



MULTICRITERIA VERBAL ANALYSIS OF TERRITORY PLANNING SYSTEM'S MODELS FROM LEGISLATIVE PERSPECTIVE

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Abstract. The process of compiling the documents (plans) of territory planning is a complicated task, requiring much time, effort, knowledge and skills. Therefore, the factors influencing territory planning should be defined and their role in developing a general spatial concept, stating the priorities in land use, environment protection, monument preservation, the use of forests and water, as well as in the development of residential and industrial areas, infrastructure, the regulation of the employment of residents and the activities of natural and juridical persons, should be determined. The main principles of territory planning at state level in Lithuania, Poland and Germany are considered. The paper aims to analyse the models of territory planning used in Lithuania, Poland and Germany and to define key criteria influencing this process in the considered countries. The models analysed are compared using a multicriteria method of verbal analysis (*UniCom-BOS*).

Keywords: territory planning, sustainable urban development, multicriteria verbal analysis, decision-making person (DM).

1. Introduction

Territory planning at the national level is analysed as a complex multifaceted technological process. The decisions made in this process are influenced by natural, economic, demographic, planning, technical, managerial and other factors. Their influence is evaluated from three major perspectives, including *economic, social and environmental* aspects. The interaction of these aspects makes the basis of the sustainable development of territories. The conditions ensuring sustainable development should be reflected in legal documents of territory planning.

Part 1 of the Article 3 of the territory planning law of Lithuanian Republic states the main aims of territory planning, which are as follows: 1. to maintain the balance in social, economic and ecological territory development; 2. to develop healthy and harmonized environment for the life, work and recreation of people, seeking to create better living conditions on the whole territory of the state; 3. to form the policy of developing residential areas, infrastructure and other areas of human activities; 4. to protect, rationally use and restore natural resources, as well as natural and cultural heritage and recreational resources; 5. to form the natural framework and to provide the conditions for maintaining the sustainable development of territories; 6. to form land plots, reserving (outlining) the territories for developing the infrastructure of residential areas and other areas of activities and for various uses of land; 7. to harmonize the interests of natural

and juridical persons and their groups, as well as the society, municipalities and the state in using territories and land plots for developing their activities; 8. to stimulate the interest of investors in making investments in social and economic development of territories. It should be noted that all goals are equally important and should be taken into consideration in preparing territory planning documents. It means that social needs, landscape, geographical situation, geological conditions, the requirements of urban development, architecture, technical aspects, environment protection, land use, as well as the rights of land owners and third persons and the requirements of state safety and defence should be considered (Seimas of Lithuanian Republic 2009). Moreover, the officially acceptable criteria and methods of evaluating the sustainable development of the territory of Lithuania have not been created yet. Therefore, the process of compiling the documents of territory planning is a complex procedure requiring much time, effort, knowledge and skills. The demand for monitoring processes, as mentioned in the Law on Territorial Planning (Seimas of Lithuanian Republic 2009), is just a statement, since it is not supported by any particular acts (Jakaitis *et al.* 2009).

Quite a few various problems should be solved in the area of territory planning. They are associated with the change of climate and global power engineering, demographic and cultural factors, social aspect of engineering infrastructure and the lack of transport and communication services, making a challenge to our cities, towns,

villages and their inhabitants. The plans being developed should ensure sustainable territory development and growth of economic development, employment and investments. This requires the creation of a complex system of national plans' implementation. To achieve this aim, the evaluation criteria should be defined, and a system capable of ensuring a comprehensive and objective analysis of territory development and changes, information collection, accumulation, storage and processing as well as a mechanism of decision drafting and making should be created (Jakaitis *et al.* 2009).

On January 8, 2008, the prime minister of Lithuania issued a decree Nr. 7 to establish a special work group (The decree of the Prime Minister... 2008) for solving the problems of territory planning and urban development, which assessed the situation and stated that:

- urban development policy has not been developed (a general plan of territory development adopted by the Seimas (Parliament) of Lithuania is not being fulfilled);
- there are no institutions responsible for management and implementation of sustainable development of the considered area;
- the legislation in the field of territory planning does not conform to the current trends of its development and no consultations with experts are held;
- the public interest and public infrastructure in the field of territory planning have not been legitimized;
- municipalities lack finances and legislative mechanisms to solve the problems of territory planning and to create public infrastructure. They also have no rights for land using;
- the problem of training specialists in territory planning and urban development has not been solved.

