How Can Lean Construction Improve the Daily Schedule of A Construction Manager?

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Abstract. The outcome of construction projects highly depends on effective management. The site manager is responsible for the site, and has a key role in executing construction projects. Especially this position has a wide range of tasks and a high volume of workload, which has to be carried out in a high pressure and high stress environment. Chaotic construction processes often create these working conditions. Lean Construction can help to organize the construction site in a better way and automatically supports the site manager.

1. Introduction and structure of the paper
Building projects are characterized by contingent environmental conditions, unforeseeable events and uniqueness. Construction site processes fluctuate over the course of a project and are prone to disruptions. To achieve goals for time, cost and quality regardless of these factors, significant effort is required for controlling a project. Therefore, the project outcomes are highly dependent on effective management. The methods of Lean Construction for identifying waste and increasing efficiency offer approaches to provide solutions to optimize processes and can thereby offer a significant contribution to the management of a project. The construction manager is in control of a building site, and has a key role in executing construction projects. Multiple and complex tasks together with the changing requirements of the everyday working conditions of a construction manager mean that his or her work must be carried out in a high pressure and high stress environment. A study by Germany’s Federal Institute for Occupational Safety and Health (BAuA) on the topic of psychological stress for persons engaged in management activities in the construction industry which was carried out from 1994 to 1997 derived similar conclusions pointing to factors such as cost pressure, working under time pressure and disruptions to work as the most common stressors. In order to gain insight into the current situation, six construction managers were observed in their everyday working environment (for a total of 55 hours). Thereby 371 activities were evaluated. The goal of the research was to evaluate the current and real state of the daily routine of construction managers.

2. Current situation in the construction sector described in literature
Germany’s Federal Institute for Occupational Safety and Health (BAuA) commissioned a research project on the topic of “Psychological Stress for Person’s Engaged in Management Activities in the Construction Industry” which was carried out from 1994 to 1997. The authors based the study on the fact that there was a noticeably above average incidence of sickness in the execution side of the construction industry, and the clear psychological strain on construction managers. The goal of the study was to determine and analyse the main stress factors. In addition, the effects of psychological oversteer were noted, and strategies for stress reduction and prevention were listed. These were
compiled as a set of guidelines. Based on a random sample of 70 construction managers, a list ranking the requirements and stressors for construction managers was defined. Alongside this, participants were asked to rate the frequency at which specific stressors occur, and what short and long term effect these have on the affected person. Furthermore, the interviewees were asked to identify possible strategies and resources for combating stress and possible solutions for problem solving [1]. The five most frequently named stressors were cost pressure, working under time pressure, interruptions to work, disruptions on the construction site and making decisions without sufficient information. As these results are 20 years old and in this time there have been for example major advances in information communication technology, it is questionable to what extent these results are still applicable. Therefore, to gain an impression of the current situation, further investigations were carried out.

3. Execution of the study and results

The results of the abovementioned research serve as a starting point to further investigate and analyse the workload and tasks of construction managers. This demanded an appropriate observation method for gathering the necessary data. As the work of a construction manager includes a varied range of activities and frequent changing between tasks, gathering accurate data requires the support of a data processing solution. Due to the abovementioned factors, the application of “Bauleiter Monitoring” was selected. This app is freely available on the Apple App Store. This data processing based tool serves the purpose of gathering data related to the activities and various circumstances affecting the daily work of a construction manager. The app allows documentation from various processes to be gathered in a quick and simple way including time logging to the nearest second. After completing the observations, each construction manager took part in a structured interview lasting approximately 35 minutes. This has the advantage of being able to ask questions exploring the reasons for the actions observed. Research hypotheses that could not be measured using the app could be discussed in greater depth. Additionally, the participants were asked to rank the representability of the time period observed. To gain an impression of the current situation, six construction managers (in total 55 hours) were observed over the course of one day. Thereby 371 activities were assessed. It must be noted that the entire workday was recorded to gain a complete picture. The focus point of the investigation were construction managers of building projects in the area of turnkey construction, construction of the building shell or industrial projects. The majority of the construction sites were in the later stages of execution. All construction contractors had more than 250 employees.

The results of the study show in particular that construction managers’ work is characterized by frequent changes between tasks, long working hours, increased effort for specific tasks and frequent disruptions. Figure 1 shows the average duration of a process (an activity) per construction manager. The mean value of all construction managers is 8:03 minutes. The change of task or process may be caused by a disruption or bringing a task to completion. This means the construction manager’s influence on when to change tasks is limited. On average a construction manager changes his or her task 7.6 times per hour. Quickly changing between tasks can be seen a main requirement for construction managers and can be linked back to increased workload. At once per 35 minutes the construction managers’ activities were interrupted close to twice per hour. Normalized to an eight-hour workday, this results in 15 interruptions per day. Figure 2 shows the proportion of disruptions attributed to each cause. Phone calls cause almost half (46 %) of all disruptions to work. Workers cause 36 % of disruptions.

