Exploring Deep Uncertainty Approaches for Application in Life Cycle Engineering

Uncertainty assessment and management, as well as the associated decision making are increasingly important in a variety of scientific fields. While uncertainty analysis has a long tradition, meeting sustainable development goals through long-term Life Cycle Engineering (LCE) decision making demands addressing Deep Uncertainty (DU). DU characterizes situations where there is no agreement on exact causal structures, let alone probabilities. In this case traditional, probability based approaches cannot produce reliable results, as there is a lack of information and experts are unlikely to agree upon probabilities. Due to the nature of LCE, this paper argues that methods to better cope with DU can make a significant contribution to the management of LCE. We introduce a set of methods that use computational experiments to analyze DU and have been successfully applied in other fields. We describe Robust Decision Making (RDM) as the most promising approach for addressing DU challenges in LCE. We then illustrate the difference between applying traditional risk management approaches and RDM through an example, complemented with the interview findings from a company using RDM. We conclude with a discussion on future research directions.