A clear distinction should be made between legislative aspects of territory planning and preparation of plans, thereby preventing uncontrolled, chaotic development and helping to establish the priorities and criteria of evaluating this development. The forms of involving the public in the process of territory planning should also be defined more clearly to ensure that none of the key issues is missed (Rudzkiene and Burinskiene 2007). To achieve that each landowner could choose the development of the territory on which his/her property is located, favourable conditions of land ownership and management should be outlined in the confirmed territory development plan. We have already noticed that the market provides an important but not the best regulating mechanism for solving problems and tasks of territory planning. The demand for power requirements of present civilizations make a key issue for sustainable development (Mickaityte *et al.* 2008). Private investments aimed at ensuring the effective and profitable use of the selected plot of land cannot help to achieve the sustainable development because the latter is aimed at harmonizing the economic development, in turn could ensure social development based on the effective use of natural resources, as well as maintaining

ecological balance and providing good living conditions for the present and future generations. (Baltic work agenda series 21...). People, businessmen, society and authorities can act together in seeking to achieve more effective economic development, environment protection and social welfare (Viteikienė and Zavadskas *et al.* 2007). Therefore, the problems of sustainable development of territories should be solved by specialists, taking into account the needs of the society. Determining public needs, the opinions of all interested parties should be taken into consideration and assessed objectively.

2. Planning systems in Lithuania, Poland and Germany

One of the key criteria, strongly influencing the achievement of political, strategic, economic and social aims, is territory planning, usually perceived as integrated planning (Bass *et al.* 1995). Prof. P. Jushkevichius defined the current state of the problem as follows: "The quantitative and qualitative development of urban planning system in Lithuania is extremely slow, and a set of evaluation criteria of this process has not been determined." Moreover, the trend of personified evaluation of urban development, based on the use of subjective and objective criteria, prevails in Lithuania (Juškevičius 2005; Barauskienė 2007a). The German planning system makes an exception: the autonomous land use planning is officially recognized as landscape planning, but, at the highest levels, it may be converted into administrative strategic programming (Kiemstedt 1993; Kavaliauskas 2008).

General territory plans of Lithuanian municipalities make a part of the hierarchical system of strategic territory planning. Based on general plans, a vision of special planning of a town, municipality, region or state territory is created, taking into account the suggestions of wider public and various institutions. Long-term priorities are determined and strategic investment projects are outlined, thereby ensuring the sustainability of development (Barauskienė 2007b).

To determine the effectiveness of the legislative basis of territory planning in Lithuania, it was decided to compare it with respective processes, taking place in Poland and Germany. For this purpose, the main principles and goals of territory planning laws in these countries should be analysed, the procedures of coordination and approval of plans as well as the control of their implementation should be compared and the legal effect of the coordinated plans and the cooperation with the community in making final decisions should be described. To develop a model, researchers should take into account the history of each country, the level of its development, the needs of its population and national traditions.

The achievement of sustainable development goals in territory planning is a complicated task. The concept of sustainable development emphasizes the governance of a regional planning process, where the strategic and physical planning subsystems are coordinated and balanced. The principle of sustainable development applied to physical planning must ensure the priority of rational use of territories and harmony between effective social-economic development and maximal protection of natural

resources and landscape (Kavaliauskas 2008). An effective model for sustainable territory development should comply with political, economic, social, cultural, institutional, technological, environmental, legal/regulatory and educational conditions in the considered country (Kaklauskas et al. 2009).

The analysis of the aims of planning and methods of their achievement is often based on the use of decision support systems (Nijkamp 2007). The main features of national-level territory planning in the considered states are given in Table 1 (Vision and Strategies... 2000).

