ID 1662 | GROUP DECISION MAKING

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1 INTRODUCTION

How to take into account various players' values? How to balance interests of various parties engaged in city development? How to divide resources between various groups? How to prepare city strategies so that no one feels omitted? Urban planners face these questions all the time during their work. It is a challenge to meet the needs of several groups: developers, local authorities, lobbyists, environmental activists, and – last but not least - citizens. These are just few groups whose interests shall be considered and taken into account while preparing new plans and strategies. The purpose of the paper is to encourage a discussion on possible solutions and answers to the questions listed above.

An overall description of the Polish spatial planning law is followed by presentation of methods derived from operational research as it seems that multi-criteria decision analysis (MCDA) might serve urban planners with several promising tools. Methods such as Analytic Hierarchy Process or PROMETHEE Group Decision Support System could aid the planning process at local or regional level. The paper offers a brief description of these methods and discusses examples of how to use them in everyday work of urban planners in order to make the policy making process more transparent and objective.

2 SPATIAL PLANNING SYSTEM IN POLAND

To describe the spatial planning law in Poland, an overall picture of the country's territorial division is necessary. According to the Constitution, the territorial system of the Republic of Poland ensures the decentralization of public power. The institutions of the state have competence at one of the four levels of territorial division: central (country), regional (voivodeship), supra-local (poviat), and local (commune). The inhabitants of communes form a self-governing community in accordance with the law. The local governments participate in the exercise of public power. A substantial part of public duties statutorily lies in the jurisdiction of the communes, which they perform in their own names and under their own responsibilities. There are several acts and regulations which constitute the Polish planning law. The Act on Spatial Planning and Management issued on 27th March 2003 states that the spatial planning system shall be managed adequately to the territorial division of the country at all governmental levels. The basic instrument of spatial planning in Poland is the local spatial management plan. Its regulations are binding and serve as the basis for implementing planning decisions. An attention should be paid to a relatively large number of bodies, institutions, and groups involved in the decision making process and the fact that the interests of these parties may sometimes be in conflict. Therefore, developing a new approach which would take into account all important challenges of urban policy making seems to be unavoidable in the next years. Following factors seem to be crucial (Ossowicz, 2003):

- the essence of city governance: definitions (city management, city governance, spatial policy, urban policy, etc.), features of governing, city governance in the light of organization and management theory, uncertainty and risk in spatial planning;
- local government: its role and tasks, structure, features, and management instruments;
- urban planning: actors, features and attributes of the local level spatial planning, models of integrated planning in cities, models of strategic planning (including models taking into account the specificities of public organizations management);
- city finances;
- controlling and monitoring.

The participation of local society is described in the Spatial Planning and Land Development Act from 2003 in the article 11 and 17. Both articles of the Act allow the local society to submit remarks to planning documents and to take part in public discussions on them. However, these rights are not always executed by the local community, as "they do not believe that it can change anything in their life or in the local unit" (Feltynowski, 2015). As OECD (2016) notices, indicators of social capital and social trust are exceptionally

low in Poland; however, a culture of public engagement in the planning process is growing. According to the Spatial Planning and Development Act from 2003, public participation has three goals:

- to inform the society about making up of new plans,
- to receive feedback from actors involved in the planning process,
- to accept (or reject) the resulting feedback.

In general, two main steps can be distinguished; firstly, society is offered proposed changes and may submit their observations or hints and secondly, the local plan is presented and undergoes public discussion. The legal aspect of issuing a plan, including public input and engagement, is checked by the regional authority. Nevertheless, public engagement is perceived to be rather limited, "formal and only protecting interests of inhabitants and owners, while failing to encourage municipalities to offer alternative development solutions" (OECD, 2016).

Consequently, large number of players involved in the decision making process and policy formulation requires new approach and new methods in order to ensure fair participation of all stakeholders. Not only tools supporting coordinated and transparent process shall be developed, but also several improvement within legal frameworks shall be carried out; otherwise, the planning process will remain limited and archaic.

3 METHODS

There are several methods that could aid the spatial planning process and structure decision making problems. It seems that urban planners may look for solutions among methods derived from other disciplines. MCDA (multi-criteria decision analysis) or MCDM (multi-criteria decision making) is a sub-discipline of operational research and was developed in 1960s in the business sector. MCDA is used in the situation of having multiple, usually conflicting, criteria. Such situations we approach in everyday life, e.g. when choosing a car we take into account price, size, fuel consumption, safety, comfort, etc. Instead of following the intuition, the decision making process could be made more rational with use of the MCDA methods. The development of MCDA is related to the computer development, which enabled to decision makers to conduct complex analyses of multi-criteria problems. MCDA addresses mainly discrete ill-defined problems (no optimal solution) with not very large sets of alternatives. It can be used to conduct following operations: choice, ranking, or sorting (Xu, Yang 2001). Therefore, it can be used to choose (new location for an investment, team of workers, investment plan), rank (cities, regions, universities, students), or sort (research projects, cities).

