified	17 activities

The data collection has previously been used by Lindhard (2014) identifying the triggers, but in the presented research the analysis steps one step deeper and try to reveal underlying patterns and tendencies.

This is a pre-published version
Lindhard, S., Jensen, K.N., Larsen, J.K. 2017 "Looking for Improvement in Last Planner System: Defining Selection Criteria", Proceedings of the 2016 International Conference on Construction and Real Estate Management (ICCREM). American Society of Civil Engineers https://doi.org/10.1061/9780784480274.040

RESULTS

The 5 WHYs is a tool designed to digging deeper into the underlying causes asking why an activity is not completed according to the schedule. By applying the 5 WHYs, the degree of the details to each observation is increased. Thus, the not completed activity is viewed in its context, which increase the insight and helps to understand the triggers and identify the root causes. The results from applying the 5 WHYs technique to the construction case (see Table 2).
Moreover, it can be difficult to determine when the root cause is identified, and thus when to stop asking why. By repeatedly asking the question WHY, where five times is a good rule of thumb, as it can peel away the layers of symptoms, which can lead to the root cause of a problem. The 5 WHYs method gives compared to the PPC calculation, an increased detail level and understanding to why an activity is not completed. If this information is not used, there is no reason applying the 5 WHYs and it is always important to bear in mind that the gains should be greater than the effort.

Analyzing the results using problem chains:

In order to extract knowledge from the data collected by applying the 5 WHYs technique, the findings are analyzed by drawing problem chains (Johansen et al. 2006). Problem chains are drawn by following the not completed activities at each step of WHY, and by looking into how the problems are changing hands (see Figure 1).
The problem chains drawn in Figure 1 can be analyzed by looking for tendencies and patterns. In total 11 problem have been analyzed whereof the problem chains revealed that 6 (55%) were the contractors own problems, 3 (28%) were caused by site-management, 1 (9%) were caused by architects and 1 (9%) were caused by suppliers. Moreover, 1 (9%) problem was forwarded twice, 4 (36%) problems were forwarded once and 6 (55%) problems emerged among the contractors and were not forwarded.
One learning pointe from the small sample of activities analyzed, by using the problem chains, is that every problem is ending at the contractors. The explanation to why all problems are ending at the contractors is what have been measured, which are activities not completed on time, or in other terms: delays in execution. Delays in execution end up at the contractors because the contractors are the ones, who execute the plans.
In this small sample, the contractors have the responsibility for the delays in execution in approximately half of the incidents, while the other half of the incidents are forwarded problems, which should have been solved at its origin source instead of being forwarded and causing problems in the downstream operations. Of cause, Figure 1 contains only the problem-chains to problems, which were not solved, because the solved problems do not lead to delay. Hopefully, the 11 registered problems are only the few who manage to get through the eye of the needle.
Another approach analyzing the not completed activities by using problem chains is by looking at possible changes in the identified cause as each layer of the problem. The analysis divides the causes into seven categories, corresponding to the seven preconditions identified by Koskela (1999). The categories are as follows: Design, Workforce, Connecting Works, Material, External Conditions, Space, and Equipment. The drawn problems chains (see Figure 2).
Figure 2 reveal that out of the 11 problems 4 (36%) relates to Design, 3 (27%) relates to Materials, and 4 (36%) relates to External Conditions. Moreover, none of the problems changed category. Despite the small data sample, the fact that none of the problems changed category indicates that these changes

This is a pre-published version
Lindhard, S., Jensen, K.N., Larsen, J.K. 2017 "Looking for Improvement in Last Planner System: Defining Selection Criteria", Proceedings of the 2016 International Conference on Construction and Real Estate Management (ICCREM). American Society of Civil Engineers https://doi.org/10.1061/9780784480274.040

occur only rarely, thus the first evaluation (at the first WHY, see Table 2) is a good evaluation. To make a general conclusion the sample size needs to be enlarged significantly with more registrations from other construction projects.

Table 2. Application of the 5 WHYs Technique in an Attempt to Identify Root Causes (Lindhard 2014).

