Lean production principles in construction projects design and delivery

Zuzana Struková
Institute of Civil Engineering Technology and Management, Faculty of Civil Engineering, Technical University of Košice, SLOVAKIA, Košice, Vysokoskolská, 4, E-mail: zuzana.strukova@tuke.sk

Whereas lean principles are not only manufacturing oriented, they are of use in a special industry like construction is, lean thinking can be considered as a manner to manage construction. The paper deals with the lean production application in construction projects design and delivery.

Keywords: lean construction, lean production, construction design, integrated project delivery, collaboration

I. Introduction

Design and construction can be understood [1] to be a series of activities, where some add value and others do not. There are various time consuming, non-value-adding activities in the design process, such as correction of errors and rework, the physical handling and organization of documents, and transportation, inspection, and movement during the construction process. The ratio of non-value-added or wasteful activities in a typical construction project was estimated [2] at 55% to 65%.

In construction, similarly as in manufacturing, is important to save money and stay competitive. One of sufficient ways to get over this inefficiency in construction industry and to eliminate is based on identifying abundance in construction and determination a method for removing the abundance and replacing it with value adding alternatives.

II. Waste origin in design and construction

Among essential causes for the poor performance of the building design process belong: poor communication, lack of adequate documentation, deficient or missing input information, unbalanced resource allocation, lack of coordination between disciplines and erratic decision making.

In like manner, construction projects are typically fragmented. Mostly, subcontractors do their work disregarding how their work impact the work of other subcontractors. Such performance of the project usually creates problems relating to schedule and quality.

Other problems of construction in the world [3], as well as in our country, leading to reflect upon Lean production as a key to improve the industry consist in: much of construction time is spent waiting on the next trade to show up and fixing mistakes; the average construction
worker operates at 40% efficiency; qualified and skilled workers are to seek; the return on equity for construction declines when comparing with other industries; customers are frustrated with poor quality, confrontation, excessive change orders and scheduling delays.

III. Lean construction

The lean production principles, whose founder is the Toyota Motor Company, include reducing lead times, eliminating non-value adding activities and reducing variability and are enabled by methods such as pull scheduling, simplified operations, and buffer reduction. Hence, lean thinking principles are not only manufactory oriented, they are of use in a special industry, like construction and is can be considered as a manner to manage construction.

The lean construction can be understood to be the continuous process of eliminating waste, meeting or exceeding all customer requirements, focusing on the entire value stream and pursuing perfection in the execution of a constructed project.

IV. Increased collaboration in construction

If design decisions are being made by architectural and engineering groups that do not communicate with each other, collisions and interferences are typical at the site and they have been seen as a fact of life. When for example design of plumbing results in a water pipe going through structural steel, costs increases as work has to stop for the plumbing system to be redesigned and reworked on the go. Lean construction aims [4] for a smooth flow of design and construction activities by improving trust, communication, clear understanding of scope, and the reliability of the team work plan. Collaboration among companies in the value chain is facilitated by 3D and 4D modeling of the product and process. This focuses the players on constructability, avoiding costly mistakes and assuring just-in-time availability of materials and workers. There is already known term 5D technology, where the core is just BIM. 4D BIM presents the dimension of time and 5D BIM presents the dimension of costs.

V. The Lean Project Delivery and Integrated Project Delivery

The Lean Project Delivery System is a product of the Lean Construction Institute [5] founded in the U.S. in 1997 and dealing with research to develop knowledge regarding project based production management in the design, engineering, and construction of capital facilities. The System consists of thirteen modules, nine organized in four interconnecting phases (triads) extending from project definition to lean design, to lean supply, to lean assembly plus two production control modules (work flow control and production unit cost) and the work structuring module, both conceived to extend through all project phases. The Lean Project Delivery System captures both the linear and the iterative nature of the design and construction process and recognizes the importance of certain aspects of design and construction happening in parallel rather then sequentially.

In traditional construction [6] projects are comprised of many two-party contracts creating a vertical chain of relationships that flow back to the owner, but do not interconnect project participants across contractual lines. Each participant operates under commercial terms that provide economic incentive for it to maximize its own interests regardless of whether its actions would hurt other project players or benefit the project as a whole. The Integrated Project Delivery (IPD), similarly as Lean Project Delivery, defines a new way of being and a new set of relationships in a project. It organizes for open communication making it easier for project stakeholders to share knowledge. The key principles of IPD show these performance characteristics [7]: early involvement of key participants; shared risk and reward; multi-party contract; collaborative decision making and control; liability waivers among key participants; jointly developed and validated project goals.

Conclusion

Lean construction is a systematic application of lean thinking to the design and construction of buildings that do what clients and end users want provide value. Lean process improvement is not absolutely a new concept, but it is relatively new to construction. Lean principles hold the promise of reducing or eliminating wasteful activities, costs, and inefficiencies in construction, creating a system that provides value to customers.

Integrated Project Delivery is the way to organize project teams to achieve lean construction at a time when the industry is searching for ways to eliminate waste, cut costs, improve productivity, and create positive outcomes.

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References