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Smart Media
KOREAN INSTITUTE OF SMART MEDIA

Oral Presentation 3

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Adapting the Analytic Hierarchy Process (AHP) Technique for Importance Analysis and Prioritization on Use Case

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Abstract. The existing studies suggested the Importance and Prioritization Methods which can reflect customer's requests exactly for the proper extraction of requirements and prioritization. However, this method decides ERRC (Eliminate, Reduce, Raise, Create) of Use Case by the customer's subjective judgment, and moreover, such a process can't present a verification method for logical consistency about customer's judgment. In order to solve such a problem more objectively, this paper suggests a method for the importance extraction and prioritization of Use Case which uses AHP. It compares and verifies the data extracted as a method of Use Case Point and AHP, and also judges whether the customer's idea is determined consistently through Consistency Assessment of AHP. It tried to adapt Case Study to Automobile Goods Management System, and consider customer's requests exactly.

Keywords: Hybrid Approach, Use Case Point, Goal Oriented Requirements Engineering Process, Analytic Hierarchy Process (AHP)

1 Introduction

The existing studies suggested the method of Use Case-Goal Oriented Requirements Engineering [2, 3] compared with ViRE [1]. This method has a goal to reflect the customer's requests exactly in developing software. However, in this method, customers subjectively judged and decided ERRC of Use Case according to the judgment standard of Hybrid Approach [2,3]. Moreover, it is very difficult for customers to judge the extracted Use Case consistently with this method. In order to solve such a problem, this paper extracts the importance of Use Case with AHP, and prioritizes it. For performing this work, it extracts the importance of AHP-based Use Case and compares it with the importance of the existing Use Case Point-based Use Case. Also, it judges whether the idea of the majority is determined consistently through the estimation of AHP consistency. This paper is composed as follows: Chapter 2 explains the method of ERRC decision adapting AHP method and Chapter 3 mentions Conclusion and future studies.

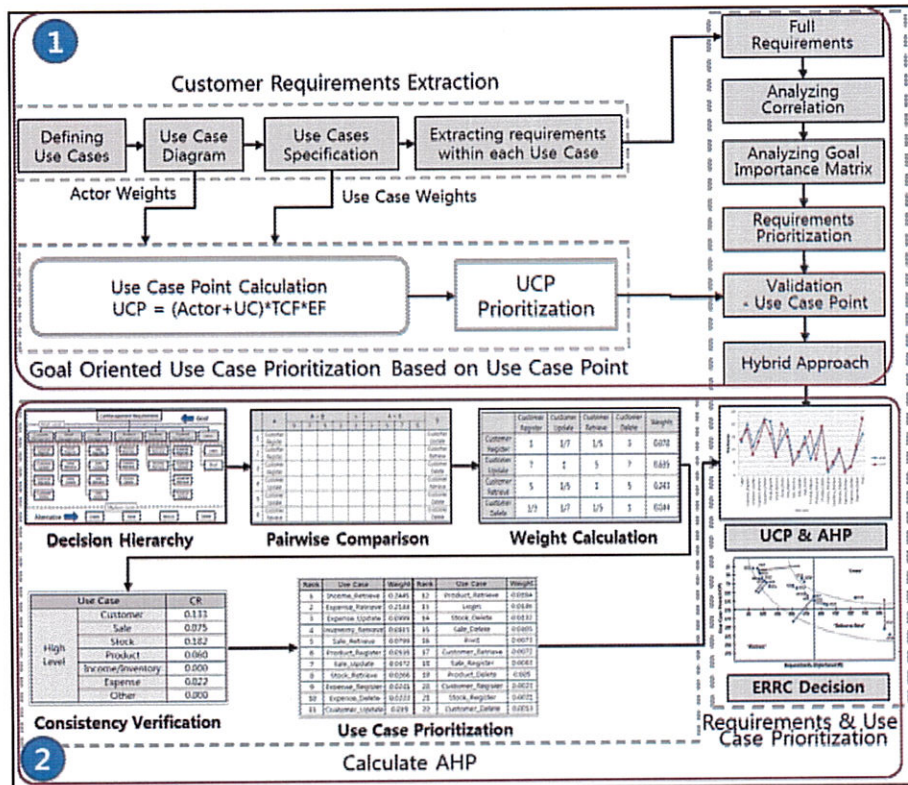## 2 Decision Method of Use Case-based ERRC Using AHP Technique

Fig. 1. Decision Process of Use Case-based ERRC using AHP Technique

AHP, which was developed by T. Saaty, performs the pairwise comparison between factors composing the decision hierarchy, and it accomplishes the assessor's consistency estimation with such a pairwise comparison. Accordingly, it can decide human being's subjective judgment reasonably. Fig, 1 shows the decision process of Use Case-based using AHP technique. However, this method decides the customer's requests with the subjective judgment finally, so it is not objective. Moreover, it lacks the verification about whether customers judge and decide the extracted Use Case consistently. Accordingly, this paper intends to solve these problems with AHP technique. In Fig. 1, ② is the process to adapt the result of ① to AHP technique, decide ERRC, and to perform the consistency assessment.

In the first step of decision hierarchy, it arranges Use Case extracted in (1) in the hierarchical order. In the second step, it collects data through participant's survey, and performs the pairwise comparison. In the third step, it measures weights. The calculation method is to input the weights on the pairwise comparison matrix, and gets the total of each row. In the regularization step, it divides each item of the pairwise comparison matrix into the total of each row [4]. The value of weights can be gotten when calculating the average of each column in the regularized matrix.

