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A Uniform Model Library and Knowledge-based Decision Support for Water-Energy-Food NEXUS Projects

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Abstract: In preparation of a planned Indo-European Project on water-energy-food NEXUS we develop an integrated modeling and knowledge-based decision support tool. The foundation is provided by a uniform modeling paradigm named process-oriented modeling. A process is a generic, elementary phenomenon that contributes to the dynamics of a complex system and is represented as an association between preconditions for its activity and the resulting effect. The goal is generating a library of the relevant processes in the domain, covering not only natural (rain, evaporation, etc.) and technological ones (oxidation, flocculation, …), but also construction and agricultural activities, social, economic, and governance processes. This library is the input to two steps in the decision support: situation assessment (semi-)automatically constructs a causal account for given observations as a configuration of instantiated processes, while solution/remedy proposal extends the situation with interventions that produce intended effects and given objectives.
The intention is supporting research on and deployment of NEXUS solutions in several ways: the library is meant to establish a growing repository of domain knowledge that can be shared by different projects and researchers. Fed with information about the local conditions, objectives, available resources etc., a decision support system supports the choice of appropriate technologies. For an established solution, the decision support is provided to those who operate the plant, esp. in the case of abnormalities, which appears important to non-expert operators in distributed solutions.
We illustrate the approach with a principled structuring of the knowledge base and examples of processes and the configuration of governance structures.

***Keywords**:* Water-energy-food NEXUS; model-based decision support; model library; process-oriented modelling.