Risk-based decision making in construction: a case of planning and risk assessment of construction alternatives

J E Avendano Castillo, S H S Al-jibouri & J I M Halman
University of Twente, The Netherlands

Keywords: risk identification, construction process, Monte Carlo simulation, failure costs

Informed decision making is crucial for the successful completion of a construction project. The decision making process takes place at various stages throughout the project. At the beginning of construction stage for example, decisions are taken in order to determine the set of construction activities and methods needed for doing the work; and to draw the necessary plans for carrying them out. Such decisions could have a significant impact on the performance of work. In the case of a contracting company in particular, this could mean the difference between completing the project lucratively and making loss due to the occurrence of failure costs (Avendano Castillo et al., 2009). Considering all sets of activities, sequences and possible methods for a construction process in the decision making is complex as the number of alternatives can grow very high and each alternative will have different risks associated with it. In practice it is not possible for managers to deal or investigate the high number of options available and instead they merely rely on judgement and experience in choosing the construction method to be used for carrying out the work (Flanagan, 1993). The consequence of such approach is that decision will be made without taking into account the full range of feasible alternatives that might produce more favourable results in terms of reducing potential risks.

Project risk management techniques have matured over time to become a fundamental facilitator in decision making (Smith, 1999). Nevertheless, risk management in practice is heavily orientated towards the techniques of managing risks and normally less attention is given to the identification of risks (Chapman, 2001). It is not possible to manage risks if the risks are not identified and hence the underestimation of the importance of the risks identification process will negatively affect the effectiveness of a decision.

This work describes a proposed risk based simulation model for supporting decision making in construction planning to evaluate the costs and risks associated with various alternatives methods to carry out the construction process in building pits. The objective of the simulation model is to assess the performance of all feasible construction alternatives simultaneously taking into account the risks associated with each alternative, the sequence of the activities and the alternative execution methods.

The simulation model presented in this paper is based on the process based framework for modelling risks and possible failure costs in construction. This framework considers that a construction works can be modelled as a process that contains a set of construction activities and that risks may occur at activity level as well as at process level. For this reason risks are categorized into two types, activity based and process based. Activity based risks are those that only relate to an activity and that will affect its performance in terms of cost and time. The process based risks are those that once materialized affect other activities and the process as a whole. Furthermore the
framework considers that failure costs are the result of many contributing factors that amass over time during the execution of a process. To a certain extent this means that every activity in a process can contribute to the generation of risks and failure costs. Therefore when assessing the generation of failure costs due to process failures it is important to take into account the development of the failures over the process.

As an example for the application of the model, a rectangular shape building pit is assumed. For this exercise there are 6 alternatives identified derived from the network diagram in Figure 1. For this example, there are two moments in the process where decisions that can have impact on performance need to be made. The first key decision moment is at the start of the process where a decision is required on selecting one of three options for the constructing the pit wall activity. The second critical decision moment is required as soon as the struts activity is completed. At this point it is possible to choose between two different paths in the process: either carrying out a wet excavation or a dry excavation.

Figure 1. Network diagram containing process alternatives.

The work described in this paper has shown that there can be many combinations of activity sequences and construction methods to carry out any type of work in construction. Combined with the effects of risks, it is difficult for mangers to get insight into all these combinations and their related costs to be able to select the best one. The work has described how a computer simulation model can be used to assist managers to make decision on the best construction method option to take to minimise potential failure costs.

Findings based on preliminary data have indicated that construction experts can in fact benefit from the model in that it supports decision making by providing the decision maker with an overview of the performance of a number of alternatives available for a particular construction process. This is extremely useful when considering that the number of alternatives can be high. Additionally the use of the model is expected to provide more reliable assessment of the risk associated with the various alternatives.

References