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# THE USE OF AHP FOR DECISION MAKING PROCESS IN OGRANIZATION

**Summary.** When company makes decision about different strategies or investments and want to take into account not only quantitative but also qualitative data, AHP methodology can help and make evaluations of all important criteria easier. In conclusions of this paper AHP methodology is defined as the tool of decision making in situation when it is difficult to evaluate and compare all data. As the result of calculations the best alternative was chosen.

**Keywords:** information, AHP, ANP, decision making.

# WYKORZYSTANIE METODY AHP DO PODEJMOWANIA DECYZJI W ORGANIZACJI

**Streszczenie.** W procesie wybierania strategii lub kierunku działalności inwestycyjnej przedsiębiorstwo powinno wziąć pod uwagę nie tylko dane jakościowe, lecz także ilościowe. Metoda AHP ułatwia proces podejmowania decyzji w organizacji i pomaga w ocenie ważności wszystkich kryteriów. Jest ona wykorzystywana w procesie wspomagania decyzji, w przypadku gdy nie można ocenić wszystkich danych ilościowo. Za pomocą metody AHP w rezultacie wybrano najlepszą alternatywę.

**Słowa kluczowe:** informacja, AHP, ANP, podejmowanie decyzji.

## 1. Introduction

Economics of information is crucial for decision making process at the organization. Nowadays for the organization it is important to know how and which information to use in

purpose to make decision making process more successful and to increase financial results of the company[1].

Information is a basis in the communication of the organization and decision making process in the economic and social life. In purpose to make a good choice or decision it should be made special system for information gathering, proceeding and displaying which would give a possibility to observe the organization activity and make the proper decisions. The lack of information creates difficulties in the decision making process.

One of way to increase company competitiveness is to improve its effectiveness by introduction the Information System. This process can be costly, so if the organization doesn't want to spend money for buying IS, it is better to work with programs which helps to solve economic problems and which available for free ( for example as Super Decision Software).

## 2. Economics of information

Development of economics of information started in early 1960 by Stigler and in 1962 by Machlup. It was claimed that there is no meaningful link between equilibrium and information economics. In 1983 Stonier analyzed information within the framework of production function, where information becomes a factor of production together with capital and labor. But problem of information cannot be meaningfully analyzed within the framework of neoclassical production function[2].

Knowledge refers to sum of what is known, while information is associated with items of knowledge. Machlup in 1962 wrote about the act of information and state of knowledge. He wrote that information refers to the act or process by which knowledge is transmitted. According to him information is a freedom of choice when you select a message[3].

The production of information has become the price of business of many firms in the service sector[4].

Nowadays it is important to be informed, to have the latest information which makes decision making faster and easier. For this purpose there are invented many information systems and technologies, which help for the market participants to be more profitable and efficient.

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[1] Babik W.: Zarządzanie informacją we współczesnych systemach informacyjno-wyszukiwawczych – nowe wyzwanie współczesności. „Zagadnienia Informacji Naukowej", nr 1(75), 2000, s. 51-63.
Babik W.: Zarządzanie wiedzą we współczesnych systemach informacyjnych. „Zagadnienia Informacji Naukowej", nr 1(85), 2005, s. 3-22.

[2] Stigler G.: The Economics of Information, The journal of Political Economy, vol. 69, p. 213-225, 1961.

[3] Marchlup F.: The Production Distribution of Knowledge in the United States, Princeton University Press, 1962.

[4] Strydom P.: The economics of information, The Investment Analysts Journal, 1984.

## 3. AHP and ANP applications in business

Analytical Network Process is a new development of professor Saaty. ANP methodology doesn't have assumption that all elements from different levels or same hierarchy levels (clusters of criteria and alternatives) are independent. Unlike AHP, which has assumption about independence among levels, ANP has not this limitations.

The structure of ANP is a network of clusters that contain nodes within them. Between them relations are defined and priorities are calculated by pairwise comparison and judgments.[5] The difference between AHP and ANP is that in AHP criteria determines the importance of alternatives but in ANP the alternatives partly determine the importance of decision criteria.

It is important to see where AHP and ANP methods were already applied before. Professor T. Saaty together with C. Brady wrote the book "Encyclicon", where they described all practical examples in which they used ANP method for decision making purpose. Three chapters of this book belong to business strategy, business operations and business location selection. So it confirms that ANP was already successfully used in business decisions in practice. Also apart business field, ANP methodology was used in decision making process of National government, State and Local government, social policy, international relations, international affairs, education and career, personal investments and sports[5].

