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# MODELLING THE STRUCTURES OF STAKEHOLDERS PREFERENCES IN REGIONAL DEVELOPMENT PROJECTS

**Summary:** Regional development projects have great influence on our life. Their success leads to positive attitude to changes. Different groups of stakeholders can have different power and different influence on project. Determining they influence, we can establish priorities for all the project. As we claim, they are also consequence of the stakeholders structure. Determination this structure, can be helpful in managing the project. The problem was solved using an Analytic Network Process (ANP). The objective of this paper is to adopt previously proposed method to regional development projects. Based on hypothetical data, a priority vector was obtained. It could be interpreted as the influence index.

**Keywords:** stakeholders management, Preference Modelling, Regional Development Projects.

**JEL Classification:** C44, O22, R58.

## Introduction

The huge funds available from the European Regional Development Fund cause that regional development projects play a significant role. They evaluation depends on all interested parts, called stakeholders.

Project evaluation by stakeholders is one of the key elements of the project's success. The establishing new knowledge areas in the ISO 21500 standard [ISO 21500, 2012] and also in fifth edition of PMBoK [Project Management Institute, 2013], dedicated only to the stakeholders, is the realization of this view.

In practical projects we have many stakeholders with different influences. Moreover, they have influence on each other. This paper propose to use Analytic Network Process to describe stakeholders structure. The objective of this paper is to adopt method proposed in [Targiel, 2017] to regional development projects. Stakeholders structure may be later used to need prioritizations.

The AHP method, which is the predecessor of the ANP method, was used to requirements prioritisation, for quite a long time [Berander, Andrews, 2005]. Used mainly for software projects. The first works using ANP for prioritization appeared recently [Akinli Kocak et al., 2013; ali Khan et al., 2016]. However, they did not make structure of stakeholders, which is the main contribution of this paper.

First part of paper presents short introduction to Analytic Network Process. Next part explains on simple example idea of proposed approach. The work ends with conclusions and proposals for further research.

## 1. Analytic Network Process

Analytic Network Process (ANP) [Saaty, 1996] is a extension of Analytic Hierarchy Process (AHP). In this method both criteria and variants are called elements. They are grouped into components (clusters). As seen in Figure 1 was defined source components, sink components and intermediate components. They are connected with paths of influence. We can consider two types of dependence: inner dependence between elements of this same component and outer dependence between elements of different components.

We are able to define paths of dependencies using tabular method as presented in Table 1.

**Table 1.** Tabular method

| Influencing components | List of components | Influenced components |
|:---:|:---:|:---:|
| $C_2$ | $C_1$ | |
| $C_2, C_1$ | $C_2$ | $C_2, C_j$ |
| … | … | … |
| $C_2, C_j$ | $C_N$ | $C_1$ |

Source: calculations based on: [Saaty, 1996].

The impact of a given component on another component is derived from paired comparisons as in AHP method. The derived weights ($v_{ij}$) are used to weight the elements of the corresponding column blocks of structure, called initial supermatrix ($W$) [Saaty, Vargas, 2006]. It is assigned zero, when there is

no influence. Initial supermatrix is obtained by paired comparisons on the elements within the clusters. This supermatrix is a two-dimensional matrix. The priority vectors from the paired comparisons appear in the appropriate column of this structure. We obtain weighted supermatrix ($\bar{W}$) using equation (1):

$$\bar{W} = \left[ W_{ij} * v_{ij} \right] \tag{1}$$

where symbol * means multiplication operation of block of matrix $W_{ij}$ by scalar $v_{ij}$.

Then we compute limited supermatrix (G), raising the weighted supermatrix to $k$ power, using equation (2):

$$\lim_{k \to \infty} \bar{W}^k = G \tag{2}$$

Columns of limited supermatrix gives as priorities of components and elements. Detailed explanation of this method can be found in [Targiel et al., 2014].