Id	Rep.	Problem observed	Why (1)	Why (2)	Why (3)	Why (4)
1	3	Roofing task not completed	Due to rainy weather	The roof was not covered	It was on 13th floor the covering would need extra construction for handling wind. This was considered too expensive.	
2		Vendor task not completed	Our stuff is ready but we are missing material	We did not receive a delivery as expected	The deliver lost their order (impact we will receive materials in 3 weeks)	No reason identified
3		Material not present	No reason identified			
4		Delivery of materials arrived to soon	Subcontractor thought the task should be completed the following week (even though the plan said otherwise)	Subcontractors schedule did not match the projects master schedule	Subcontractor used his own schedule	
5		Design not approved	Activity put on weekly work plan still with constraint	Architect promised to provide the information Monday–but it did not happen	No reason identified.	
6		Roof task not completed due to weather	Thought it was going to rain so we did not start the roof demolition	Weather prognoses (very strange because it was very nice weather all week)	Weather prognoses was incorrect	
7	3	Incorrect time estimate	No particular reason it just took longer time than expected to begin with.			

This is a pre-published version
Lindhard, S., Jensen, K.N., Larsen, J.K. 2017 "Looking for Improvement in Last Planner System: Defining Selection Criteria", Proceedings of the 2016 International Conference on Construction and Real Estate Management (ICCREM). American Society of Civil Engineers https://doi.org/10.1061/9780784480274.040

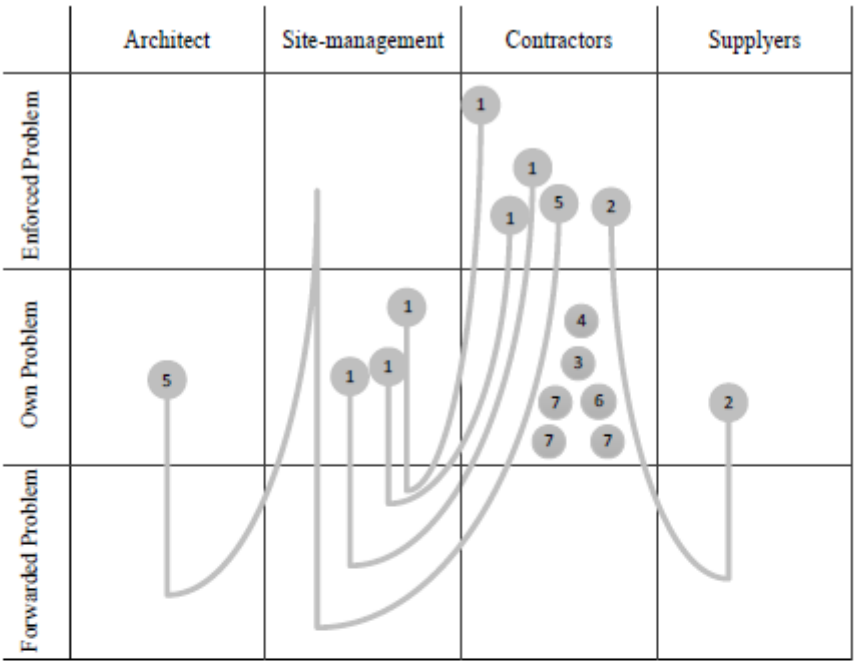

Figure 1. Problem changing hands.

