THE USE OF AHP METHOD IN THE INVESTMENT ACTIVITIES OF COMPANY

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1. Introduction

In the world, lots of different factors affect people. Factors are linked mutually. Manager's are bewildered by opposed information. They want to know which information is insignificant or important. We don't need more complicated way of thinking. Much better is to see our problems in the organized framework. The organized framework enables us independence of judgment and interaction between factors. Analytic Hierarchy Process (AHP) tries to provide this framework. AHP makes possible to prepare an effective decision in complicated situations, to simplify and speed up natural decision making. AHP is the method of decomposition complicated unstructured situation on simpler components - so-called hierarchic system. By the help of subjective evaluation of paired comparison this method assigns individual components numeric values which represent their importance.

2. Analytic Hierarchy Process (AHP)

The Method of AHP was proposed by prof. Saaty in 1980. During the solution of decision problems we must allow for all elements, which influence result of analysis, relations between them and their intensity.

The hierarchic structure is important too. The hierarchic structure is schematic representation of relations between aim, criteria and alternatives (Fig. 1).
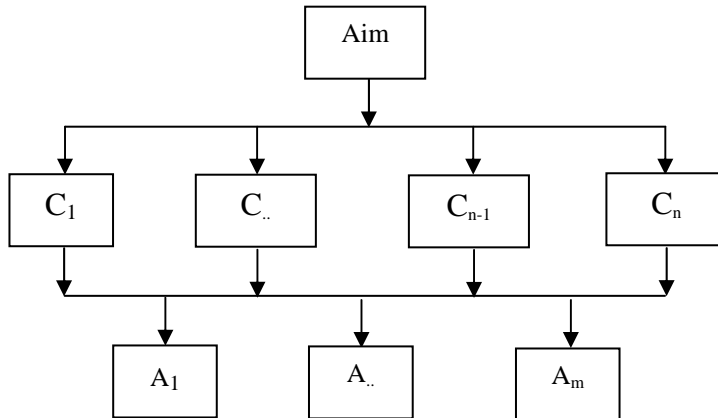

Fig. 1 General Hierarchic Structure

Where:

Ci – criterion , where i = 1, 2, 3,….,n

Aj – alternative, where j = 1, 2, 3, …,m

The Method of AHP is a practical tool for support of decision-making. Possible application of AHP Method is for example: purchase a car, choice of future career, social – economic decision-making problems of different professions (business, financial engineering, planning, etc.).

- A systematic method for comparing a list of objectives or alternatives
- When used in the systems engineering process, AHP method can be a powerful tool for comparing alternative design concepts
- Form a pairwise comparison matrix, where the number in the i row and j column gives the relative importance of O_i as compared with O_j

Comparison matrix

$$
\begin{array}{cccc}
 & O_j & O_j & O_j \\
O_i & a_{ij} & a_{ij} & a_{ij} \\
O_i & a_{ij} & a_{ij} & a_{ij} \\
O_i & a_{ij} & a_{ij} & a_{ij}
\end{array}
$$

- We use a 1-9 scale, with

  $a_{ij} = 1$ if the two objectives are equal in importance

  $a_{ij} = 3$ if O_i is weakly more important than O_j

  $a_{ij} = 5$ if O_i is strongly more important than O_j

  $a_{ij} = 7$ if O_i is very strongly more important than O_j

  $a_{ij} = 9$ if O_i is absolutely more important than O_j

  $a_{ij} = 1/3$ if O_j is weakly more important than O_i

- Thus we might arrive at the following matrix:

$$A = \begin{vmatrix} 1 & 1/5 & 1/3 & 1/7 \\ 5 & 1 & 3 & 5 \\ 3 & 1/3 & 1 & 3 \\ 7 & 1/5 & 1/3 & 1 \end{vmatrix} = \begin{vmatrix} 1.000 & 0.200 & 0.333 & 0.143 \\ 5.000 & 1.000 & 3.000 & 5.000 \\ 3.000 & 0.333 & 1.000 & 3.000 \\ 7.000 & 0.200 & 0.333 & 1.000 \end{vmatrix}$$

- To normalize the weights, compute the sum of each column and then divide each column by the corresponding sum

- Using an overbar to denote normalization, we get:

$$\overline{A} = \begin{vmatrix} 0.063 & 0.115 & 0.071 & 0.016 \\ 0.313 & 0.577 & 0.643 & 0.547 \\ 0.188 & 0.192 & 0.214 & 0.328 \\ 0.438 & 0.115 & 0.071 & 0.109 \end{vmatrix}$$

- The next step is to compute the average values of each row and use these as the weights in the Objective Hierarchy

- For this example , the weights would be:

$$w = \begin{vmatrix} 0.066 & 0.520 & 0.231 & 0.183 \end{vmatrix}^T$$

- Note that by construction, $\sum_{i=1}^{4} w_i = 1$

- These weights would be used in summing the measures as required in the evaluation of the Objective Hierarchy

3. Description of the situation

The production company solves its business investments within the scope of the business plan. These investments concern three areas (information technology, transport and logistics). By the help of AHP (Analytic Hierarchy Process) will be find the solution. The output of method of AHP is the determination of sequence of single investments according to their importance for the company.

Three business investments are following:

- investment (O_1): New company information system – purchase and implementation of new company information system by the company SAP.

- investment (O_2): Transport modernization (vehicle park) – purchase vans, lift trucks and pallet trucks.

