Criticality in Location-Based Management of Construction

The present thesis adds to the current theory of location-based management (LBM). Research has suggested that LBM is better suited than the prevailing techniques for scheduling and controlling construction projects because it takes continuous work flow, resource limitations, and location conflicts into account. The thesis describes how the different constraints in LBM affect a project’s lead time, and how the criticality of the activities changes when LBM is applied, in contrast to the prevailing techniques. It is important for construction managers to understand these changes because current techniques fail to provide information about vital limitations in their production processes. The prevailing techniques only take technical constraints into account when determining the criticality of an activity. LBM also includes location, continuity and productivity constraints. Therefore, the prevailing techniques can cause misperceptions of the critical activities on building projects because the constraints that determine the activities impact on project’s lead times are not explicitly dealt with. This lack of information can result in disruptive work sequences, ineffective consumption of resources, and, ultimately, unnecessary prolongation of a project’s lead times. LBM explicates additional constraints that influence a construction projects lead time, which means that the entire perception of when activities are critical changes when LBM is applied rather than the prevailing techniques. However, the current literature does not include a collected description of what constitute critical activities in LBM. Nor have the implications for scheduling and control efforts of these changes in criticality been described. Accordingly, the present thesis establishes a collected criticality principle of LBM; highlights the implications of this alternative criticality principle to the schedule and control effort on construction projects; and suggests how time buffers should be applied on LBM projects to protect critical activities, compress project’s lead times, optimize flow, and minimize resource consumption. The thesis offers three main results that contribute to the current LBM literature and close some of the gaps therein. The thesis conceptualizes the criticality principle of LBM by analyzing the relationship between inherent constraints in LBM and the lead times of projects. The collected criticality principle of LBM is suggested to contain the following aspects:

- Activities or tasks on the longest path or paths through a project’s dependency network with zero float are critical.
- Activities or tasks are critical if they are allocated to a location that imposes time delays on activities on the longest path or paths in a project’s dependency network with zero float.
- Activities or tasks that cause discontinuity of activities and tasks on the longest path or paths through a project’s dependency network with zero float are critical.
- The most critical activity or task is that which has the lowest production rate on the longest path or paths through a project’s dependency network with zero float.

The implications that follow from these additional constraints were studied by analyzing as-built production data with the LBM technique from a project that used the prevailing scheduling and control techniques, thus highlighting the differences. The findings suggest that the combined criticality principle of LBM entails five major differences:

- The number of activities that are critical, and appear to be critical, increases.
- Critical activities can be prioritized by means of the slowest critical task.
- Consequences from slower-than-planned production performance of critical tasks are forecasted more negatively.
- Work crews’ flexibility of work sequence through a building is reduced.
- The sensitivity to disturbances and fluctuation in production rates increases.

The last of these points inspired the third part of the research project. Although sensitivity is mitigated by applying time buffers in LBM, buffer management in LBM is treated sparingly in the current literature and no guidelines exist as to how buffers should be placed and prioritized. Therefore, the thesis’ final contribution is to offer suggestions regarding the placement and prioritization of buffers in LBM, which was established using theoretical guidelines of critical chain theory and a case study with practitioners. Specifically, these suggestions are that stage buffers and weather contingency buffers should be avoided. Moreover, activity buffers should only be applied to the most sensitive critical tasks, and should otherwise be reallocated; and productivity feeding buffers should be incorporated ahead of the slowest tasks, leaving the project buffer to predominate.

General information
State: Published
Organisations: Department of Management Engineering, Production and Service Management, MT Højgaard AS
Contributors: Büchmann-Slorup, R., Andersson, N., Fuhr Pedersen, L.
Number of pages: 218
Publication date: 2012

Publication information
Publisher: Department of Management Engineering, Technical University of Denmark
ISBN (Electronic): 978-87-92706-83-6
Original language: English
Electronic versions:
Criticality_in_Location_Based_Management_of_Constructionv.pdf

Bibliographical note
The thesis is the result of three years of research from January 2010 to December 2012. The research was performed through an industrial PhD program in collaboration with the Department of Management Engineering at the Technical University of Denmark and MT Højgaard A/S, Denmark’s largest contracting company. The research was funded by the Ejnar and Meta Thorsen Foundation and the Danish Agency for Science, Technology and Innovation.