1 https://itunes.apple.com/de/app/bauleiter-monitoring/id797547739?mt=8
The disruptions would not have big effects if the tasks were continued immediately and continuously after the disruption. Figure 3 shows the results of the investigation. 60% of the disrupted tasks will not be continued. Five out of six construction managers did not agree that their responsibilities could be carried out within the hours defined in their contracts (without overtime). This position is supported by the recorded working hours with the mean value being 8:28 hours. Construction manager 1 recorded a duration that was significantly shorter than usual due to extraordinary circumstances. Excluding construction manager 1, the mean value for construction manager 2-6 is 8:55 hours, and represents five overtime hours per week. Despite numerous overtime hours, only approximately 2/3 of the entitled breaks are actually used. The proportion of communication by email and Mobil phone is slightly under 25%. Phone calls are responsible for 46% of disruptions. As reported by the construction managers, there is a strong expectation on construction sites that he or she is always reachable by mobile phone. It is characteristic for all construction managers to be carrying out activities from multiple project phases at the same time despite only one
of those phases taking place at the time. Figure 3 details this situation, showing the division of activities across different working areas based on duration.

Figure 3: Activities across different working areas

4. Causes and effects for the current situation

The tasks of construction managers do not directly create value, but rather support the creation of value on the construction site. The results of the observations confirm that there is no structure during the course of the daily work of a construction manager, and that the various processes are not standardized. A lack of standards for construction site processes prove a hindrance to structuring construction management. If a construction site is unstructured, so too will be the organization of the construction manager’s work. As a result, the construction manager’s work is primarily reactive rather than structured and proactive. Too many changes in activities and frequent disruptions cause an increased workload and prevent optimized management of construction site management. The following will explore the effects of this in detail from the perspective of work science.

According to the reports of construction managers, disruptions are stressors, as they are always followed by a phase where the construction manager must familiarise him or herself with the task being carried out before the disruption. It is particularly difficult to continue the previous line of thinking in the case of complicated tasks. Research studies on the topic of disruptions to work conclude that these cause: increased task duration, increased occurrence of errors, tasks being forgotten and an increase in negative emotions such as fear and anger [2].

In general, multitasking is considered as a quick changing between tasks. “As soon as a change of tasks is required, there are costs associated with the changing, which as a rule is manifested as a lost time [3]. As a result, multitasking causes reduced productivity in most cases [3]. Research from the University of Michigan shows that the human brain is from 20 % to 40 % less competent when tasks are completed “simultaneously” rather consecutively [4]. “So, a person who is only removed from a task for three minutes, or makes a decision about another task, requires two minutes to return to the pre-interruption status [4]. For many years work scientists have shown that long working hours and psychological stress are correlated [5]. Longer working weeks lead to increased perception of working intensity. Time pressure and pressure to perform increase, and the affected parties tend to feel
overwhelmed by the amount or intensity of work [6]. It was also shown that in the case of longer working hours, fewer breaks are taken.

The causes of the effects described above may be a result of the high level of fluctuation in workloads on construction sites which can lead to chaos on site. Because of this the construction manager’s workday is disrupted by unforeseen arising problems which require an immediate reaction and lead to an increased level of management and required coordination. Problems are often recognized and eliminated when the consequences have already occurred. Therefore, the construction manager takes on the role of a “firefighter” [7]. As a consequence, the construction manager has no chance to structure his or her organization or daily work. Small disruptions can also be escalated as a result of the “Bullwhip Effect” causing bigger disruptions requiring more attention [8]. “Firefighting” as a management approach can function well in individual cases. However, this often leads to everyday activities being balanced out by an extraordinary effort as this method cannot be efficient. Open communication and documentation between the parties involved often do not exist in practice. In this situation, the construction manager acts as the command station of the building site. All information flows and decisions are thereby managed through the construction manager. As soon as the level of complexity exceeds the competency of the construction manager, the system collapses. A regulated construction sequence, higher transparency between involved parties and short-cycled target-actual comparison on the construction site can minimize these problems.