The initial data used for selecting the method of analysis may be characterized as follows:

- uncertainty of the estimates of decisions concerning the alternative variant of the problem;
- qualitative evaluation of the decision concerning the alternative variant of the problem;
- the estimates of the alternatives based on the analysis of each particular criterion are elicited only from experts;
- a lack of an objective measurement scale of estimates based on various criteria.

The factors complicating the analysis are as follows:

- uncertainty;
- planning does not yield the immediate results;
- planning is a continuous process.

Table 1. Major features of national planning in the countries considered

Country	Germany	Lithuania	Poland
Criterion			
The title of the plan in the language of a particular country	<i>Landesplanung (planning at the federal land level)</i>	A general plan (of the country's territory)	<i>Koncepcja Polityki Przestrzennego Zagospodarowania Kraju</i>
Planning object	The whole territory of federal lands	The territory of Lithuanian Republic	The whole country
Customer	A ministry responsible for planning	Ministry of Environment Protection	The government/The government centre of the study of strategies
Approving institution	A ministry responsible for planning	The Seimas of Lithuania	The government, i.e. the Council of Ministers and respective ministers, agencies and regional authorities
Is planning compulsory or optional?	Compulsory	Compulsory	Compulsory if national development strategy is elaborated
Conditions required for approving a plan expertise	Should be approved by the state Parliament	Should be coordinated with regional and special plans, if not prepared – with regional authorities; should be approved by state institutions and the state commission of Territory Planning Control	National policy developed and presented by the state centre for the study of strategies makes the basis for developing programmes for particular sectors, which are approved by the Council of Ministers
Publicity	None	Published in national press, two months for the public to get acquainted, one month exposed to the public	None
With whom should a plan be coordinated?	Ministries	It should comply with state level plans and strategies and general regional plans	The minister responsible for dwelling and urban development; regional assemblies; other ministries
Legislative effect	Integrating effect on planning	Restricting effect on state level special plans, plans of national and regional development and general and special regional plans	There are no legal commitments to the third countries; there is an effect on the programmes of particular sectors and regions; there is an indirect effect on the local level plans
Report on plan implementation	None	The report of the Government submitted to Seimas	Not regulated
Indemnities for damage caused by planning restrictions	None	Property owner or user may apply for indemnifying for damages	None
Changing of the plan	Legally possible	A new plan	Changes are not specified by the law but may be made possible after discussing the plans and submitting the programmes or investigating the conflicts of interests at the administration or community levels

In developing a model for assessing the effectiveness of territory planning system, the following issues were taken into account: the object of planning; the necessity of plan development; the conditions to be satisfied for getting approval of the developed plans; complexity of procedures of plan coordination and approval; the legislative effect of plans; indemnities for damages caused by the restrictions found in the process of planning; the conditions to be satisfied for getting the approval of the developed plans; the requirement to submit a report on the implementation of the approved plan; managers of planning; possibilities of changing plans and the related problems; the structure of spatial plans. These criteria describe the system associated with compiling of documents of territory planning from legislative perspective.

Coming into effect on 12th December 1995, the territory planning law of the Lithuanian Republic was thereafter changed 19 times. The table below presents data corresponding to the regulations of the law effective up to 31st December 2009. Furthermore, by resolution No. 422 “Regarding a Concept of a New Wording of the Territory Planning Law of the Lithuanian Republic” adopted on 31st March 2010, the Government of the Republic of Lithuania ratified the new concept of the Law on territory planning. If approved the new wording of the law will affect the legal regulation of the territory planning process as well as preparation of plans.

3. Structuring of the problem

At the stage of structuring, the decision-making person (DM) should state the alternative’s selection problem in a natural language in terms of the respective problem area (Ustinovichius *et al.* 2009). The alternatives available for selection should be listed, the evaluation criteria determined, and verbal scales of evaluation based on each criterion should be defined. A set of alternatives for selecting the best of them will be denoted by A .