Many other scientists also appreciate AHP and ANP methodology and use them in their researches. For example AHP was applied by prof.Parlinska at the wholesale market, Koziol-Kaczorek used AHP method in agriculture real estate evaluation[6].

The range of different cases where AHP were used is very big. Bhattarai used AHP methodology in banking, Humel used AHP in health economy evaluation[7].

In book "Enciclicon" T.Saaty proposed for decision making process to use the guide, which explain how to work with ANP step by step. According to this guide the decision making should have the following parts:[5]

1. Listing of objectives and alternatives
2. Choosing the control criteria and sub-criteria and making comparison among them
3. Making the general network of clusters

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[5] Saaty T.: Encyclicon. Vol. 2: Dictionary of Complex Desicions Using the Analitic Network Process, Pittsburg 2008, p. 1-11, 297-303.

[6] Kozioł-Kaczorek D., Parlińska M.: Zmienne decydujące o wartości rynkowej nieruchomości rolnej z zastosowaniem AHP, Roczniki Naukowe Stowarzyszenia Ekonomistów Rolnictwa i Agrobiznesu, t. 13, z. 2, 2011, s. 236-239.
Parlinska M.: Rola informacji w gospodarce rynkowej na podstawie wybranych rynków hurtowych, Wydawnictwo SGGW, Warszawa 2008.

[7] Bhattarai S.: AHP application in banking: unfolding utility in a situation of financial crisis: http://www.isahp.org/2009Proceedings/Final_Papers/11_Bhattarai_and_Shivjee_Roy_Yadav_REV_FIN.pdf
Hummel M., Steuten L, Groothuis-Oudshoorn K., IJzerman M: Applying the AHP in health economic evaluations of new technology, Proceedings of the International Symposium on the Analytic Hierarchy Process, 2011.

4. Creating of inner and outer dependence relationships
5. Choosing either to influence or to be influenced
6. The supermatrix construction
7. Performing of pairwise comparison on cluster elements
8. Performing pairwise comparison on the clusters
9. Calculation of the limit priorities of the supermatrix
10. Synthesizing the model results using BO/CR formula
11. Developing of strategic criteria and BOCR priorities to synthesize using additive formula
12. Performing of sensitivity analysis

## 4. Super Decision Software

For making AHP and ANP calculations easier it was developed Super Decision Software by T. Saaty which implementing the AHP and ANP for decision making with dependence and feedback[8].

The process of decision making using AHP methodology looks like the following: at the top it is created the main goal (Level 1); by doing pairwise comparison the criteria of importance getting their weights (Level 2); and finally at the bottom level there are situated the alternatives (Level 3), which are compared according to each criterion[9].

In AHP method all from the goal to the criteria and to the alternatives arranged in a hierarchic structure. This hierarchy structure is presented in fig. 1. The hierarchy consists of 3 levels: main goal, criteria of importance and alternatives (choices).

In purpose to choose the best option it was made by prof. Saaty special scale from 1 to 9, using which all criteria of importance and alternatives are evaluated. The goal of practical part of this paper is to choose the best country to invest money.

[8] Super Decisions: an Introduction: http://www.superdecisions.com/super-decisions-an-introduction/

[9] Background: Why use Decision-making Software that can do Feedback?: http://www.superdecisions.com/background-why-use-decision-making-software-that-can-do-feedback/

