

## Motivation and Problem

- Bayesian networks are commonly used for determining the probability of events that are influenced by various variables.
- The following challenges arise at the construction of Bayesian networks:
  - identification of variables that are relevant to the considered domain (nodes),
  - identification of relationships between the identified variables (links), and
  - creation of the conditional probability table for each variable.
- Approaches aiming at reducing the number of probabilities to be assessed and tools for supporting the quantification task in the construction of Bayesian networks are required.

## Goals

- Based on existing domain ontologies, we developed a method for the ontology-based construction of Bayesian networks. The method supports the automated
  - construction of the graphical Bayesian network structure (nodes and links)
  - construction of CPTs that preserve semantic constraints of the ontology, and
  - incorporation of already existing knowledge facts (findings).

## Approach

- The proposed ontology-based approach for constructing Bayesian networks consists of four main phases:
  1. Selection of relevant classes, individuals, and properties
  2. Creation of the Bayesian network structure
  3. Construction of the CPTs
  4. Incorporation of existing knowledge facts
- While the first phase requires the input of a domain expert, the remaining three phases are conducted automatically based on the output of phase 1.

## Evaluation

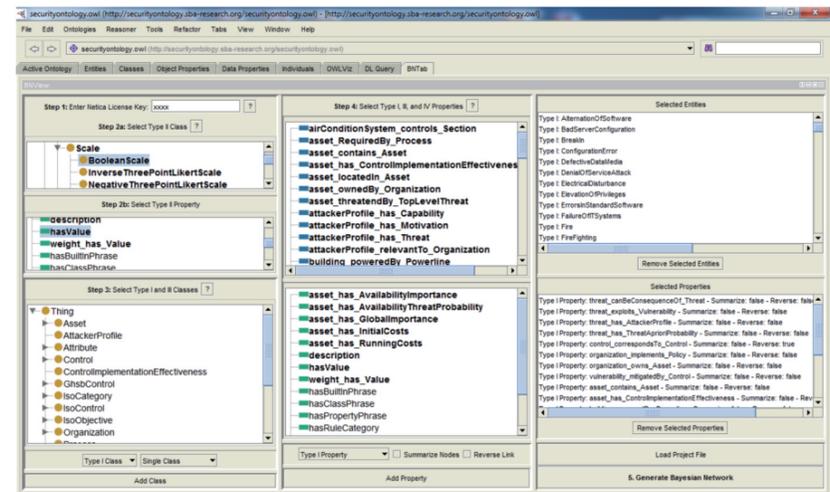


Figure 1: Prototype – user interface

- Within the evaluation we produced a basic Bayesian network containing 557 nodes, 579 directed links, and 30,687 conditional probabilities. Our tool enabled the domain expert to create a Bayesian network within 5 min.
- Estimated manual construction time without the calculation of 30,687 conditional probabilities: 2.5 h.
- The proposed method saves time, especially in the construction of Bayesian networks with more than 18 nodes.

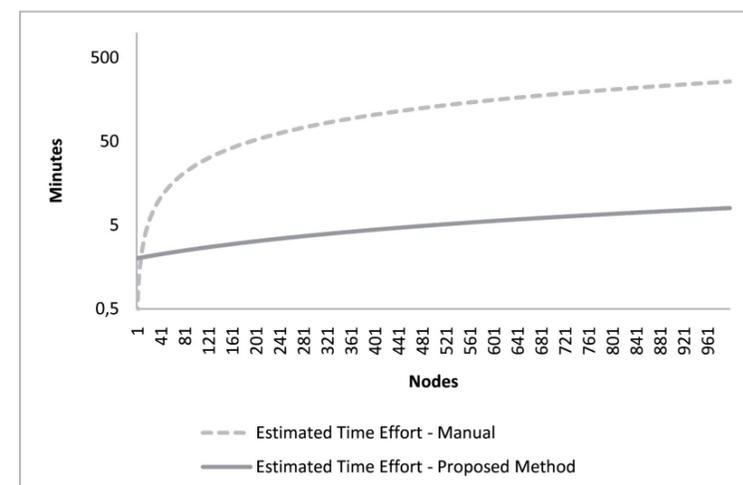


Figure 2: Evaluation – estimated time effort

## Conclusion

- Compared to existing approaches we provide a Bayesian network construction method that
  - uses already existing ontologies without the requirement for specific extensions for Bayesian network construction
  - reduces the complexity and time effort of modeling Bayesian

- networks by using high-level classes and properties to integrate relevant sub-classes into the Bayesian network
- utilizes already existing findings and their weights at the construction of CPTs
- preserves the ontological semantics at the CPT construction.