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Modeling and Simulating Productivity Loss Due to Project Changes

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Abstract : The context of large engineering projects is particularly favorable to the appearance of engineering changes and contractual modifications. These elements are potential causes for claims. In this paper, we investigate one of the critical components of the claim management process: the calculation of the impacts of changes in terms of losses of productivity due to the need to accelerate some project activities. When project changes are initiated, delays can arise. Indeed, project activities are often executed in fast-tracking in an attempt to respect the completion date. But the acceleration of project execution and the resulting rework can entail important costs as well as induce productivity losses. In the past, numerous methods have been proposed to quantify the duration of delays, the gains achieved by project acceleration, and the loss of productivity. The calculation related to those changes can be divided into two categories: direct cost and indirect cost. The direct cost is easily quantifiable as opposed to indirect costs which are rarely taken into account during the calculation of the cost of an engineering change or contract modification despite several research projects have been made on this subject. However, proposed models have not been accepted by companies yet, nor they have been accepted in court. Those models require extensive data and are often seen as too specific to be used for all projects. These techniques are also ignoring the resource constraints and the interdependencies between the causes of delays and the delays themselves. To resolve this issue, this research proposes a simulation model that mimics how major engineering changes or contract modifications are handled in large construction projects. The model replicates the use of overtime in a reactive scheduling mode in order to simulate the loss of productivity present when a project change occurs. Multiple tests were conducted to compare the results of the proposed simulation model with statistical analysis conducted by other researchers. Different scenarios were also conducted in order to determine the impact the number of activities, the time of occurrence of the change, the availability of resources, and the type of project changes on productivity loss. Our results demonstrate that the number of activities in the project is a critical variable influencing the productivity of a project. When changes occur, the presence of a large number of activities leads to a much lower productivity loss than a small number of activities. The speed of reducing productivity for 30-job projects is about 25 percent faster than the reduction speed for 120-job projects. The moment of occurrence of a change also shows a significant impact on productivity. Indeed, the sooner the change occurs, the lower the productivity of the labor force. The availability of resources also impacts the productivity of a project when a change is implemented. There is a higher loss of productivity when the amount of resources is restricted.

Keywords : engineering changes, indirect costs overtime, productivity, scheduling, simulation
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