In order to prioritize requirements, we will define the structure of the relationship between stakeholders. An example structure is shown in Figure 2. The structure was obtained by a tabular method as shown in Table 2.
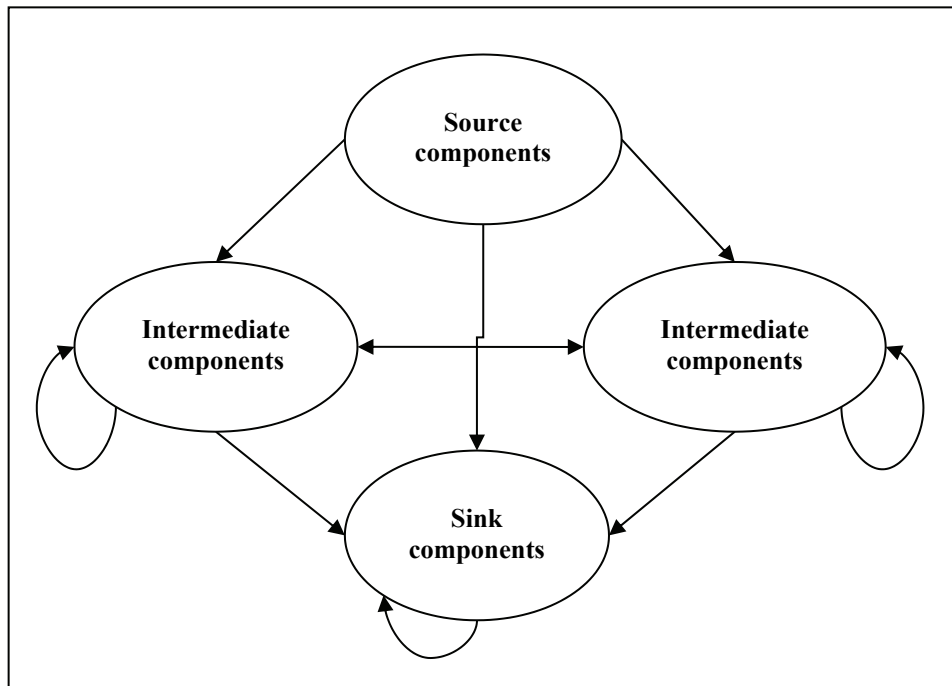


**Figure 1.** ANP model structure

Source: based on: [Saaty, 2005].

## 2. Proposed method

In order to define stakeholders structure in regional development project, we find the relationship between stakeholders. An example structure is shown in Figure 2. The structure was obtained by a tabular method as shown in Table 2.

**Table 2.** Tabular method

| Influencing components | List of components | Influenced components |
|---|---|---|
| WW, SCP | MW | |
| WW, SCP | LG | SCP |
| MW, LG | WW | MW, LG |
| MW, LG | SCP | MW, LG |

Source: calculations based on: [Saaty, 1996].

We have in clusters with stakeholders Silesian Voivodeship Marshal (MW), Silesian Voivode (WW), Silesian Center for Entrepreneurship (SCP), Local Governments (LG).
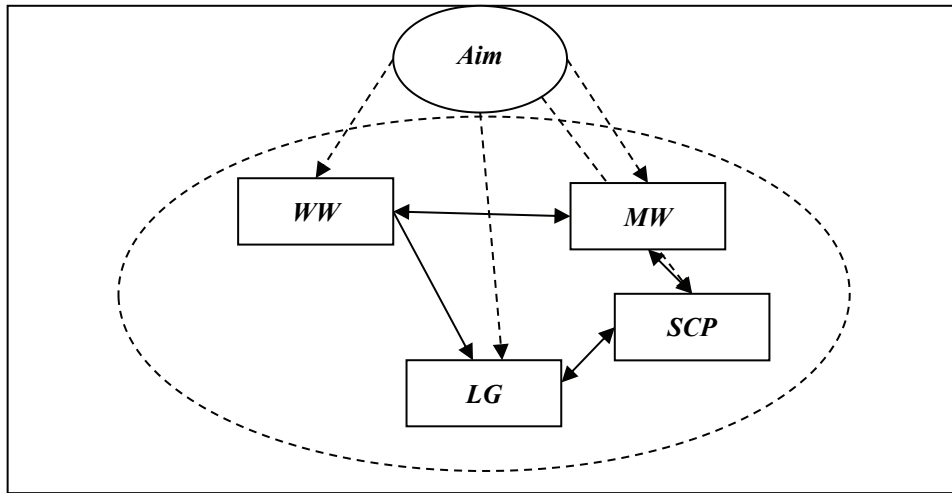


**Figure 2.** ANP model structure

Source: based on: [Saaty, 2005].

