Risk assessment should be a critical component of decision-making process. This work proposes a practical modern way to manage risks: a new key risk indicator, a method to summarize risk scenarios, and a safety factor to avoid contingency overrun; these findings open the door for risk management to enter into the new digital age. The whole solution has been implemented in a multinational construction company by programming an application program running since July 2016. The theoretical basis of the proposal has been fully validated through a doctoral thesis defended in July 2019 that has awarded with the prestigious prize Julio Castelo in December 2019.

This research project aims to provide a solution to improve control and risk management, as requested by professionals and in the scientific literature.

Risk assessment in construction projects today is more complex than ever because of the volume of risks (in the hundreds) and their sheer variety. There is a need for a generic risk indicator and a risk summary to rate the overall risk, and breakdown techniques introducing dimensions and components make it still more difficult asking for a solution that conventional risk assessment methodologies do not provide.

This conducted study records the process of the analysis of existing solutions, a study of scientific literature in search of works that could serve as a guide, selection and development of the research methodology, definition of solutions, and justification of results.

To become familiar with best current practices required interviews with professionals and consultants, as well as the compilation of thousands of scientific and business documents that were categorized, filtered and analyzed, and then integrated into a document database of around 300 references.

The most commonly used techniques were analyzed, focusing especially on risk indicators, evaluation methods, scales, and methods for calculating overall risk in any one scenario, and the total cost of those risks. The theoretical bases of these practices and their applicability to risk assessment were also analyzed, especially the Expected Utility Theory and the Central Limit Theorem. That meant investigating the most common characteristics of risk scenarios in terms of number, dependency, and uniformity of risk events. The various techniques (brainstorm, interviews, questionnaires, Delphi, Monte Carlo simulation, etc.) were also studied to gauge their applicability and adaptability to typical corporate work environments.

The studies carried out confirmed that current practices do not satisfy the need that evaluators and companies have to evaluate and communicate efficiently what the risk status is and facilitate decision making.

But what is yet more important is the discovery regarding limitations and errors implicit in some of the techniques and methods most often used. The indicator resulting from the product of impact times likelihood, in spite of being commonplace, is so non-intuitive and hard to understand that it leads to an underestimation of the importance of the risk. Drawing the overall risk level as a sum or average of the previous products highly restricts the modification of the risk catalog and the importance of each risk individually and yields a result that can underestimate the risk level. The total risk cost as the sum of the products of probability times cost provides an average value that does not allow for the probabilistic properties of the scenario and which in reality overruns 50% of the time, and by a large amount.

The inadequacy of existing solutions led to research into the design of a new solution, starting with the definition of the characteristics that an ideal solution would possess. The scientist methodology has followed separated research lines. Three independent methods (literature review, brainstorming sessions and structured interviews) gave rise to three lists of proposals. The lists were integrated by applying semantic techniques and appropriate weighted coefficients yielding a prioritized list of 66 improvement parameters that define the required characteristics.

Scientist methodology involves several combined techniques to provide a solution that meets the defined requirements, and a calibration and testing process to validate the results. To define the new indicator the visual thinking technique and subsequent mathematical study were applied, bearing in mind earlier works, though achieving a final formulation for it. To define a risk summary system, building on the previous technique, a weighted square was incorporated, in line with other research, but with an innovative design based on the new defined indicator. To find a solution that provides reliable calculations of the total risk cost of a scenario, simulation models were used in combination with the Monte Carlo simulation, applying to the results non-lineal and multiple regressions, combined with successive approximations.

There are several main results presented there, as well as the 66 improvement parameters: a new indicator which is quantitative, linear and intuitive, the Visibility Factor, calculated using impact and likelihood values assigned to every risk event; a risk scenario summary method that combines an ingenious and simple combinatorial algorithm with a weighted square based on the Visibility Factor, and which offers as a summary an equivalent risk event with its own impact, likelihood and Visibility Factor; and lastly, an enlargement coefficient which can be obtained using a table or formula, to be applied to the conventional total risk cost (the sum of cost times likelihood for each risk event) obtaining a confidence level of 85%, greatly reducing the chance of a cost overrun.

The new system proposed here meets the main improvement parameters that were defined in the list and has analytical capacities, converting qualitative evaluations into quantitative values ready for analysis, which facilitates decision making. Its use will not create extra work for evaluators because it will make the most of existing impact and likelihood evaluations.

The proposed system has been tested with simulation models and in real projects of distinct companies, comparing the outcomes with the companies' risk system and the proposed system. Risk levels that went unnoticed before are now detected.

Related conferences and publications:

http://pmi-valencia.org/pmi2018/index.php/noticias-y-eventos/noticias/260-resumen-de-las-xii-jornadas-valencianas-de-direccion-de-proyectos

https://recyt.fecyt.es/index.php/EPI/article/view/epi.2017.nov.06
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(DOI: 10.7764/RDLC.17.3.423)

http://www.pressacademia.org/archives/jbef/v8/i4/5.pdf
(DOI: 10.17261/Pressacademia.2019.1166)

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