Value function can be used to derive preferences for the alternatives. To give an insight into these methods, the Analytic Hierarchy Process (AHP) can be briefly described; the method is based on mathematics and psychology and it is widely used to help decision-makers in the fields of business, transportation, or education. The most important feature is the group decision making, where each decision-maker can have different priorities and values. The problem is decomposed into sub-problems. The pairwise comparison of various aspects of the problem and pairwise comparison of criteria are conducted independently. The decision-makers can either provide concrete data or just use their individual and subjective judgement. Those evaluations are computed in order to obtain a comprehensive evaluation of the decision problem. The capability to compare incommensurable elements distinguishes the AHP from other MCDA methods (Saaty, Peniwati 2008).

The second group (methods based on outranking relations) is widely known mostly for two approaches, i.e. ELECTRE and PROMETHEE. Outranking methods were first developed in France in the late sixties following difficulties experienced with the value function approach in dealing with practical problems. As in the value function approach, outranking methods build a preference relation among alternatives evaluated on several criteria. It is a binary relation S on the set X of alternatives such that xSy if there are enough arguments to declare that x is at least as good as y while there is no essential reason to refute that statement. In most outranking methods the outranking relation is built through a series of pairwise comparisons of the alternatives (Bouyssou 2001). ELECTRE I is the first outranking method and it gives a good notion of the ideas behind outranking. Other outranking methods are more advanced as they accept differences in the strength of the decision maker's preferences as well as the possibility of the decision maker being indifferent with respect to two alternatives (de Boer et al. 1998). Another outranking method is

PROMETHEE (and its descriptive complement geometrical analysis for interactive aid which is better known as GAIA). The fields of application are similar as in the aforementioned AHP technique. The main advantage of the PROMETHEE method is the clear reasoning which helps decision makers build well-structured framework for the decision problem. It is useful for solving complex problems with several criteria that need to be evaluated. The method could be applied to: choosing the best location for an investment, ranking action projects or investment plans, allocating resources. The information requested by PROMETHEE and GAIA is particularly clear and easy to define for both decision makers and analysts. It is based on a preference function associated to each criterion as well as weights describing their relative importance. Usually there is no alternative optimising all the criteria at the same time, therefore a compromise solution should be selected.

The algorithms, most common uses, and possible extensions of AHP and PROMETHEE methods are well-described in literature. The algorithm of PROMETHEE is following:

Step 1: Using the data contained in the evaluation matrix, the alternatives are compared pairwise with respect to every single criterion. The results are then calculated and expressed by the preference functions, which are calculated for each pair of options and can range from 0 to 1, where 0 means that there is no difference between the pair of options (indifference), 1 indicates a strong preference, and value between 0 and 1 indicates weak preference:

$$Pj(a, b) = Fj\,[dj(a, b)]\ \forall a, b \in A$$
$$\text{where:}$$
$$dj(a, b) = gj(a) - gj(b)$$

For criteria to be minimised, the preference function should be reversed or alternatively given by:

$$Pj(a, b) = Fj\,[-dj(a, b)]$$

In order to facilitate the identification of preferences six types of particular preference functions have been proposed (Brans and Mareschal, 2005). Additionally, such parameters as threshold of indifference or threshold of strict preference can be used.

Step 2: Aggregated (global) preference degree for each pair of alternatives on each criteria is calculated:

$$\pi(a,b) = \sum_{k=1}^{q} P_k(a,b) \cdot w_k$$

Step 3: Positive and negative flow scores are calculated:

$$\phi^+(a) = \frac{1}{n-1} \sum_{x \in A} \pi(a,x)$$
$$\phi^-(a) = \frac{1}{n-1} \sum_{x \in A} \pi(x,a)$$

Step 4: Net flow score is calculated in order to obtain a complete ranking of alternatives:

$$\phi(a) = \phi^+(a) - \phi^-(a)$$

Step 5: Group decision making. The global evaluation and GAIA analysis for group decision-making are carried out so that all the decision makers are advised on the potential conflicts. The last step of the process is summarized as follows:

$$P_i(a,b) = F_i[\phi_i(a) - \phi_i(b)] \quad i = 1, \ldots, m$$

where $P_i(a,b)$ denotes the preference of alternative a to alternative b for DMi.

