

Post-Probabilistic Uncertainty Quantification: Discussion of Potential Use in Product Development Risk Management - DTU Orbit (08/11/2017)

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Uncertainty represents one of the key challenges in product development (PD) projects and can significantly impact a PD project's performance. Risks in PD lead to schedule and cost over-runs and poor product quality [Olechowski et al. 2012]. Risk management is one response for the identification and management of risks. Acknowledging the increasing societal and business criticality of product development projects, there is a need to more thoroughly explore the various fundamental approaches to describe and quantify various types of uncertainty as part of the overall decision making process. Decisions made by PD managers and engineers have a significant impact on the strategic value of the asset delivered, and these decisions depend on the quality of information on which they are based [Ewejeet al. 2012]. Uncertainty plays an important role in decision making. Decision making quality improves if uncertainty is carefully addressed (e.g. [Prelec and Loewenstein 1991], [Riabacke 2006]). In the risk management community there is a strong argument that at least two distinct types of uncertainty have to be taken into account: aleatory and epistemic. Epistemic uncertainty arises due to lack of knowledge and can be reduced by collecting and acquiring new knowledge. This is in contrast to aleatory uncertainty that is of stochastic nature, and therefore cannot be reduced, but can be well modelled and described by probability distributions. In addition to uncertainty, ambiguity needs to be considered that addresses the different ways in which factual statements may be interpreted by different individuals [Klinke and Renn 2002]. [Flyvbjerg 2007] observed that the main challenges of large projects, including PD projects, are inadequate, unreliable or misleading information; and conflicts between decision making, policy and planning. It has been proven by empirical studies (e.g. [Levi 1990], [Sahlin 2012]) that the amount and quality of information behind probabilities and utilities is an important factor when making decisions, in other words, people tend to make different decisions if they are aware of the amount and quality of the data on which probability and utility assessments are based. Arguably, the key challenge in PD risk management today is that uncertainty quantification relies solely (or at least heavily) on probabilistic models. While these are appropriate to describe aleatory uncertainty, they are fundamentally ill-suited to model epistemic uncertainty. In this paper, we will explore novel post-probabilistic uncertainty quantification models that promise to better address epistemic uncertainty, and their possible application in the context of PD risk management.

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