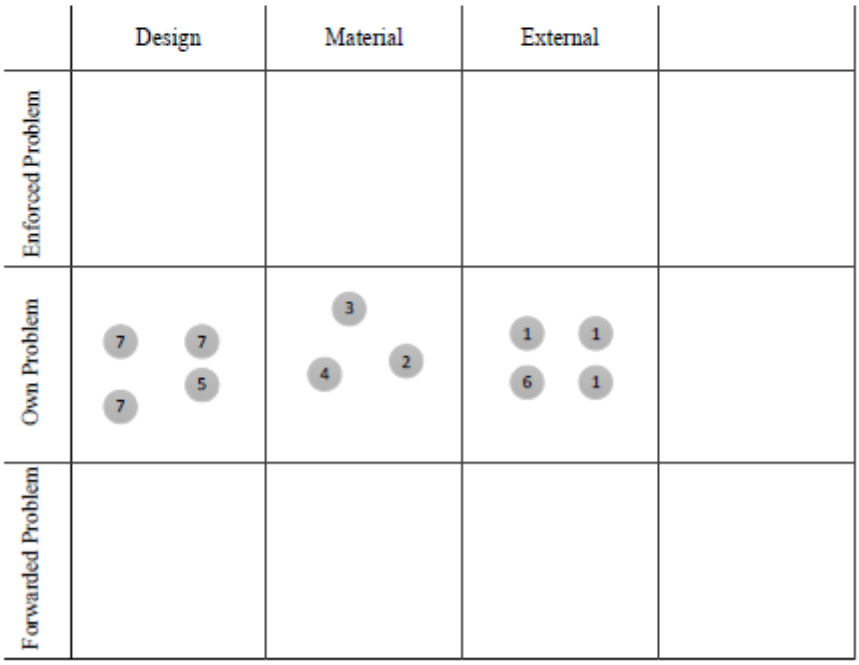

Figure 2. Changes between categories.

This is a pre-published version
Lindhard, S., Jensen, K.N., Larsen, J.K. 2017 "Looking for Improvement in Last Planner System: Defining Selection Criteria", Proceedings of the 2016 International Conference on Construction and Real Estate Management (ICCREM). American Society of Civil Engineers https://doi.org/10.1061/9780784480274.040

CONCLUSION

The 5 WHYs method is an method to identify the root cause to why activities are not completed on time. The 5 WHYs method have been applied at a single case study where 11 problems have identified and the root cause revealed.
The 11 problems have been analyzed by drawing problem chains and looking for patterns.
Fist the trail of "trade responsible" was drawn. The small data sample showed that all problems end at the contractors, because they are the ones executing the plans. Approximately half of the problems emerged among the contractors while the rest were enforced problems forwarded from the other project participants.
Second the trail of "identified cause" was drawn. The causes were divided into seven categories (Design, Workforce, Connecting Works, Material, External Conditions, Space, Equipment) corresponding to the 7 preconditions. From the small data sample, the 11 problems identified to be within either: Design, Material or External conditions, and none of the problems changed cause, thus, this indicate that the initial evaluation in relation to cause is often a good evaluation.
In future research the data set will be expanded; which will strengthen the validity of the findings and help to draw a general conclusion.

REFFERENCES

Eisenhardt, K.M. (1989). "Building theories from case study research." *Academy of Management Review,* 14(4), 532–550.

Hamzeh, F., Ballard, G. and Tommelein, I.D. (2012). "Rethinking lookahead planning to optimize construction workflow." *Lean Construction Journal,* (1), 15–34.

Johansen, J., Riis, J.O. and Arlbjørn, J.S. (2006). *Analysis and design of production systems: emphasising management and organizing,* Aalborg University Press, Aalborg.

Koskela, L. (1999). "Management of production in construction: a theoretical view." *7th Annual Conference of the International Group for Lean Construction,* Berkeley, U.S., 241–252.

Lindhard, S. (2014). "Applying the 5 WHYs to identify root causes to non-completions in on-site construction." *Proceedings of the 7th World Conference on Mass Customization, Personalization, and Co-Creation,* Aalborg, Denmark, 51–61.

Lindhard, S. and Wandahl, S. (2014). "Scheduling of large, complex, and constrained construction projects-an exploration of LPS application." *International Journal of Project Organisation and Management,* 6(3), 47–57.

Lindhard, S. and Wandahl, S. (2013). "Improving onsite scheduling: looking into the limits of last planner system." *The Built & Human Environment Review,* 6(2013), 46–60.

Love, P.E.D., Tse, R.Y.C. and Edwards, D.J. (2005). "Time-cost relationships in Australian building construction projects." *Journal of Construction Engineering and Management,* 131(2), 187–194.

Simonsson, P. and Emborg, M. (2009). "Increasing productivity through utilization of new construction techniques and lean construction philosophies in civil engineering projects." *Nordic Concrete Research Publication,* 39(1), 53–74.

Tsao, C.C.Y., Tommelein, I.D., Swanlund, E. and Howell, G. (2000). "Case study for work structuring: installation of metal door frames." *Proceeding of the 8th Annual Conference of the International Group for Lean Construction*, Brighton, U.K., 1–14.