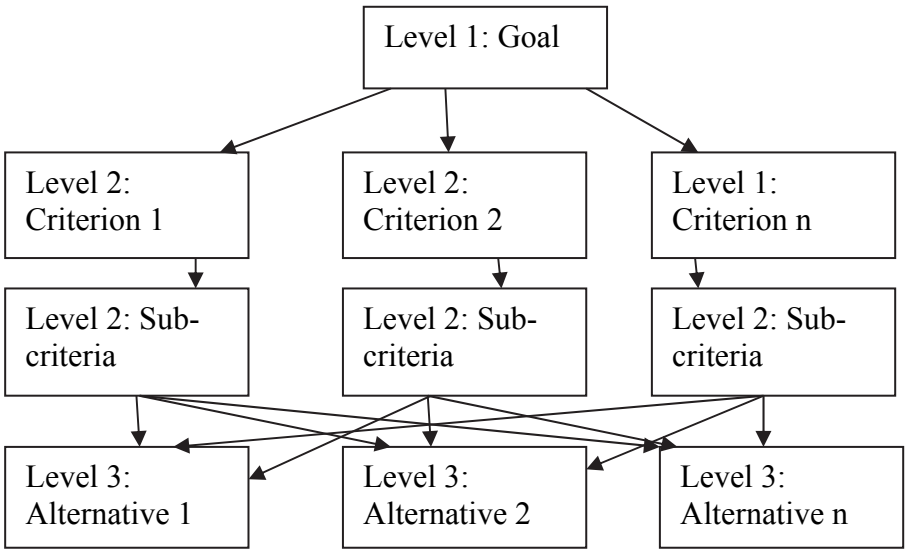


Fig. 1. Levels of hierarchical structure of decision making process with use of AHP
Rys. 1. Poziomy struktury hierarchicznej w procesie podejmowania decyzji z wykorzystaniem metody AHP
Source: Journal of Building Appraisal[10].

## 5. Decision making process in the organization with use of AHP and Super decision software

In the paper it was used the Analytical Hierarchy Process as a method of decision making process in the organization. This method was developed by professor Saaty in 1970.

For the results calculations it was used Super Decision Software, which gives possibility to create all connections between goal, criteria, alternatives and to evaluate them.

Organization can have many opportunities to invest money. One of them it is to invest outside of the country, which means to invest abroad. Here the decision making team can meet different problems connected with evaluation of the benefits, opportunities, costs and risks of investments. Analytical Hierarchy Process can make easier evaluation of all these important criteria.

Professor Saaty in his book Encyclicon wrote the part about "Long-Term Investments in the Search Engine Industry". The aim of that research was to evaluate companies and decide which one is the best to invest money[11].

The main question of practical part of this paper will be: "In which non-EU country in Eastern Europe to invest money in agriculture sector?".

For the practical part of the paper it was used the same strategic criteria of importance, which Professor Saaty used in investments decision making.

[10] Journal of Building Appraisal: http://www.palgrave-journals.com/jba/journal/v4/n3/fig_tab/jba200834f4.html
[11] Saaty T.: Encyclicon. Vol. 2: Dictionary of Complex Desicions Using the Analitic Network Process, Pittsburg 2008, p. 1-11, 297-303.

The following criteria of importance were chosen[12]:

- Costs and revenues(0,224)
- Competitive advantage(0,149)
- Customer value(0,065)
- Risks management(0,267)
- Investor confidence(0,295)

In the brackets there are shown the weights of importance, according to which each alternative will be evaluated.

The research sample consist of three countries from Eastern Europe: Ukraine, Russia and Belorussia.

All alternatives were evaluated according to strategic criteria with taking into account following indicators[13]:

- Costs and revenues: taxes, number of regulations and documents needed to open business, inflation rate
- Competitive advantage
- Consumer value: access to technology(Internet), level of education in agriculture areas, demography in agriculture sector
- Risks management: number of currency fluctuation during year, political risks
- Investors' confidence: Corruption level, GDP per capita

Based on all these criteria each country was evaluated using Super Decision Software and compared between each other based on pairwise comparison rules.

First it was built a hierarchy structure (Fig. 2), where all clusters must be connected starting from top goal then to criteria and after to alternatives.

[12] Saaty T.: Encyclicon Vol.2: Dictionary of Complex Desicions Using the Analitic Network Process, Pittsburg 2008, p. 1-11, 297-303.

[13] Factors Influencing Foreign Investment Decisions: http://www.globalization101.org/factors-influencing-foreign-investment-decisions/

