Summary Report

Title

A risk-based decision support system for supporting the project management / controlling (Risk management, tendering and project evaluation)
Submitter: University of the Armed Forces Munich, Institute for Project Management
Project leader: Univ.-Prof. Dr.-Ing. Jürgen Schwarz

Motive / Initial Situation

In the development of construction projects, a large number of criteria are evaluated and designed aimed to fulfil the desired expectations of the planned project. These criteria might or not be risk based; nevertheless they are always analysed in separate proceedings. The application of decision analysis enables the development of a single assessment process that integrates all the criteria. Besides artificial neural networks is united into risk analysis.

Subject of the research project

As one of the first task it was necessary to study the project development in order to identify the potential applications of decision analysis. With this goal was first established direct contact with different project managers from the practice. Hence it became clear that the project development a great need for decision analysis and transparency for its performance, at the same time risk management is another major challenge, due the fact that for many entrepreneurs it is still performed in a very qualitative way.

Decision analysis provides a systematic and transparent approach to decisions; they develop mathematical models by measuring, evaluating and allocating all the required criteria. Currently decision analysis is used in various research fields and finds slowly its application in construction projects. Accordingly 37 decision making procedures were examined to define the appropriate procedure for this research project. As a result, the AHP method developed by Saaty was selected. This method allows a simple decision's processing and shaping in hierarchies and through the use of weights, the expectations of the project can be represented; in this form the selected alternative, reflects the requested expectations and requirements.

To evaluate the applicability of AHP in the practice a further investigation in the form of a diploma thesis "Development of a model for se-

lection of ceiling formwork" was carried out. This study confirmed that the decision analysis increases the reliability of decision making; AHP provides a simple and transparent decision's procedure, furthermore the use of weights allows setting the expectations in the evaluation of alternatives. This thesis won the first competition Award of the Bavarian construction industry in 2009/2010.

On the other hand, it was process "risk analysis", aimed to integrate it into the decision analysis system. Therefore further investigations in the form of a diploma and three bachelor theses were performed for establishing the requirements and conditions for the use of risk analysis in the practice, thus the risk management system of a civil engineering contractor and different risk analysis methods were examined and evaluated. This includes the artificial neural network method (ANNs), which opens new opportunities for risk analysis. As a result of these investigations ANNs was included in the developed system for risk analysis as a new method, combining ANNs + MCS (Monte Carlo Simulation). This procedure allows dispersion's reduction in the input information from risk analysis and ultimately in the results of the simulation. This determines a risk value for the consideration of the uncertainties, directly calculated from the measurement and analysis of historical data. Thus, the safety and reliability of risk analysis is enhanced and improved.

The developed decision analysis system permits a graphical representation and analysis of the decision that includes all the necessary criteria. However, the criteria weighting is problematic when a large number is available. Therefore, a new simple methodology has been suggested that the criteria comparison (weights) simplifies, in this way it can be easily, quickly and verifiable performed, with the use of percentages. Furthermore, it was also an adjustment in the calculation of the weights proposed, that enables to use at the same time maximal and minimal targets for the alternative comparisons, which the traditional AHP does not allow.

Finally, project information from the practice were calculated and verified with the here developed system, with the aim of reviewing and assessing its applicability in the practice. As a final step, the new capabilities of the system were evaluated using an empirical practical example. The modular functionality and allocation of the system allows a transparent, systematic and reliable alternative assessment for the project management, and or development

Conclusion

The elaboration of a decision analysis process that aids the alternative's assessment for the total project development procedure was possible. The application of such systems allows the integration of risk management from stochastic basis as well as increasing the transparency and reliability in project development and overall in the construction industry.

The Institute of Construction Management at the University of the Armed Forces Munich leads further researches aimed for the further development of the system and its further implementation in practice. The system has aroused great interest in USA and Germany and was developed with the support of "Caltrans" and "Kellar holding".