$$\pi_{gdss}(a,b) = \sum_{i=1}^{m} P_i(a,b) w_i$$

where **Π**gdss(a,b) is defined as the weighted sum of Pi(a,b) for all decision makers with wi as the weight for DMi. The PROMETHEE partial and complete rankings are obtained from the following equations:

$$\phi^{+}{}_{gdss}(a) = \frac{1}{m-1} \sum_{x \in A} \pi_{gdss}(a,x) \text{ and } \phi^{-}{}_{gdss}(a) = \frac{1}{m-1} \sum_{x \in A} \pi_{gdss}(x,a)$$

$$\phi_{gdss}(a) = \phi_{gdss}{}^{+}(a) - \phi_{gdss}{}^{-}(a)$$

Therefore, PROMETHEE GDSS can capture multiple decision makers' beliefs, calculate them, and provide better insight into the decision making problem (Tavana et al, 2013). The second method, namely Group AHP, serves the same purpose; however it algorithm is different (Saaty and Shang, 2007; Saaty and Peniwati 2008):

Step 1: Creating a pairwise comparison matrix A. The matrix A is a m×m real matrix, where m is the number of evaluation criteria considered.

Step 2: The normalized pairwise comparison matrix Anorm is computed:

$$\overline{a}_{jk} = \frac{a_{jk}}{\sum_{l=1}^{m} a_{lk}}.$$

Step 3: The criteria weight vector w (that is an m-dimensional column vector) is built by averaging the entries on each row of Anorm

$$w_j = \frac{\sum_{l=1}^{m} \overline{a}_{jl}}{m}.$$

Step 4: Computing the matrix of option scores:

The matrix of option scores is a n×m real matrix S. Each entry sij of S represents the score of the ith option with respect to the jth criterion. In order to derive such scores, a pairwise comparison matrix B is first built for each of the m criteria, j=1,...,m. The matrix B is a n×n real matrix, where n is the number of options evaluated. Each entry of the matrix B represents the evaluation of the ith option compared to the hth option with respect to the jth criterion. Second, the AHP applies to each matrix B the same two-step procedure described for the pairwise comparison matrix A, i.e. it divides each entry by the sum of the entries in the same column, and then it averages the entries on each row, thus obtaining the score vectors s(j), j=1,...,m. The vector s(j) contains the scores of the evaluated options with respect to the jth criterion. Finally, the score matrix S is obtained:

$$\mathbf{S} = [\, \mathbf{s}^{(1)} \dots \mathbf{s}^{(m)} \,]$$

Step 5: Ranking the options. Once the weight vector w and the score matrix S have been computed, the AHP obtains a vector v of global scores by multiplying S and w, i.e.: v = S · w

Step 6: Checking the consistency index. Consistency Index (CI) is obtained by first computing the scalar x as the average of the elements of the vector whose jth element is the ratio of the jth element of the vector A·w to the corresponding element of the vector w.

$$CI = \frac{x - m}{m - 1}$$

Step 6: Group decision making. We can consider two issues in group decision making. The first is how to aggregate individual judgments, and the second is how to construct a group choice from individual choices. For the purpose of the study presented in the next chapter of this paper, weighted geometric mean is used to conduct aggregation of individual judgements (AIJ):

$$c_{ij} = \exp \frac{\sum_{k=1}^{N} w_k \ln a_{ij(k)}}{\sum_{k=1}^{N} w_k}$$

Both methods can be used while solving decision problems with several alternatives evaluated on several criteria by several decision makers. An example of how to use Group AHP for the purpose of spatial planning is discussed in the next chapter.

4 EXAMPLE – CHOOSING A SITE LOCATION

In Poland, participatory processes have recently been applied more frequently; however, their performance is still low in terms of engaging key actors and sharing decision-making power with them (Cent et al, 2014). While making important decisions related to formulation of city policies, several bodies and parties are involved in the process. The possibility to take into account all players' needs and objectives is a key challenge for city authorities. In this chapter, a theoretical example use of Group AHP method is offered.

Let us assume that city authorities are facing a problem where to locate a new bridge. The actors involved in the process might be:

- Department of Transportation – a body within a municipality which is interested in improving transportation system and road network while taking into account limited budget of the city,
- Department of Environment – a body which main focus is on environmental protection,
- Urban Development Department – a body consisting of urban planners, who try to balance costs of investments with their functionality and aesthetical function in order to improve citizens quality of life.

All these actors take into account the same criteria, such as: cost of building, impact on transportation network, design and aesthetics, impact on environment. Of course, each decision maker can have different from others values and preferences on the criteria and available alternatives. By conducting pairwise comparison of the adopted criteria, we can gain an insight into the opinion of each decision maker. Furthermore, consolidation of decision makers' preferences allows for numerical and transparent presentation of the decision making process. Results of pairwise comparison of criteria by each decision maker and consolidated results are presented in the Table 1. All calculation were conducted using MS Excel.

