A Decision-making Model to Choose a Cloud Service using Fuzzy AHP

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Abstract. In rapid chaining business environment, information and communication technology (ICT) is a must for the survival of a company and is becoming increasingly important. The emergence of cloud computing represents a fundamental change of ICT services and cloud services continue to grow rapidly with increasing functionality and more users. As a result of this growth, it is a critical issue to select the suitable cloud service provider which meets all the business strategies and the goals of the company. This study presents a decision-making model to choose a suitable cloud service provider using fuzzy analytic hierarchy process (AHP) for companies’ users.

Keywords: Cloud Service, Decision-making Model, Fuzzy AHP

1 Introduction

In rapid chaining business environment, information and communication technology (ICT) is a must for the survival of a company and is becoming increasingly important. The emergence of cloud computing represents a fundamental change of ICT services and cloud services continue to grow rapidly. As a result of this growth, the global and Korean major cloud service providers launched commercial B2B and B2C cloud services such as IaaS, PaaS, and SaaS [1]. According to increasing companies’ users of cloud services, it is a critical issue to select the suitable cloud service provider which meets all the business strategies and the goals of the company.

This study presents a fuzzy AHP based decision-making model to choose a suitable cloud service provider focused on the IaaS provider for companies’ users. In order to achieve this goal, the multiple criteria to select a cloud service provider were determined and then compared according to their importance. Finally, the candidate IaaS providers as cloud service providers were evaluated to select the best IaaS provider according to the predetermined criteria [2].

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2 Research Background

2.1 Analytic Hierarchy Process (AHP)

An analytic hierarchy process (AHP) was first proposed by Saaty, and it is one of the most commonly used methods for solving multiple-criteria decision-making (MCDM) problems in political, economic, social and management sciences [3]. Using AHP, opinions and evaluations of experts can be integrated, and a complex problem can be devised into a simple hierarchy system with higher levels to lower ones.

2.2 Fuzzy Set Theory

Fuzzy set theory is introduced to solve problems involving the absence of sharply defined criteria by Zadeh [4]. If uncertainty (fuzziness) of human decision-making is not taken into account, the results can be misleading. Fuzzy theory is used to solve uncertainty (fuzziness) of human decision-making problems, and it has been applied in a variety of fields.

Fuzzy set theory has evolved in various directions, and one of distinct direction of them is dealing with fuzzy sets as mathematical objects subject to the linguistic method. The underlying logic of linguistic method is that the truth-values are fuzzy sets and the rules of inference are approximate rather than exact [5].

3 The Proposed Decision-making Model

This chapter presents the construction of hierarchy model, the application of fuzzy AHP and the results of the best IaaS provider selection.

3.1 Construction of Hierarchy Model

In the first part of the study, the most important factors for evaluating traditional ICT providers and for evaluating cloud service providers, especially IaaS providers, are examined. After a detailed review of the literature and interviews with domain experts, the three criteria such as provider, service and support perspectives and the 8 sub-criteria according to three criteria are identified as shown in Table 1 [1].

Table 1. Criteria for decision-making model

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Provider perspective</th>
<th>Service perspective</th>
<th>Support perspective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provider</td>
<td>Name recognition</td>
<td>Service availability</td>
<td>Service Level Agreement (SLA)</td>
</tr>
<tr>
<td>Sub-criteria</td>
<td></td>
<td>Service performance</td>
<td>Service support</td>
</tr>
<tr>
<td>Service</td>
<td>Option</td>
<td>Service scalability</td>
<td></td>
</tr>
<tr>
<td>Price</td>
<td>Price</td>
<td>Service security</td>
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</table>
3.2 Application FAHP and the Result of IaaS Provider Selection

FAHP is used to generate the weighting of the three criteria perspectives and the weighting of the performance indicators. There are six steps [5]:

Step 1: Construct the hierarchical structure with decision elements (e.g., criteria and detailed criteria).

Step 2: Analyze consistency. The consistency property of the matrix is checked to ensure the consistency of judgments in the pairwise comparison.

Step 3: Construct fuzzy positive matrices. The scores of pairwise comparison are transformed into linguistic variables.

Step 4: Calculate the fuzzy weights of decision elements

Step 5: Integrate the opinions of decision makers. Geometric average is applied to combine the fuzzy weights of decision makers.

Step 6: Obtain final ranking.

To determine the importance of the three criteria and the 8 sub-criteria, a nine-point scale is used in the questionnaires to collect experts’ opinions. Fifteen experts are asked to fill out the first questionnaire and they calculate the weight according to their importance.

Next we compared the five IaaS providers according to the predetermined importance of criteria calculated by FAHP. In this study, we use the expert choice 11.5 to compare and choose the best IaaS provider.

The final results of importance of criteria and sub-criteria and the optimal IaaS provider selection present in Fig. 1.

The service perspective (0.496) has the highest weighting. This indicates that providing services to users should be stressed by IaaS selectors of companies. As shown in Fig. 1, IaaS provider 1 was selected as the best IaaS provider with 0.239 finally.
4 Conclusion

This paper proposed the fuzzy AHP based decision-making model to select a suitable cloud service provider focused on the IaaS provider for companies’ users. The three criteria such as provider, service and support perspectives for decision-making were identified and the hierarchy model was also constructed. And then, the importance of three criteria and 8 sub-criteria were determined by fuzzy AHP.

The results show that service perspective has the highest weighting. This indicates that providing services to users should be stressed by IaaS selectors of companies. The IaaS providers were selected to evaluate for the proposed model. In this study, we compared the five IaaS providers which are domestic and international providers and serviced in Korean cloud service market. The proposed IaaS provider selection methodology was applied successfully.

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References