Prioritization of Large dataset of Requirements with ANP using super decision

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Abstract

Decision making process is the most challenging and important task, which decides the success and failure of a software project, in software development life cycle. Deciding a good requirements prioritization technique can reduce our effort in terms of time and cost. In this research we have conducted an empirical study on requirements prioritization techniques to decide which technique in better in terms of scalability. We select AHP and ANP from the literature as AHP is the most cited technique and ANP is the generic form of AHP. We prioritize a large dataset of software requirement with ANP using SuperDecision tool to identify the scalability of ANP. This research shows the limit of the number of input requirements that ANP can prioritize efficiently using SuperDecision tool.

Index terms: Requirements Priority, Priority Techniques, AHP, ANP, Manual techniques, Super-Decision tool.

Introduction

Requirements prioritization is used in software product management for identifying that which requirements of a software product should be included first in a certain release. Requirements are also prioritized to identify risk factors early and minimize them during software development. Requirement prioritization is also used for cost estimation of the software system that helps to achieve the business value through high quality and minimize the maintenance effort [1]. Since the last decades Artificial intelligence also shows their role in different phases of software engineering.

Requirement prioritization is more complex in terms of time and effort if we need prioritize large number of requirements. The previous researches also ignore the scalability factor in requirements prioritization techniques. In this study we are going to evaluate the most cited and empirically evaluated technique AHP and ANP [2].

Background

prioritization techniques are also proposed using different algorithms that are fuzzy logic and evolutionary algorithms [3] [4][5] But a very limited focus towards the empirical validation of these technique. And the empirically evaluated techniques still have some limitation that is lack of focus on scalability, easy to use and learn-ability [6].

A systematic literature review was conducted on requirements prioritization techniques in which they mention the empirical/case study of the requirements prioritization techniques. According to their results AHP was again the most cited and accurate technique but still has some limitation like computational complexity.

The other techniques also have limitation like scalability, rank update (updating, deleting or adding a requirement) and most of the AI techniques have issue like validating their results through empirical study, or conducting a case study in different context, comparatively evaluation of these techniques are also needed [2].

In this research we will empirically evaluate the manual and the automated techniques to analyze them in terms of Accuracy, Efficiency and scalability. The selected techniques are AHP and ANP because they are multi criteria decision making techniques and both of these techniques allow user involvement in decision making process.

We will evaluate the results of these techniques by comparing them to the baseline dataset of requirements through different size of requirements (data set). We will also measure the effect of accuracy and efficiency of the techniques for different scale of requirements.

Methodology

We start with the literature review of existing manual prioritization techniques. We also study literature related to the empirical studies of these techniques. We identify several issues in these studies; most of the empirical studies do not fully address the factors like scalability accuracy and performance of the techniques.

We select AHP and ANP techniques from the literature on the bases of its multi criteria decision and user involvement in there techniques. We also propose an experimental design for the selected techniques to empirically evaluate their scalability for different number of requirements.

Experimentation

In this section we are going to explore the selected techniques for large data-set to identify the effect of different size of data-set on the accuracy and the efficiency of the technique. There was only one tool available that support AHP and ANP techniques called SuperDecision.

- **Analytical Hierarch process (AHP)**

Analytical Hierarch process (AHP) is pair-wise comparison technique used for prioritization. And it is definitely the most widely used studied requirements prioritization technique, developed by Saaty and was applied in the field of software engineering by Karlsson [15].

The tool that we are using for evaluating AHP's decision is Super-Decision software developed by saaty, which automate the manual input of data into models and helps us in pair-wise decisions [16]. The tool is used for AHP prioritization in many fields of business and marketing [17] and also used for requirements prioritization especially for multi criteria decision making (MCDM) process [18].

We mentioned our factors that are Stakeholders priority, risk and cost, according to which we prioritize our requirements. The tool facilitates us to mention all the factors as criteria and all the requirements in the form of clusters and also show their relation to the mention factors that is criteria.

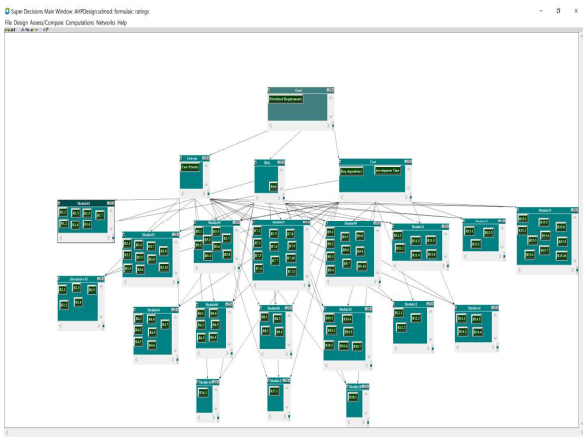

Fig. 4.1(a) screen shot of AHP in super-decision software.