	Department of Transportation	Department of Environment	Urban Development Department	Consolidated (according to DMs weights)
Cost of building	26%	10%	7%	**13,6%**
Impact on transportation network	56%	26%	48%	**48,5%**
Design and aesthetics	6%	4%	26%	**11,1%**
Impact on environment	12%	60%	19%	**26,9%**
weights	*0,3*	*0,3*	*0,4*	*1*

Table 1. Consolidated decision matrix for criteria

Similarly, decision makers can conduct pairwise comparison of alternatives (instead of criteria). Partial ranking of bridges can be also consolidated into one global ranking. The results of this calculation are presented in the Table 2.

	Department of Transportation	Department of Environment	Urban Development Department	Consolidated (according to DMs weights)
Bridge A	28%	24%	10%	**18,9%**
Bridge B	65%	67%	64%	**67,8%**
Bridge C	7%	9%	26%	**13,3%**
weights	*0,3*	*0,3*	*0,4*	*1*

Table 2. Consolidated decision matrix for alternatives

Furthermore, the Group AHP method allows for calculating consistency of decision makers. In the first case (evaluation of criteria) consensus equals 61,8%, while in the second case (evaluation of alternatives) consensus reached 90,3%. Results obtained within this case study can be further used to obtain global ranking: to combine consolidated alternatives with consolidated criteria, or – with use of other methods – to provide other rankings with additional input provided by experts. The case study offered above is an example of how to use Group AHP for providing better insight into decision making process, but PROMETHEE GDSS could be also used for this purpose.

5 CONCLUSIONS

The paper offers an example of bringing together group decision support systems and urban management in order to make the decision making process within spatial planning more rational, transparent, and inclusive. Large number of players involved in planning procedure demands comprehensive and fair methods which can ensure that each player's voice is taken into account. Consequently, looking for solutions outside the discipline of spatial planning seems to be unavoidable. Methods discussed in this paper can be used to better structure the decision problem and to obtain ranking of alternatives, while incorporating evaluations provided by various actors, whose interests may sometimes stay in conflict. Numerical approach to the planning procedure seems to be an interesting solution, which shall be further developed.

Moreover, observations of planning practices and literature review suggest that comprehensive and transparent grasp of various stakeholders' views and opinion is rarely happening. Shortcomings of the current legal framework and planning reality in Poland discourage some members of local community to participate in the planning process. Therefore, establishing new approach supported by innovative methods ensuring fair treatment might in the next years an interesting challenge for urban planners and researchers.

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ID 1663 | A SOCIO-JURIDICAL CRITICISM TO URBANISTIC LAW FOR A NEW URBAN STRATEGY IN NATAL/RN/BRAZIL

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1 INTRODUCTION

The principle of the dignity of the human person is a moral, social and juridical value inherent in the person, that is, every human being is endowed with this precept, and this is the highest principle of the democratic state of law.

While it is a right the idea of dignity in a collective dimension concerns tolerability per temporal, spatial and cultural circumstances. Thus, the city must be the place of the exercise of the dignity of the human person.

Based on this idea and based on a dialectical perspective, the research proposes to discuss the effectiveness - notably ineffectiveness - of the norms of urban law, through the confrontation between the Federal Constitution, the City Statute, the Metropolis Statute, and the Municipal Master Plan in the State of Rio Grande do Norte located in Brazil.

For purposes of this work, effectiveness is understood as the conformity of the actual situation to the legal situation granted or determined by the standard. In this sense, the first stage of the work consists in the revision of the literature focused on the legislation and legal instruments of urban law that regulate the urban space in the municipality of Natal.

Next, we intend to criticize the illusion of urban law and the predominantly positivist conception that predominates both in the elaboration of legislation in Natal-RN and in the application of such norms. In addition, to investigate the causes of noncompliance with norms of urban law, it is necessary to study the city and society in which we live, the relation of identification and belonging of the individual with the city in which he lives, what mechanisms of participation Effectiveness of such individuals. In other words, we must understand in depth the ideas of democracy and justice, from the precepts of freedom and equality to the understanding of our reality. In this sense, the objective is to evaluate if the usual means and procedures used in the city of Natal-RN in the legitimization of public decisions in the sphere of urban policies, are backed by social legitimacy, once we experience the daily practice of civil disobedience in relation to the laws in the coexistence of the legal city and the illegal city.

Thus, it is essential to discuss the right to the city from the study of popular participation. Therefore, it is urgent to rethink conceptually law as a science, specifically the role of urban law and urban plans in the current Brazilian scenario, and the necessary change from its normative-rationalist character to a more pluralistic view that the promotion of less unequal social and territorial justice.