Basic Information

Lemma: Risiko- und Entscheidungsfindungsmethoden am Bau
Research clusters: —
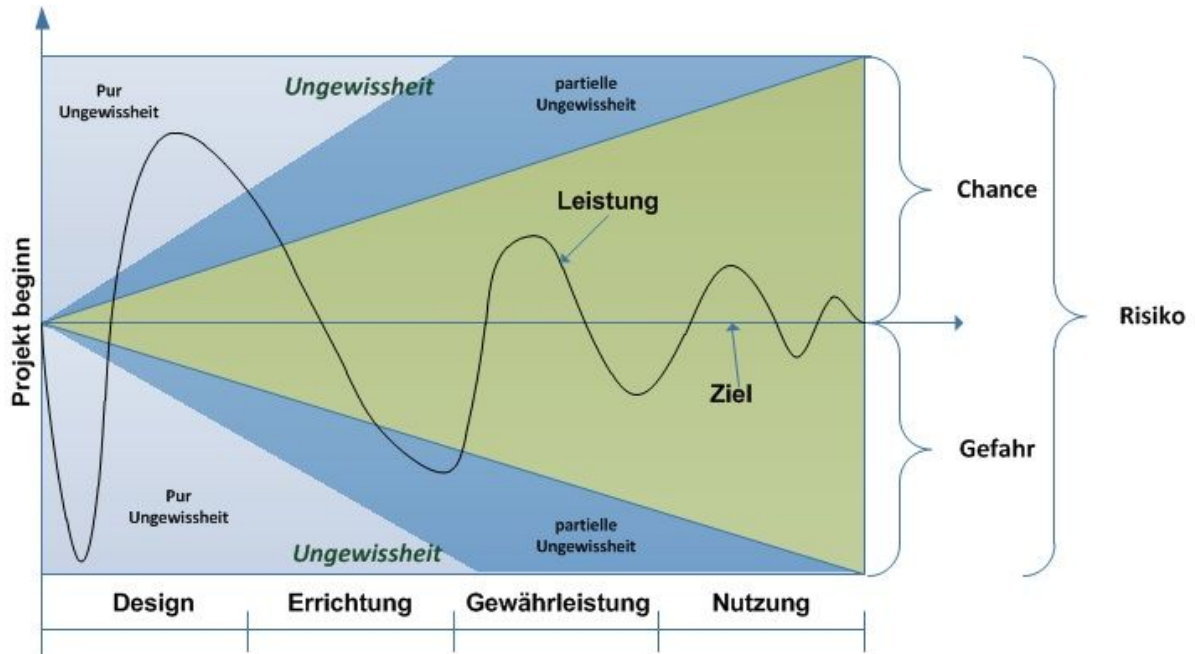Submitter/ Universität der Bundeswehr München, Institut für Baubetrieb e.V. / Univ.-Prof. Dr.-Ing. Jürgen Schwarz
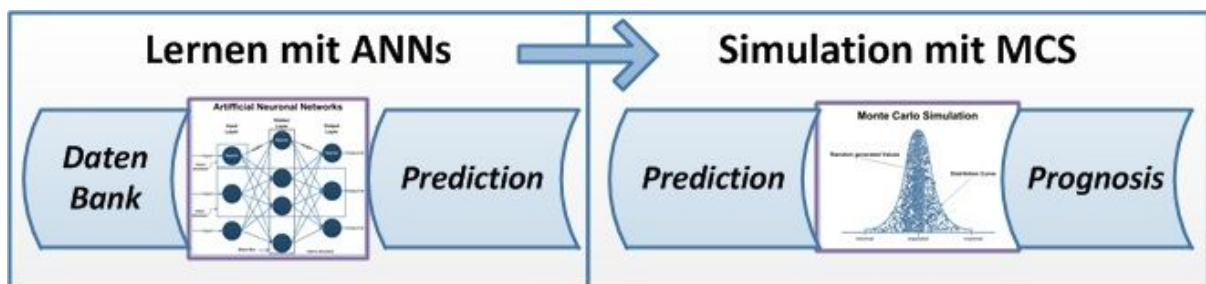Total Costs: 88,000 €
Share of federal grant: 30,100 €
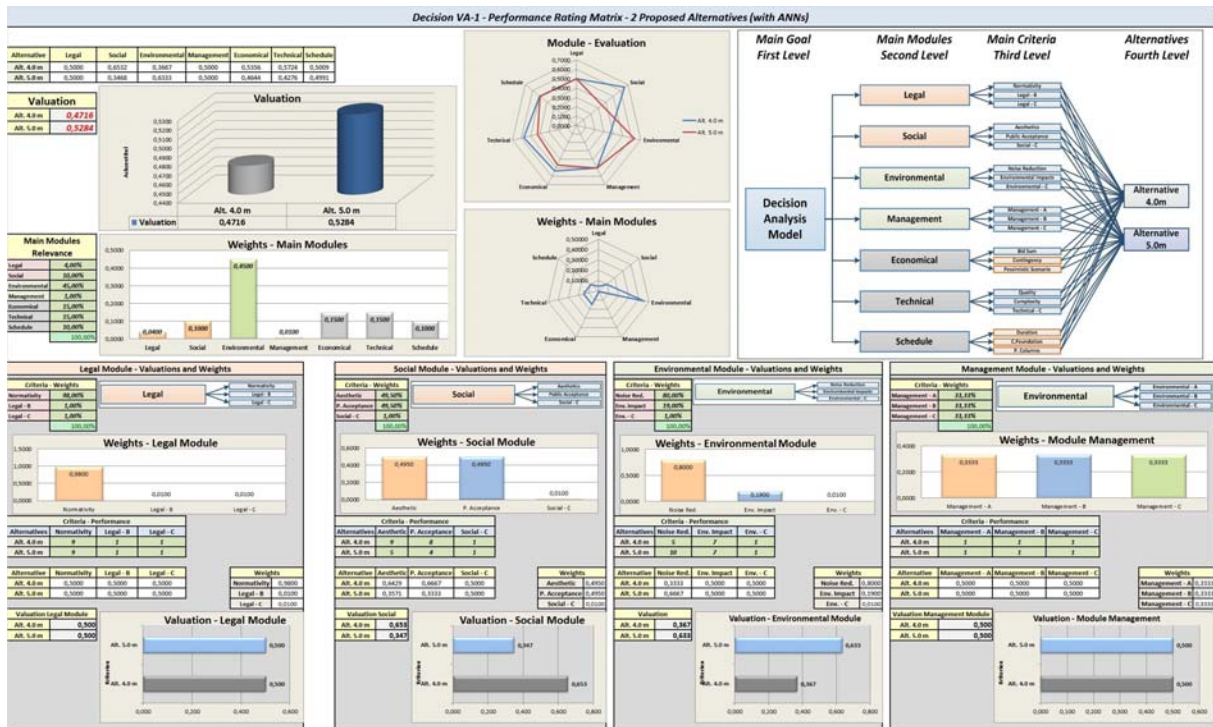Project duration: 01.01.2010 until 07.31.2011

PICTURES:

Picture 1: Risk and Uncertainty. © Fraunhofer-Institut für Bauphysik

Picture 2: ANN + MCS Functionality. © Fraunhofer-Institut für Bauphysik

Picture 3: Partial representation of the decision analysis model. © Fraunhofer-Institut für Bauphysik