5. Lean Construction as a Solution

5.1. What is Lean Construction
Lean Construction is the application of Lean Management to the construction industry [9]. Lean Management is summarized as the globally successful production approach of the Toyota Production System. At the centre of this approach is focusing all activities on value from the perspective of the customer. A significant contribution to this is eliminating all kinds of waste from the production process. Every process includes various kinds of waste. The identification and associated reduction is not always readily identifiable in practice. This means identification of waste is a significant challenge. There are various forms and methods under the Lean Construction movement. Two significant forms can support construction managers to address the problems described in this paper. Firstly, open and transparent communication with all participants is the basis of improvement. Before this step is implemented, there is a considerable waste in the process. Interfaces in the process are often unknown or deliberately not spoken about, as the mistakes of others could generate a win situation. Achieving transparency should be the beginning of the value creation process. Methods such as the Last Planner System™ provide a good basis for this. If transparency is achieved and weak points are identified, then it is possible to begin with standardization of processes. With this step, the second form – a standardized and structured construction process – can be implemented. Methods such as Takt Planning and Takt Management become more significant in this case. Thereby a construction site is divided to a fine-grained level to achieve an optimized value creation sequence. This sequence of works is given a uniform duration. Hereby the process of value creation moves systematically and consistently through a structure. Management of a construction site is thereby simplified. The construction manager can adjust his or her work to ensure optimal support for value creation.

5.2. Why does it help?
Through focusing on generating value from the perspective value to the customer, construction managers can better prioritize their work. Relevant works that serve the flow of value generation can be more actively monitored. Blocks of work can be weighted before they are structured. The use of Takt Panning and Takt Management as Lean Construction methods improve the chance of the construction sequence and construction manager’s activities interlinking. A taked construction
sequence increases the requirements of the supply chain process for materials, planning and execution. The speed of the system as a whole is decisive rather than the speed of individual trades. Lean Construction as an approach leads to a reduction in fluctuations in the construction process and early identification and sustainable resolution of problems to ensure the system functions seamlessly. Here the standardized processes and methods play a significant role in structuring value creation on a construction site. Based on a standardized construction sequence the supply-side processes can be measured and better coordinated. Takt offers the chance to simplify coordination and construction site management. Thereby it is possible to be proactive rather reactive. Short-cycled planning and inspection in the form of daily meetings reduce the role of the construction manager as “firefighter”. Workers can independently access information, which prevents unnecessary communication. For this form of project execution, the daily work of the construction manager must also be structured, as the site will not otherwise receive the necessary attention and management. Further waste in the work of the construction manager can thereby be further eliminated. Continuously determining performance indicators and transparently showing these simplifies reporting of the progress of construction and possible deviations. Clearly defined interfaces regulate the flow of work and information. Collaboration at an early stage and collaborative teamwork from all parties leads to increased trust, common understanding and thereby more value creation. Through standardization of work sequences, waste in the processes can be identified. Through further development of the standards the process becomes more efficient and potential optimizations can be identified.

5.3. Structured daily work for construction managers
After the prioritization of blocks of work according to value to the customer and interlinking with construction site processes, it is possible to eliminate or reduce excess work. Thereby Lean Construction and the use of Lean Principles on construction site allows construction managers to efficiently plan their daily work. Reduction of waste in the daily work of construction managers is a significant factor for optimization. The findings of this study draw attention to the possibility for improvement in the organization of construction managers’ work. A conceivable solution would be a more structured workday. This should reduce disruptions, the frequency of switching between tasks and the number of overtime hours to reduce the workload of construction managers. A structured workday should follow certain standards, but also be flexible to take individual factors of the construction site into account. The study showed that the beginning of the workday is particularly suited to being structured. This includes completing a round of the construction site and meetings at various levels. An example is the Takt Control Meeting according to the approaches of Lean Construction of Binninger et al. [10]. This option for organizing the construction site is based on visualizations and a universal functionality. It offers a counter to complex and chaotic systems which are difficult to implement due to insufficient language skills. Possible hindrances and unclarities are identified in advance, and later problems are pre-empted. The remainder of the workday can be divided into blocks of approximately 90 minutes. Every block, shown in figure 4, of work can be allocated a module to allow a clear division between site planning and site management. Different modules can be allocated tasks with different characteristics. For example, tasks, which require the full attention of the construction manager, could be allocated to the module Concentration. Here tasks such as checking drawings or calculations could be completed. This allows a disruption free and concentrated working approach, which leads to less errors, and time saved during the workday.
6. Conclusions and prospects

Fluctuations in work and disruptions over the course of a project lead to an unstructured construction site. These factors are then reflected in the daily work of construction managers. To continue to meet the goals of a project, an increased workload for management and coordination is needed. The construction manager must work as a “firefighter” and has no structure in the way his or her work is organized, which is necessary due to the unstructured construction sequence. Various consequences like disruptions and frequent changes between tasks lead to an increased workload or poor performance for the construction manager and prevent an optimal management of the construction site. Lean Construction can help to stabilize the construction process and provide a long-term optimization. A structured construction site requires the necessary attention to be properly managed. This time can be made available to the construction manager through optimization and structuring of his or her daily work. The implementation of this method of working comes with some challenges, as construction managers currently have substantial freedoms in planning their day. However, a structured and standardized daily routine is necessary for management of a takted construction site.
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