- investment (O_3): Technology RFID (Radio Frequency Identification) - purchase and implementation of technology RFID.

Estimated costs of single investments:

- O_1 – estimated total costs are 1,8 million EUR. Costs include the purchase of software of SAP company, implementation costs of this software in the company, etc.

- O_2 – estimated total costs are 1 million EUR. Costs include the procurement vans (approximately 500 thousand Kč, lift trucks (approximately 18 thousand EUR) and pallet trucks (approximately 450 EUR)

- O_3 – estimated total costs are 1,2 million EUR. Total costs include costs which are connected with the purchase and implementation of technology RFID (for example: purchase of mobile terminals - approximately 2 thousand EUR)

Top management of company has following four basic criteria:

C_1 : total cost of investment

C_2 : time intensity

C_3 : return on investment

C_4 : contribution for company

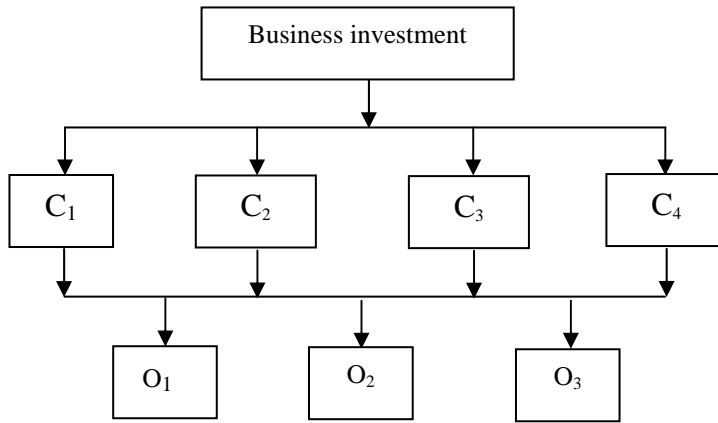Whole situation of decision-making problem is illustrated on Fig. 2

Fig. 2 Hierarchic Structure

4. Use the AHP method for solution of investment activities of company

Information technology

	O_1	O_2	O_3
O_1	1	7	5
O_2	1/7	1	1/3
O_3	1/5	3	1

normalize columns sum rows divide by nbr of features

	O_1	O_2	O_3
O_1	0,745	0,636	0,790
O_2	0,106	0,091	0,053
O_3	0,149	0,273	0,158

sum rows
2,171
0,250
0,580

divide
0,724
0,083
0,193

Transport

	O_1	O_2	O_3
O_1	1	1/5	1/7
O_2	5	1	3
O_3	7	1/3	1

normalize columns   sum rows   divide by nbr of features

	O_1	O_2	O_3
O_1	0,077	0,130	0,034
O_2	0,385	0,652	0,724
O_3	0,538	0,217	0,241

0,241
1,761
0,996

0,081
0,587
0,332

Logistics

	O_1	O_2	O_3
O_1	1	5	1/3
O_2	1/5	1	1/7
O_3	3	7	1

normalize columns   sum rows   divide by nbr of features

	O_1	O_2	O_3
O_1	0,238	0,385	0,226
O_2	0,048	0,077	0,097
O_3	0,714	0,538	0,678

0,849
0,222
1,930

0,283
0,074
0,643

Final matrix

O_1	1,088
O_2	0,744
O_3	1,168

The sequence of single investments according to their importance for the company determinates size of value in the final matrix. Higher value is in the final matrix the investment is more important. Consequently the company should be realizing the investment O_3. It means the implementation RFID technology. From the point of view of the total costs the investment O_3 constitutes the middle way of company which the company should be realizing within its investment activities.

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Resumé

VYUŽITÍ METODY AHP V INVESTIČNÍ ČINNOSTI PODNIKU

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Příspěvek se zabývá vužitím metody analytického hierarchického procesu (AHP), která je jednou z metod vícekriteriálního rozhodování. Metoda AHP je systematická metoda pro porovnání jednotlivých cílů a jejich alternativ. Jedno z možných využití metody AHP je např. v investiční činnosti podniku. V našem případě daná společnost řeší tři různé investice (nákup a implementaci nového podnikového informačního systému, modernizaci vozového parku a využití technologie radiofrekvenční identifikace (RFID)). Výstupem metody AHP je určení pořadí jednotlivých investic podle jejich významnosti pro podnik.

Summary

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This article deals with method of AHP (Analytic Hierarchy Process). The method of AHP is a systematic method for comparing a list of objectives or alternatives. We can use this method in the investment activities of company. In our example our company proposes three different types of investment (new company information system, transport modernization and using of RFID (Radio Frequency Identification) technology in the company). The output of method of AHP is the determination of sequence of single investments according to their importance for the company.

Zusammenfassung

DIE AUSNUTZEN DER AHP METHODE IN DER INVESTITIONSTÄTIGKEIT DES BETRIEBS

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Der artikel beschreibt die Ausnutzen der AHP Methode in der Investitionstätigkeit des Betriebs. Die AHP Methode ist systematisch Methode für den Vergleich die Einzelziele und ihre Alternativen. Die Bestimmung der Folge der EinzelInvestitionen ist der Output der AHP Methode. Ihre Folge wird nach der Gewichtung für den Betrieb festgestellt.

Roman Hruška, Petr Průša:
The use of AHP method in the investment activities of company