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From Risk Analysis to Decision Support

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The role and character of risk analysis and risk assessments have undergone significant changes over the last 3-4 decades. From being mainly a procedural instrument to document that nominal risks associated with a given decision are under control and compliant with specified targets, risk analysis and risk assessments are increasingly utilized for optimizing or ranking decisions based on information on the actual risks they imply. Risk informed decision-making has attained a crucial role as an instrument for strategic, operational and tactical management both in industry, in public administration and regulation.
This development rests on increased emphasis and ability to represent systems affected by decision making in consistency with available knowledge, not least with respect to the systems performance characteristics, the uncertainties affecting these, the objectives of decision-making and the decision options whereby these may be optimized.
Building on the generic approach to risk assessment of engineered systems developed by the Joint Committee on Structural Safety, together with more recent developments in probabilistic systems representations and advances in applied decision analysis in engineering, the present contribution provides a decision analytical framework for the management of engineered systems subject to uncertainty.
The framework may be utilized to rank decision alternatives for the management of systems accounting for possible consequences to life safety and health, damages to the qualities of the environment and financial efficiency –in consistency with societal and individual preferences for their management. The framework facilitates both traditional engineering bottom up modelling as well as results of data mining and accounts for deep systemic uncertainties. The pre-posterior decision analysis, through the concept of Value of Information (VoI) analysis, is introduced as an efficient means to identify how additional knowledge may best support the management of a given system. Furthermore, in addition to risk and reliability, the system characteristics vulnerability, robustness and resilience are formulated probabilistically, providing enhanced understanding of the performances of the systems and how these may be managed optimally.
Finally, the application of the framework is discussed with reference to a selection of examples from practice and a discussion is provided on challenges and prospects for further developments.

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