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The Role and Limits of Engineering Decision-Making

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Engineering decision-making occurs in a wide variety of contexts including routine engineering practice, the specification of engineering performance requirements, the development of engineering standards and regulations, societal risk management and the over-arching context of environmental and social impacts. Engineering decisions at all levels are based on decision models that are necessarily limited in their scope and do not explicitly account for external factors that should be taken into account through higher-level decision and management processes (such as regulatory processes). The engineering profession serves society by providing professional advice and making decisions within the engineering domain, and society places its trust in the engineering profession to ensure that the consequences of engineering decisions are generally consistent with societal expectations and have limited repercussions beyond the engineering domain.

Engineering decision-making often involves the management of risks and sometimes involves decision-making based on quantitative modeling of the risks. Some of the techniques for calculating the hypothetical quantities in probabilistic risk assessments are elegant and sophisticated and they give an impression of authority and precision. Furthermore, in the context of engineering, the calculated risks are often presumed to provide a rational and objective basis for decision-making in accordance with the mathematical rules of statistical decision theory. Based on the success of quantitative risk-based decision models for engineering, it is tempting to extend the application of such models to account for societal impacts beyond the immediate engineering domain. However, in the context of social policy-making, quantitative modeling in areas that extend beyond the natural sciences is treated with skepticism, and important decisions often depend on value judgements that cannot be conveniently resolved by quantitative modeling. Therefore, questions arise concerning the role and limits of quantitative risk-based engineering decision-making in the broader context of societal decision-making.

The paper discusses the role and limits of risk-informed engineering decision-making, with particular reference to the societal impact and treatment of inter-generational effects. It is argued that the engineering profession has a responsibility to identify all significant risks associated with engineering decision-making, a responsibility to make engineering decisions that are consistent with societal expectations, and a responsibility to inform the public and societal decision-makers of any significant risks that extend beyond the narrow confines of the engineering domain. Conclusions are presented concerning the appropriate role and limits of quantitative modeling and engineering decision-making, and associated requirements for effective risk communication to assist societal decision-making.