Chapter 7
Web-Based Decision Support System for Solving Multiple-Objective Decision-Making Problems

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ABSTRACT

A web-based Decision Support System WebOptim for solving multiple objective optimization problems is presented. The system WebOptim is designed in a modular principle, extensively using XML as communication standard and web services. Its basic characteristics are: user-independent, multisolver-admissibility, method-independent, heterogeneity, web-accessibility. Core system module is an original generalized interactive scalarizing method. It incorporates a number of thirteen interactive methods. Most of the known scalarizing approaches (reference point approach, reference direction approach, classification approach etc.) are realized in this method. The Decision Maker (DM) can choose the most suitable for him/her form for setting his/her preferences: objective weights, aspiration levels, aspiration directions, aspiration intervals. This information could be changed interactively by the DM during the solution process. Depending on the DM's preferences form the suitable scalarizing method is chosen automatically. The chapter begins with an overview of Decision Support Systems (DSS). Examples of DSSs and their applications are discussed.

INTRODUCTION

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The Decision Support Systems (DSSs) are computer assisted tools that support Decision Makers (DMs) in solving different real problems. The concepts of DSS appeared in 70s soon after introducing the concepts of Decision Making by Herbert Simon (1960) - see Scott-Morton (1962), Filip et al. (2017). During the time there are various definitions and interpretations of DSSs. They all consider three characteristics of DSS – existing of a complex decision situation, a person or group of persons authorized to make decisions (Decision Maker(s)) and computer based tool to support the DM in decision making. These characteristics define and explain the constant expansion of theoretical development and practical implementation of DSS in different areas of human knowledge – Hosack et al. (2012), Power (2008), Shim et al. (2002). Respectively, the DSS' theory development and applications is inspired by the following factors:

- The necessity of taking complex decisions in our life.
- Natural limits of people.
- The potential of contemporary Information Technology tools and Optimization and Decision Making methods in theoretical and practical aspects as well.

In particular, the development of DSS considering multiple objectives in 80's started when Multiple Criteria Decision Making (MCDM) theory takes up its own place in the science - http://www.mcdm-society.org/.

Below we present a short overview of some DSS. We divide DSS in two basic classes. The first one is DSS with general purpose. What we mean by that is that DSS is designed to solve some basic class of decision making problem having exact defined mathematical model – for example linear or nonlinear or linear integer problem possibly including multiple objectives etc. When using such DSS the user has to formulate in advance his/her decision problem in terms of corresponding decision making model and after that to solve it with the help of selected DSS.

The second class are the DSS that are designed for solving a specific real problem – for example water resources management problem, or scheduling problem (job shop, flow shop) etc. This class of DSS we call specific purpose DSS or Problem Oriented MCDSS.

The paper is organized further as follows. In the next three sections we discuss examples of DSSs and their applications. The last section concerns the proposed DSS WebOptim. The paper ends with the conclusion.

DSS WITH GENERAL PURPOSE

Ruiz et al. (2015) presented a method based on the existing NAUTILUS method and called Enhanced NAUTILUS (E-NAUTILUS). This method borrows the motivation of NAUTILUS along with the human aspects related to avoiding trading-off and anchoring bias and extends its applicability for computationally expensive multi-objective optimization problems. In the E-NAUTILUS method, a set of Pareto optimal solutions is calculated in a pre-processing stage before the decision maker is involved. When the decision maker interacts with the solution process in the interactive decision making stage, no new optimization problem is solved, thus, avoiding the waiting time for the decision maker.

A DSS for solving multi-objective Redundancy Allocation Problems (RAPs) is considered by Khalili-Damghani (2014). Initially, the technique for Order Performance by Similarity to Ideal Solution method