Multi-Criteria Decision-Making in Software Production

Siamak Farshidi and Slinger Jansen[1]

***Abstract*— Software producing organizations face the challenge of including new technology in their products, such as cloud technology and database management systems. As software architects and senior developers are not experts in this domain, they need to consult external experts or acquire the knowledge themselves. Software production, therefore, provides a suitable domain to deploy decision support systems, that intelligently support these decision-makers in selecting the desirable technology for their product.**

We present a decision support system that supports decision-makers in choosing the most suitable cloud service provider. The case studies and experts confirm that the approach increases insight into the selection process, provides a richer prioritized option list than if they had done their research independently, besides reduces the time and cost of the decision-making process.

Keywords: *multi-criteria decision-making, decision support system, technology selection, model-based, rule-based*

I. INTRODUCTION

Technology selection is an indispensable decision-making problem for software producing organizations (SPOs). The challenge consists of evaluating and selecting the most suitable technology for SPOs according to their preferences and requirements. The selection process is complex because too many factors, such as suitability and cost, should consider. Therefore, the technology selection process can be modeled as a multi-criteria decision-making (MCDM) problem that deals with the evaluation of a set of alternatives, and taking into account a set of decision criteria [3].Finding a solution for an MCDM problem contends with structuring, planning, and solving the problem concerning a set of criteria [2]:

1) Identifying the objective
2) Selection of the Criteria/Features
3) Selection of the Alternatives
4) Selection of the weighing methods
5) Method of Aggregation
6) Decision making based on the Aggregation results

Typically, a unique optimal solution for an MCDM problem does not exist, and it is necessary to use a decision-maker's preferences to differentiate between solutions [2]. In recent years researchers introduced a considerable variety of techniques, methods, and tools to solve different technology selection problems for SPOs. Many variations exist, but all share the essential phases of the decision-making process. The majority of MCDM approaches in the literature use pairwise comparison techniques to calculate the weight of each related criterion to the problem domain. The pairwise comparison is a time-consuming process, furthermore, gets more complicated as the number of criteria increases. Moreover, some MCDM methods are not scalable, so in the case of modifying the list of alternatives or criteria, the whole process of evaluation should be conducted anew. Therefore, these methods are costly and applicable for a small number of criteria and alternatives.

Technology selection decisions are often made ad hoc, without reference to reliable models or sound methodologies. Furthermore, the results of technology selection solutions in the literature are valid for a specified period, so by technology advances (new updates and releases), they should be performed again. Hence, a reusable, evolvable, and expandable decision-making approach is needed to make the right decision based on the characteristics of the environment.

We designed a decision support system, called DSST, to accelerate the process of finding the most suitable cloud service provider (CSP). The DSST comprises all of the fundamental components of a standard DSS. The DSST breaks down the process of building a decision model into five separated levels to make the knowledge acquisition more reliable and trustful. A decision model in the knowledge base of the DSST contains all facts and rules of an MCDM problem. In other words, a decision model defines a decision graph to solve a specific MCDM problem. Moreover, the DSST enables decision-makers to define their domain feature requirements and preferences based on the MoSCoW prioritization technique [1]. We employed the DSST to the CSP selection problem in four case studies to evaluate its usefulness and efficiency. We intend to build trustworthy decision models to address, for instance, *Microservice Configuration selection* and *software architectural pattern selection*, as our (near) future work.

II. PROBLEM DEFINITION

This section defines the technology selection problem in software products. Let $A = \{a_1, a_2, \dots a_{|A|}\}$ be a set of alternatives (technologies) in the market. Moreover, $F = \{f_1, f_2, \dots t_{|F|}\}$ be a set of domain features, which includes the most prominent technical and non-technical domain features of the alternatives, so each $a \in A$ supports a subset of F. The goal is finding the suitable alternative a which supports a set of required domain features (R), where $R \subseteq F$. In other words, an alternative a is the suitable one that supports domain feature requirements and satisfies the preferences of the decision-maker.

[1] Department of Information and Computer Science, Utrecht University, The Netherlands {s.farshidi, slinger.jansen} at uu.nl

III. Acknowledgment

This research was supported by the NWO AMUSE project (628.006.001): a collaboration between Utrecht University, Vrije Universiteit Amsterdam, and AFAS Software in the Netherlands.

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