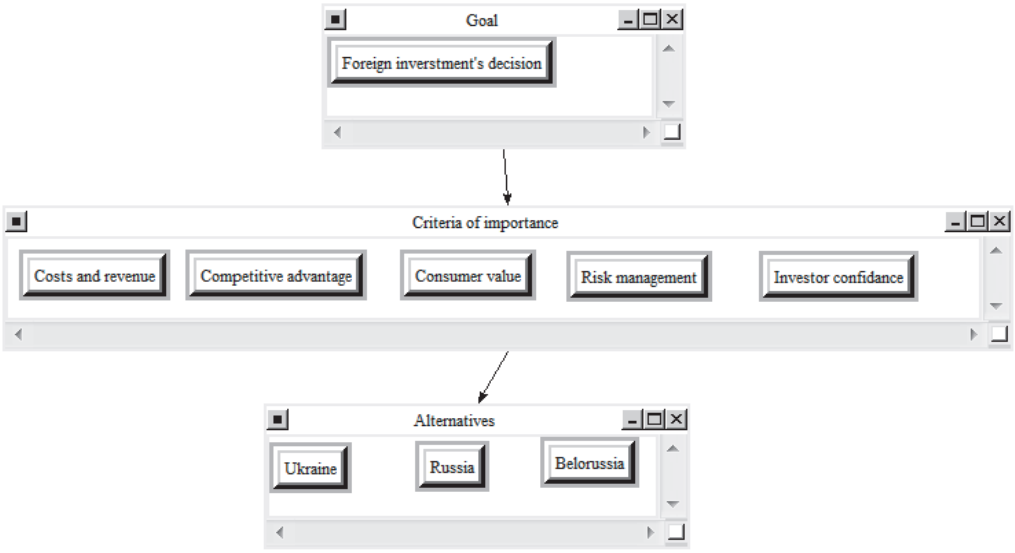


Fig. 2. Hierarchical structure of decision making process in investments
Rys. 2. Struktura hierarchiczna dla problemu podjęcia decyzji inwestycyjnych
Source: made by author using Super Decision Software.

After building the hierarchy structure and giving the weights to criteria, all alternatives should be compared based on each criterion. This process is shown in Fig. 3.


Fig. 3. Pairwise comparison of the alternatives
Rys. 3. Grupowe porównanie alternatyw
Source: made by author using Super Decision Software.

After giving the weights to each alternative based on each criterion, the final evaluation was made, where the weights of criteria of importance were also taken into account. All these calculations are made by Super Decision Software, but it is also possible to make them by Excel.

The final ranking of the alternatives is presented in Table 1.

Table 1

Final ranking of alternatives

| Country | Ranking of weights |
|---|---|
| 1. Russia | 0,453 |
| 2. Belorussia | 0,310 |
| 3. Ukraine | 0,237 |
| Sum | 1 |

Source: made by author using Super Decision Software.

In table 1 it is shown the ranking of alternatives according to their weights. Here Russia took the first place, Belorussia the second and Ukraine the third. Results of these evaluation can be explained by political non-stability in Ukraine and more stable situation on Russian and Belarussian market. So, for the company in year 2014 it was better to invest money in Russia, according to criteria of importance, which were chosen.

## 6. Conclusions

In the paper the Analytical Hierarchy Process as a method of decision making in organization was used.

This method can make company decision making process easier not only in investment field, but also in human resource management, resource allocation, outsourcing, market location and many others cases[14].

All countries were evaluated based on political, social and economic criteria. According to results the most stable situation had Russia, so for company in year 2014 it was better to invest money in this country.

In the article it was not included into political risks the current situation at Eastern Ukraine, as calculations were made before the conflict started. All these calculations can be made again by taking into account many other different criteria. Decision making team can decide at first about criteria, after give them weights, and after choose alternatives and at the end evaluate these alternatives.

For future research it can be added more criteria of importance, based on investor's preferences, and made evaluation with use of ANP, where alternatives have the weights (with dependency).

[14] Saaty T.: Encyclicon. Vol. 2: Dictionary of Complex Desicions Using the Analitic Network Process, Pittsburg 2008, p. 1-11, 297-303.

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**Omówienie**

W artykule wykorzystano metodę Analitycznego Procesu Hierarchicznego do podjęcia decyzji inwestycyjnej w organizacji. Wszystkie kalkulacje przeprowadzono z wykorzystaniem oprogramowania Super Decision Software. Została również utworzona hierarchiczna struktura procesu decyzyjnego. Odpowiednio do struktury hierarchicznej wyznaczono preferencje decydenta (organizacji) oraz alternatywy. Jako próbę badawczą wybrano trzy kraje spoza Unii Europejskiej (Ukraina, Białoruś oraz Rosja), dla których utworzono ranking. Wśród nich najlepszym krajem, z najbardziej stabilną sytuacją ekonomiczną, była Rosja.