

Lecture 6	Model-based Decision Support
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Abstract

Rational decision making in non-trivial situations requires a comprehensive analysis of the relations between decisions and their consequences typically represented by a set of outcomes (conventionally called objectives, or criteria). Therefore decision-making support is often based on development of a model representing relations between decisions and outcomes, and associated methods of the model analysis aimed at helping the decision-makers to find decisions that fit possibly well their preferences on trade-offs between attainable values of objectives. Thus, science-based decision support involves two interlinked processes of knowledge management: (1) integration (for properly representing relations between decisions and their consequences), and (2) creation (for analysis of attainable trade-offs between the consequences), both aimed at providing a basis for rational decision-making. The knowledge integration is done through development of the corresponding model, and the knowledge creation is achieved by integrated model analysis. This sounds to be an obvious and easy approach. However, its proper implementation requires much more attention to the corresponding modeling methodology and technology than is commonly recognized. The tutorial will focus on these two main pillars of model-based decision-support: integration and creation of knowledge relevant to the corresponding decision-making problem. Mathematical models are probably the best way to manage (integrate and create) knowledge for decision-making support in non-trivial situations; models are inevitable whenever problem solving involves analysis of large amounts of data and/or non-trivial relations; such relations represent dependences between decisions and outcomes, as well as between outcomes and preferences of the decision-makers. Therefore, we will discuss relations between knowledge management and mathematical modeling, and illustrate them by several practical problems coming from different areas of applications, and having different characteristics. Next, we will summarize basics of rational decision-making and relate them to modern methodology of integrated problem analysis, which in turn has implications on requirements for methods and tools for model analysis. This part will be followed by a comprehensive presentation of key elements of modeling technology (understood as methods, techniques, tools, good practice, all aimed at solving a modeling problem) applicable to a wide range of decision-support problems. The last part of the tutorial will contain a short introduction to the MCA (Multiple-Criteria Analysis), the Web-based application for analysis of discrete alternatives. MCA has been used for a wide range of problems, and is available also for researchers not familiar with advanced modeling methods. The tutorial will conclude with several lessons from both simple and complex applications of model-based decision support that also triggered development of modeling methodology and tools.