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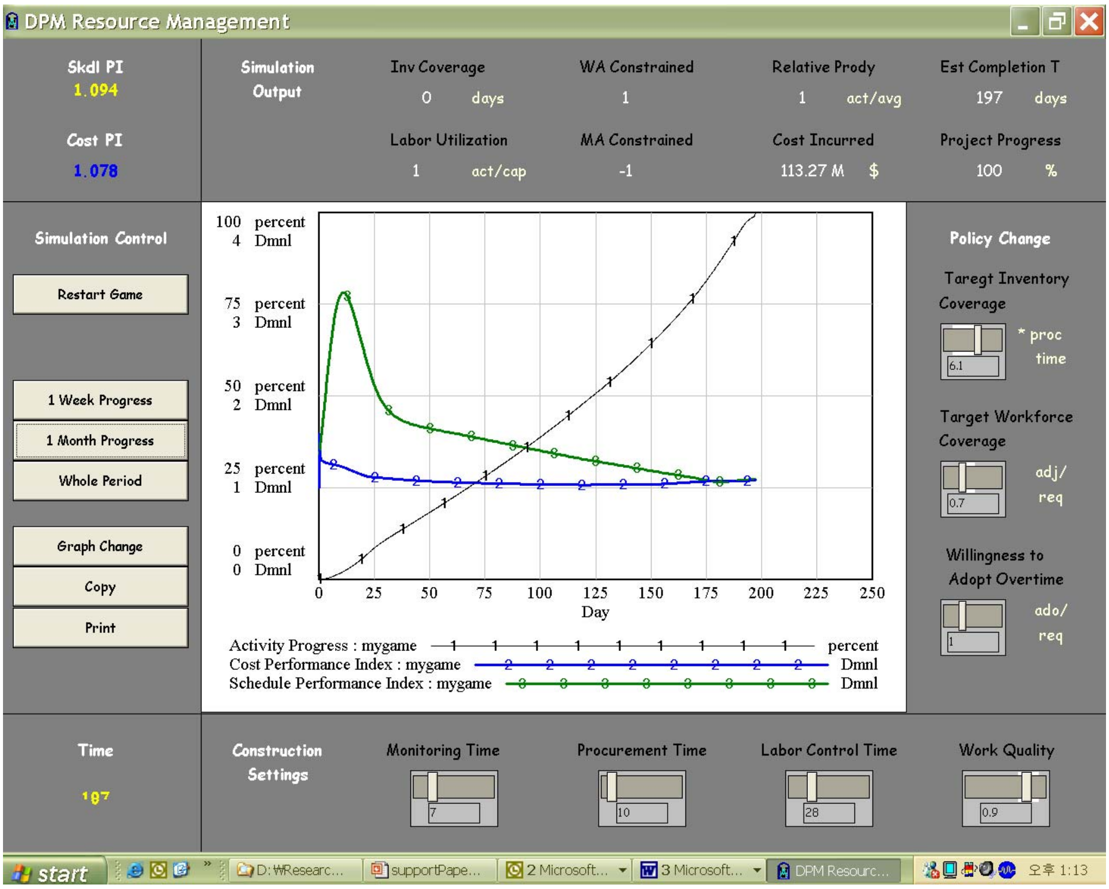
Model-based Dynamic Resource Management for Construction

Construction progress is constrained by either work availability or resource availability. Work availability at a certain progress is governed by the work dependency within the same activity (e.g. structural steel erection on the second floor can start only after completion of the first floor work) or between activities (e.g. a finish-to-start relationship between foundation and excavation). Since work dependencies are determined by the nature of work, they are normally beyond the project manager's control. In contrast, resource availability is more likely determined by resource plans and managerial decisions, which can be made independent of the construction system. This fact suggests that construction management is nothing but resource management.

For this reason, most project management text books (e.g. Shtub et. al, 1994; Lewis, 1998; Harris and McCaffer, 2001; Walker, 2002) recognize resources as the key to meeting a project schedule, addressing their significant impact on the construction system. In the same context, the importance of resource management has been emphasized in the literature [Karaa and Nasr, 1986; EL-Rayes and Moselhi, 1998, 2001; Tommelein et. al, 1999]. Various methods and formulations have been also suggested for effective resource management. For example, Padilla and Carr (1991) developed a simulation model to dynamically allocate given resources to construction activities. Karaa and Nasr (1986), and Senouci and Adeli (2001) proposed



Dynamic Resource Management Tool

mathematical formulations to optimize resource utilization. The models developed by Chan et al. (1996) demonstrated that model-based resource leveling and constraint-based scheduling are useful in shortening project duration. For the same purpose, comprehensive algorithms and neural dynamic models were also elaborated [EL-Rayes and Moselhi, 1998, 2001; Leu and Hwang, 2001]. These researches demonstrated how resource-driven planning could enhance project performance and contributed to establishing a basis for construction resource management.

Despite their different views and approaches, the previous researches commonly focused on minimizing resource idling and waste. As will be discussed, excess resource idling and waste can result in cost overruns, while low resource coverage or long lead-time in resource acquisition can delay the project schedule by creating resource bottleneck. Therefore, systematically managing this tradeoff at either planning or control stages is critical to ensuring project delivery in time and within budget. In addition, to provide practically useful guidelines and tools, the dynamic construction process needs to be realistically represented.

In this research, a model-based dynamic approach is proposed for construction resource management. Following a brief introduction of system dynamics, the research methodology, the dynamics of construction progress and its determinants are discussed. Then, having identified the tradeoff associated with resource coverage, and work dependencies involved in construction, this research describes the dynamic resource management model developed using system dynamics. By simulating the model, it examines the effect of resource coverage on project performance and obtains policy implications. Based on the research findings, generic strategies for dynamic resource management are suggested. Finally, it is demonstrated how the model supports their application as an automated tool.

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