The proposed procedure [Targiel, 2017] consists of the following steps:
1. Identification of stakeholders.
2. Grouping stakeholders in the cluster.
3. Identification the relationships between stakeholders.
4. Definition of dependency network.
5. Perform paired comparisons of clusters.

6.  Perform paired comparisons on the stakeholders within the cluster.
7.  Constructing initial supermatrix and weighted supermatrix.
8.  Calculating limited supermatrix.

Since all elements depend on each other, as shown in Figure 2, we must compare pairwise all elements with respect to each other. In Table 3 was showed an exemplary relationship between stakeholders, as measured by Saaty's scale. We assume, that Voivodeship Marshal (MW) is five time more important than Local Government (LG). We can see it in cell (2,1). The same for Silesian Center for Entrepreneurship (SCP), but MW is only three times more important than Silesian Voivode (WW), as we can see in cell (2,4). In next line we see, that SCP is the same important as LG, but five times less important than MW (the value 1/5 in cell (3,2), as MW was five times important as SCP). In last line we see the importance of WW, which is three times more important than LG and SCP also, but three times less important than MW. Of course, this relations are only valid in respect to considered "Aim" in project. In other cases this relations may differ.

When Super Decision software was used in calculations, level of inconsistency was 0,01629.

**Table 3.** Comparisons with respect to "Aim" element in "Stakeholders" cluster

| Elements | LG | MW | SCP | WW |
|---|---|---|---|---|
| LG | 1 | 1/5 | 1 | 1/3 |
| MW | 5 | 1 | 5 | 3 |
| SCP | 1 | 1/5 | 1 | 1/3 |
| WW | 3 | 1/3 | 3 | 1 |

Source: own calculations.

Comparisons with respect to Silesian Voivode (WW) element in "Stakeholders" cluster is presented in Table 4 (there is no inconsistency). With respect to WW, Voivodeship Marshal is three times more important than Local Government.

**Table 4.** Comparisons with respect to "WW" element in "Stakeholders" cluster

| Elements | LG | MW |
|---|---|---|
| LG | 1 | 1/3 |
| MW | 3 | 1 |

Source: own calculations.

Comparisons with respect to Silesian Center for Entrepreneurship (SCP) element in "Stakeholders" cluster is presented in Table 5 (inconsistency is equal to zero). With respect to SCP, Voivodeship Marshal is five times more important than Local Government.

**Table 5.** Comparisons with respect to "SCP" element in "Stakeholders" cluster

| Elements | LG | MW |
|----------|-----|-----|
| LG | 1 | 1/5 |
| MW | 5 | 1 |

Source: own calculations.

Comparisons with respect to Silesian Voivodeship Marshal (MW) element in "Stakeholders" cluster is presented in Table 6 (inconsistency is also equal to zero). With respect to Voivodeship Marshal, Silesian Voivode (WW) is three times more important than SCP.

**Table 6.** Comparisons with respect to "MW" element in "Stakeholders" cluster

| Elements | SCP | WW |
|----------|-----|-----|
| SCP | 1 | 1/3 |
| WW | 3 | 1 |

Source: own calculations.

Based on pairwise comparisons, the Initial Supermatrix is constructed. Then we construct weighted supermatrix, and then we compute limited supermatrix raising the weighted supermatrix to $k$ power, using equation (2). When $k$ is sufficiently big, we obtain identical columns in the limited supermatrix. The numbers contained in them, are the priorities of the elements. They are presented in Table 7.

**Table 7.** Elements priorities

| Elements | Priority |
|----------|----------|
| MW | 0,3922 |
| LG | 0,1078 |
| WW | 0,2941 |
| SCP | 0,2059 |

Source: own calculations in Super Decision.

In presented exemplary case, we have obtained priorities for each stakeholder. According to identified connections and relation between them, we may say than the most influential is Silesian Voivodeship Marshal (MW) with priority level 0,3922. Then Silesian Voivode (WW) with priority level 0,2941. Less influential in regional development projects are Silesian Center for Entrepreneurship (priority level 0,2059) and Local Governments (priority level 0,1078).