The fig. show the hierarchal process, the 2nd hierarchy is the factors that affect each requirement. We create clusters of the modules to represent the requirements in 3rd hierarchy of the process. After creating this model we perform the pair-wise comparisons of the requirements according to the criteria and get the prioritize list of requirements as mention in Fig. 4.1(b) below.

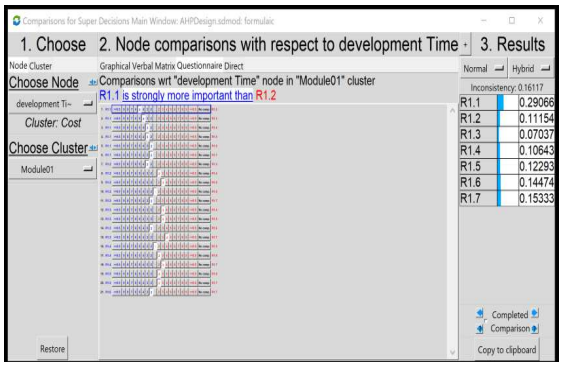

Fig. 4.1 (b) show pair-wise comparison of the requirements in the module to the cost cluster.

- **Analytical network process (ANP)**

Analytical network process (ANP) is a generalization of AHP also a multi criteria decision making technique using for prioritization. The main difference in ANP and AHP is that ANP defines a network in which one can mention the dependencies between the same level and to the upper cluster of the process while in AHP the whole process is hierarchal and only define the dependencies for the lower hierarchy [19].

In ANP the number of comparisons are almost double than that of AHP because of the bidirectional relationship between the clusters. The process model of ANP in the Super-Decision is showing in Fig. 4.2 below.

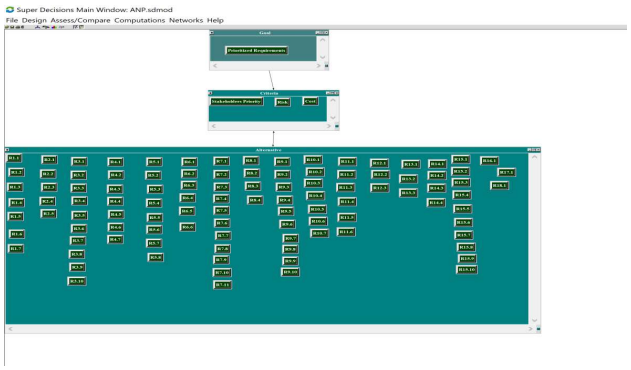

Fig. 4.2 ANP model in Super Decision.

The fig. showing the bidirectional clusters of ANP. The bidirectional arrow defines that each factor in the criteria cluster has a relationship to the elements of alternative cluster. And the elements in the alternative cluster also have a dependency on the factors of criteria cluster.

In case of ANP comparisons the process involves more comparisons than AHP and the fig. 4.2 was not able to show the comparisons of the requirements and the criteria. The fig 4.2 stuck my system for almost 5 hours and was unable to show the comparisons of the model.

The best way to use ANP model is to divide the large data-set into clusters of up-to 30 requirements in each cluster.

Dividing the requirements into clusters will probably gives the efficient results, without any time delay like stacking of operating system.

Conclusion

In this research we prioritize a large dataset to software requirements to check the scalability of the prioritization techniques. We select AHP and ANP from the literature these are the most cited and industrial used techniques for decision making process. These techniques also support multi criteria decision process and user involvement. For implementing our dataset on these techniques we used a software tool called Super-decision. Super-decision tool support both

AHP and ANP and facilitate the pair-wise comparisons of both the techniques. We got a problem for large dataset in ANP that is the super-decision (tool) didn't support the 100 or more requirements in a single cluster of ANP. Using ANP we have to divide the requirements into clusters of of 30 to get the efficient results.

Limitation and Future work

We use the super-decision tool only in Windows may be it gives different results for different operating systems like Linux and Mac-book.

In future we would like to propose a model to combine the Artificial intelligence (AI) plug-in to the super-decision tool for making the techniques i.e; AHP and ANP more efficient and to make them more useful in future.

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