Table 1. The Regularization Process of the Pairwise Comparison Matrix

Factor	Expense_ Register	Expense_ Retrieve	Expense_ Update	Expense_ Delete	Normalization			
Expense_ Register	1	1/5	1/7	1	0.071	0.045	0.090	0.063
Expense_ Retrieve	5	1	1/3	5	0.357	0.227	0.210	0.312
Expense_ Update	7	3	1	9	0.500	0.682	0.630	0.562
Expense_ Delete	1	1/5	1/9	1	0.071	0.045	0.070	0.063
Total	14	4.4	1.586	16	0.999	0.999	1	1

Table 1 shows the result inputting the collected data through the survey in the matrix, and the value of regularized matrices. Table 2 is the process of calculating weights for the pairwise comparison. Use Case is equivalent to the expense management, and has the importance in the order of expense inquiry, expense correction, expense registration, and expense elimination. The Consistency Verification Method uses the formula in Table 3, and calculates the Consistency Index(CI) and Consistency Ratio(CR) [4].

Table 2. Process of Calculating Weights for the Pairwise Comparison

Factor	Weights
Expense_Register	$(0.071+0.045+0.090+0.063) / 4 = 0.269 / 4 = 0.06725 \fallingdotseq 0.067$
Expense_Retrieve	$(0.357+0.227+0.21+0.312) / 4 = 1.106 / 4 = 0.2765 \fallingdotseq 0.277$
Expense_Update	$(0.5+0.682+0.63+0.562) / 4 = 2.374 / 4 = 0.5935 \fallingdotseq 0.564$
Expense_Delete	$(0.071+0.045+0.07+0.063) / 4 = 0.249 / 4 = 0.6225 \fallingdotseq 0.062$
Total	1

Table 3. Consistency Verification

Consistency Index(CI)	Consistency Ratio(CR)
$(CI) = (\lambda_{max} - n)/(n - 1)$ $\lambda_{max} : Eigen\ Value\ Method$	CR = CI/RI(RI: Random Index) CR<0.1: Keeping consistency CR≤0.2 : consistency in the acceptable degree

The Consistency Ratio of Case Study is lower than 0.1, which was suggested by Satty, in the rest of Use Case except customer and storage management; that is, it is shown that it has high consistency. However, it can be understood that they have a consistency ratio lower than 0.2 so it has consistency in an acceptable degree. Accordingly, it can be judged that the extracted values keep consistency in the Use Case.

Table 4. Consistency Ratio

Classification	CR	Classification	CR
Customer_Management	0.133	Income/Inventory	0.000
Sale_Management	0.075	Expense_Management	0.022
Stock_Management	0.182	Other	0.000
Product_Management	0.060		

In the fifth step, it compares the weights of the third step, and prioritizes Use Case. In the sixth step, it compares and verifies the importance of Use Case derived from Use Case Point(UCP) and AHP techniques. In the last step, it decides ERRC of Use Case(Table 5 shows AHP&UCP Results).

The left picture is the result using UCP technique, and the right one shows the result of comparing AHP with UCP(Table 5 shows AHP&UCP Results). In total, two Use Cases moved to the area of Create(UC 8, 17). On the other hand, the total number of Use Cases moving toward the area of Eliminator is 3(UC 6, 7, 9). The Use Cases of Raise Function is UC 11 and UC 16, but the Use Cases of Reduce Function are UC 2, 3, 10, 12, 13, 14, 20, 22.

Table 5. UCP&AHP Comparison
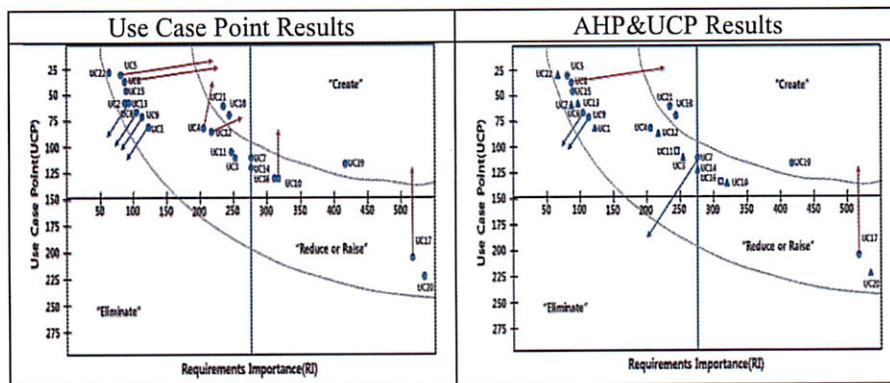
3   Conclusion

In order to extract and prioritize the exact requests, this paper compared and analyzed the methods of AHP and UCP. The existing method decides the customer's requests by their subjective judgments at last. Therefore, it is not an objective one, and cannot present a logically consistent verification method about customer's judgment. This paper extracted and prioritized the importance of Use Case with AHP technique in order to supplement the problems caused by the existing qualitative judgment. It compared the result of the existing UCP with the result of AHP and analyzed them, and could verify whether the refined requests reflect the customer's requests exactly.

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