## Conclusions

In paper we proposed ANP method to find influence stakeholders on regional development project. There was considered also relations between stakeholders. The resulting impact priorities will be used in further work to prioritize stakeholders needs.

We can conclude, that presented method can be practically used in managing regional development project, because it gives clear ranking of stakeholders as a vector of priorities. This is the first step to prioritization stakeholder requirements, according to their impact. For the completeness of the method, however, it is necessary to examine the sensitivity of subjectively given assessments to results.

Future work will aim to precisely identify stakeholders in the regional development projects. The presented work presents an outline of the method of identifying their structure.

## References

Akinli Kocak S., Alptekin G., Bener A., Gonzales G. (2013), *Requirements Prioritization Framework for Developing Green and Sustainable Software Using ANP – Based Decision Making*, Proceedings of the Environmental Informatics Conference, September 2-4, Hamburg.

Berander P., Andrews A.A. (2005), *Requirements Prioritization* [in:] A. Aurum, C. Wohlin (eds.), *Engineering and Managing Software Requirements*, Springer Verlag, Berlin, p. 69-94.

ISO 21500 (2012), Guidance on Project Management. International Organization for Standardization, Geneva.

ali Khan J., Izaz-ur-Rehman I.Q., Khan S.P., Khan Y.H. (2016), *An Evaluation of Requirement Prioritization Techniques with ANP*, "International Journal of Advanced Computer Science and Applications", Vol. 7(7), p. 419-429.

Project Management Institute (2013), *A Guide to the Project Management Body of Knowledge – Fifth Edition*, Project Management Institute, Newtown Square.

Saaty T.L. (1996), *Decision Making with Dependence and Feedback. The Analytic Network Process*, RWS Publications, Pittsburgh.

Saaty T.L. (2005), *Theory and Applications of the Analytic Network Process: Decision Making with Benefits, Opportunities, Costs, and Risks*, 3d edition, RWS Publications, Pittsburgh.

Saaty T.L., Vargas L.G. (2006), *Decision Making with the Analytic Network Process*, Springer, Boston.

Targiel K., Górecka D., Trzaskalik T., Sitarz S. (2014), *Metoda analitycznej hierarchizacji i metody pokrewne* [in:] T. Trzaskalik (ed.), *Wielokryterialne wspomaganie decyzji. Metody i zastosowania*, PWE, Warszawa, p. 51-74.

Targiel K.S. (2017), *Modeling the Structures of Stakeholder Preferences*, Project Management Development – Practice and Perspectives, Riga, p. 286-292.

## MODELOWANIE STRUCTUR PREFERENCJI INTERESARIUSZY
## W PROJEKTACH ROZWOJU REGIONALNEGO

**Streszczenie:** Projekty rozwoju regionalnego mają olbrzymi wpływ na nasze życie. Ich sukces prowadzi do pozytywnego nastawienia do zmian wprowadzanych przez kolejne projekty. Współczesne poglądy na ocenę sukcesu projektu kierują się w stronę ewaluacji oczekiwań interesariuszy. Różne grupy interesariuszy mogą mieć jednak różny wpływ na projekt. Określając ich wpływ, można także określić priorytety w projekcie. W pracy postawiono hipotezę, że priorytety te są również zależne od struktury interesariuszy, ich wzajemnych zależności. Określenie ich wzajemnych relacji może być pomocne w zarządzaniu projektem i osiągnięciu jego sukcesu. Ten problem został rozwiązany za pomocą metody ANP. Celem pracy jest przystosowanie poprzednio przedstawionej pracy do specyfiki projektów rozwoju regionalnego. Korzystając z metody ANP, na hipotetycznych danych uzyskano wektor priorytetów. Jest on interpretowany jako indeks siły poszczególnych interesariuszy. W konkluzji pracy stwierdzono, że proponowana metoda może być użyteczna w projektach rozwoju regionalnego.

**Słowa kluczowe:** zarządzanie interesariuszami, modelowanie preferencji, projekty rozwoju regionalnego.