An Alternative Treatment of Risk: A Heuristic Approach

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Abstract

A radically different approach to the issue of risk and criticality is taken in this paper, in which an extensive computational requirements of strict analytical approaches is substituted by simple indices which can be easily calculated. To respond to the question of activity criticality, and the risk involved in manipulating the activity's duration parameters (mean and variance) two easy to compute indices, the so-called Risk Indicator (RI) and Safety Indicator (SI), are proposed.

These two indicators will help the project manager to feel the degree of impact of an increase of the mean of each activity's duration on the average project total duration.

They are directly computed from available data about the project network and they can be very useful for project management. Really, a small value of SI, which is easily calculated for any activity, hints at a higher risk of delaying the project if the mean duration of the activity is increased.

1 Extended abstract

A radically different approach to the issue of **"risk and criticality"** is taken in this paper, in which an extensive computational requirements of strict analytical approaches is substituted by simple **indices** which can be easily calculated. To respond to the question of **activity criticality**, and the risk involved in manipulating the activity's duration parameters (mean and variance) two easy to compute indices, the so-called **Risk Indicator** (RI) and **Safety Indicator** (SI), are proposed. These two indicators will help the project manager to "feel" the degree of impact of an increase of the mean of each activity's duration on the average project total duration.

They are directly computed from available data about the project network. Such data include the proposed concept of "standard float". Note that in the absence of randomness, the impact of a delay in activity introduces a delay in the completion time of the project, that depends on whether or not the activity belongs to the CP (Critical Path) and on the magnitude of the delay in activity duration. This impact can be evalueted by an "Impact Factor - IF" which domain is [0;1].

When the activities duration are random variables (r.v.), the consequences of an increase in the mean duration of activity depends on the (random) realisations of all

other activities in the project. The Impact Factor itself becomes a r.v.. To estimate its mean, the authors suggest the use of the same device that was used by the originators of PERT; viz., substitute everywhere the expected duration of each activity and determine the total float of the activity and the floats related with precedind and succeding activities. The authors discuss the relationships between these floats and the estimated value of the IF.

According these relationships a Risk Indicator and a Safety Indicator, that takes in account also the activity's duration variability, are suggested. To evaluate how "good" are these indicators, they are applied to a large set of project networks generated by the model developed by the authors and described in Tavares, L.V., "Advanced Models for Project Management", Kluwer's, 1998. This model preserves key features describing the morphology of the project networks by six indicators. These six indicators $(I_1, .., I_6)$ represent the size of the network (I_1), how serial it is (I_2), how homogeneously wide it is (I_3), how connected it is (I_4), how slow is the decaying rate of the number of precedence links (I_5) and how "deep" is the maximal level length of such links (I_6).

For each network the SI is computed for each activity, as well as the estimated expected value of the Impact Factor, through a Monte Carlo sampling, assuming to be gaussian the duration of each activity.

According the results of this experimental work it is possible to conclude that between the Safety Indicator and the expected value of the Impact Factor there exists a exponential relationship quite stable. However, an increase of the number of activities tends to increase the dispersion of the impact factor, particularly for a low SI. This conclusion is quite reasonable because the impact of an activity depends on its interaction with other activities of the network and such effect is more uncertain if their number is larger. Else, it is possible to define an idealised exponential function between the SI and the expected value of the IF. The 95% confidence band applied to this function is also defined.

Obviously, these results can be very useful for project management. Really, a small value of SI, which is easily calculated for any activity, hints at a higher risk of delaying the project if the mean duration of the activity is increased. This means that the manager can estimate the activities with an expected value of the IF greater than a specify value by selecting those with a SI less than another value given by the results of this work.

However, this estimation leads to two types of errors with specific probabilities:

- $\alpha \rightarrow$ probability of missing a dangerous activity because $SI > X$ instead of being within the "dangerous" sub-domain $SI \leq X$.
- $\beta \rightarrow$ probability of selecting a non-dangerous activity as dangerous because it has $SI \leq X$.

These results are also studied and α and β are estimated from the generated networks. Finally, it is built a synthetic indicator, estimating expected value of the IF, in terms

of the features of the network and of the activity's SI. The expression that defines this synthetic indicator is a linear one and explains about 94% of the variance of the expected value of the Risk Factor.

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