A Study of Methodology on Effective Feasibility Analysis Using Fuzzy & the Bayesian Network

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Abstract. This dissertation suggests the effective methodology for the feasibility analysis of R&D program by computing priority through an AHP (Analytical Hierarchy Process) expert survey and by applying a Fuzzy Measure whereby, through which, giving objectivity and eliminating the duplicated factors. And then, utilizing of the Bayesian Network can allow inference analyses. We can quantitatively define the satisfactory/unsatisfactory level of each program/project factor and each analysis factor by assigning probability values. It is possible to analyze the relationship between program/project evaluation results (qualitative result) and feasibility analysis factor (quantitative analysis). This feasibility analysis framework can infer posteriori probability using the prior probability and the likelihood function of each feasibility factor.

Keywords: Fuzzy Measure, Bayesian Network, Methodology, Effectiveness, Feasibility

1 Introduction

Standardizing the various type and feasibility features of the different R&D programs & projects is difficult. This is largely because each of them involves a wide variety of necessary research.

Researches that objectively and quantitatively evaluate core competencies through performance evaluation systems and enhance program usefulness are necessary. Also, in the feasibility analysis of R&D program/project, researchers generally reference the data submitted by related public institutions or survey the related data to analyze the trend, level and the status of technology. Patents and theses are generally utilized to analyze the technology trend for the feasibility analysis.

Decision making system using Bayesian Networks for the objectivity security and evidence base. The accurate feasibility analysis used to find out the latest technology trends could also be useful for optimizing efficiency when analyzing.
2 Previous Research

The accuracy in the prediction process of inference greatly increases with prior knowledge and conditional probabilities from big data. In this dissertation, we use AHP, Fuzzy measure and Bayesian Network as our method for the feasibility analysis.

2.1 Bayesian Network

Using a Bayesian Network has the advantages of graphically specifying the relationships among nodes through a visual diagram. The accuracy in the prediction process of inference greatly increases with prior knowledge and conditional probabilities from big data.

A Bayesian Network is a probability model that represents the conditional dependencies among random variables. Each node of Bayesian Networks is a random variable and arrows indicate casual dependencies among nodes. Based on these dependencies, each node is considered to be discrete. The posteriori probability is inferred from the derived joint probabilities and conditional probabilities. After being given these conditional probabilities and joint probabilities, a Bayesian Network can consequently be used to predict complex knowledge and problems under uncertainty.

2.2 AHP[2] and Bayesian Network

This study use a weight calculated from AHP priorities. Probability values are assigned through the following assumptions. Since the impact value of the risk exposure is represented by a binary value of risk exposure can be considered as a probability value, thereby suggesting that weights can be used as probability values when it is regarded as risk exposure.

We developed the performance analysis framework by connecting AHP with Fuzzy measure and Bayesian Network to understand the relative priority among main factors. It is also from a pairwise comparison of AHP. Bayesian Network expresses the relationships among indicators using the result of AHP comparison [1].

2.3 AHP and utilization of fuzzy measurement

AHP is the process of making a pairwise comparison matrix consisting of figures that show each sub element’s degree of excellence compared to other sub element’s under the upper layer's element by determining each sub layer element’s importance based on the element in the upper layer.

Fuzzy Measures, as an extended concept of probability measurement, is known as a highly effective measurement utilized in evaluation problem's that are not additive, and is non-additive. The non-additivity in fuzzy measures indicates that when evaluation value of item A is 0.3 and item B is 0.6, the evaluation value considering
both A and B may not be 0.8. When the evaluation value of both A and B is bigger than 0.8 the two items have a synergy effect, while the opposite indicates that the two have a cancellation effect. Thus, Fuzzy measures is known as a measurement that can reflect the problem better compared to the general addition measurement in the decision making process[2].

2.4 Efficiency Analysis Using Big Data

Researches for the Big Data platform on the scientific and technological literatures have been performed to develop service models for Big Data analysis centric to the national R&D information, to support the establishment of science and technology strategy and to minimize possible risks from the large scaled investment and the low success probability on such activities. However, no measure to scale the technology impact of web data like the quotation degree of patents and theses has been provided.

3 The Feasibility and Performance Analysis

I can elicit feasibility analysis using the weights we obtain as shown above, which are effective for comparing the quantitative performance of each program. Existing analysis is a plain method irrespective of priority between indicators. To overcome this limitation, the method using performance index can get high efficiency

3.1 Search Keyword Selection and Utilization of Big Data

I examine the level of impact of the core technologies of the feasibility analysis cases versus other technologies in relevant fields. It is expected that web resources generally are not appropriate to utilize for a feasibility study because the credibility of web resources in general has been lower than objective measurements such as theses and patents.

The securement of high quality data needs to be precedent for the most efficient analysis of the feasibility analysis utilizing big data. Data in the web can also be utilized as high quality data like theses and patents when there is a way to provide reliability and influence. Collection of data is needed not only from patents and theses but also from the web in order to grasp the stream of market and high technology of the targeted programs/projects of feasibility analysis.

3.2 Inference Using Bayesian Network

This dissertation used a real dataset such, patents and trend data in order to analyze the level of technology impact of the core technology of the program subjected to a feasibility analysis.
Inference in Bayesian Network is to draw a value one wants by using variables that one already has. One of the most common methods is called variable elimination. It eliminates irrelevant variables by distributing the sum over the product.

3.3 Process of Fuzzy measure

The degree of priority of feasibility analysis factors was deducted utilizing the AHP method. The AHP performs on the assumption that the assessment standards are independent of each other. The method of granting priority by AHP analyzes on the assumption that assessment standards are independent of one another. Therefore the inability to take into consideration the interrelationship between the standards are a limitation. However, in real-life decision making, many standards are mostly interconnected than independent because of a diversity of reasons such as the assessor’s personal opinion or ambiguous standards.

[Step 1] Apply the priority $\omega$ of the feasibility analysis factors found by utilizing AHP and deduct the repetition coefficient among hindrance factors through surveys to experts.
[Step 2] Find the fuzzy measure $g(x)$ by utilizing the priority and the degree of repetition among factors. When doing this, use the same shape definition function proposed by Tsukamoto to calculate the $g(x)$.
[Step 3] Find the fuzzy measure with the degree of repetition applied and compare it with the deducted degree of priority $\omega$ per factor.

3.4 Likelihood Function and Posteriori Inference

All tables must be numbered consecutively. Table headings should be placed above the table. Tables should be as close as possible to where they are mentioned in the main text. Tables can span the two columns if need be within the page margins.

I can infer posteriori probability using prior probability and likelihood function. When applying data, the prior probability uses weight and likelihood function of the observed data. Likelihood function infers posteriori probability by estimating the probability between data that belong to the same element. The posteriori probability can figure out the weakness of feasibility factor, as it can predict the result that appears T or F in advance.

4 Conclusions

In this study, we selected main feasibility factors and weighted them differently considering the relative priority. We suggested a feasibility analysis framework to infer posteriori probability based objectivity and eliminating the duplicated factor. It resulted from our attempt to combine AHP with Fuzzy measure and Bayesian Network. Through this result, we can provide valuable feedback to appraisers of program/project that are in the satisfaction & dissatisfaction realm.
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References