The DM determines the characteristics of the alternatives to be used as the evaluation criteria. Let us denote a set of the criteria $C = \{C^1, \dots, C^k\}$, $K = \{1, \dots, k\}$ as a set of the criteria numbers. The criteria may be both quantitative and qualitative (verbal). The estimate of the alternative $a \in A$ based on the criterion C^j will be denoted by $C^j(a)$. The scale of evaluation $S^j = \{s_1^j, s_2^j, \dots, s_{m_j}^j\}$, $j \in K$, associated with a particular criterion, is not specified beforehand, but formed based on the estimates of all actual alternatives according to a particular criterion $S^j = \bigcup_{a \in A} C^j(a)$. In this approach,

the preliminary arrangement of the estimates on the criterion scales is not required. Various combinations of estimates make a k -dimensional space, which is, in fact, the Cartesian product of the criterion scales $S = \prod_{j=1}^k S^j$.

Each alternative $a \in A$ corresponds to the vector estimate (tuple) $C(a) = (C^1(a), C^2(a), \dots, C^k(a))$, consisting of the alternative estimates $C^j(a)$ based on the criteria C^1, \dots, C^k . Let us denote by A a set $\{C(a) | a \in A\}$ of vector estimates of the real alternatives from the set A . It is evident that $A \subseteq S$.

Thus, at this stage of problem structuring, sets of alternatives A and criteria C , as well as scales of criteria S^j and vector estimates A are determined. The task is to obtain a subset of the best alternatives based on the DM preferences.

4. Formalizing the DM preferences

Let us introduce an additional space of vector estimates, which will be required later for developing the procedures of eliciting the DM preferences. Let us also extend the scale of each criterion S^j by introducing a fictitious estimate $\omega^j : Q^j = S^j \cup \{\omega^j\}$. Then, a set of various vector estimates, including the fictitious ones, may be described by the Cartesian product of the new criterion scales $Q = \prod_{j \in K} Q^j$, similar to the set $S = \prod_{j \in K} S^j$.

Let us consider a particular vector estimate $x \in Q$ and a subset of the numbers of the criteria $J \subseteq K$. Let us denote by x^j a vector estimate, whose j -th component is equal to the j -th component of the vector estimate x , if $j \in J$, and is equal to ω^j , if $j \in K \setminus J$. A vector estimate, whose all but one values are fictitious, will be referred to as one-criterion estimate. If two estimates are real, the vector estimate will be referred to as a two-criterion estimate, etc.

A description of the DM preferences is based on binary relations P and I defined on the set of vector estimates Q :

- $(x, y) \in P$ if x is more preferable than y ,
- $(x, y) \in I$ if x and y are equally preferable,
- and the resulting binary relation is $R = P \cup I$.

In this case, for any pair of vector estimates (x, y) , making a binary relation P or I , the statement is valid that if the j -th component of one of them is equal to the fictitious estimate ω^j , the j -th component of the other vector estimate is also equal to ω^j .

It is believed that the binary relations P , I and K have the following properties:

- P is rigorous partial order (irreflexively and transitively),
- I is equivalence (reflexively, symmetrically and transitively),
- R is quasiorder (transitively, reflexively),

$$P \cap I = \emptyset; R = P \cup I.$$

In addition to the above properties, it is assumed that the criteria are interdependent in preference.

The eliciting of preferences from decision-makers begins with the comparison of one-criterion vector esti-

mates. In this particular case, the estimates of the efficiency of territory planning model in the considered countries and the estimates of the alternatives based on particular criteria should be elicited from the experts in the considered area. The DM makes a pairwise comparison of the estimates on the scale of each criterion. As a result, the estimates based on each particular criterion are arranged in the order of the DM preferences.

Unlike other methods, where the order on the criterion scale is predefined at the stage of structuring, in the case of using the method UniComBOS, the criterion scales are arranged, when one-criterion vector estimates are compared. If the scale of some particular j -th criterion has m_j estimates, $m_j(m_j-1)/2$ comparisons will be made with respect to this criterion.

Then, a pairwise comparison of vector estimates of two-, three- (and more) criteria is made. The number of the criteria with real estimates is increased only if the problem cannot be solved with the given number of criteria. A special optimization procedure is used for searching for a pair of vector estimates which will be presented to the DM. It is based on the prediction model, allowing the judgements given by the DM in the process of comparing the vector estimates, to be predicted. The above optimization procedure used at this stage of eliciting the DM preferences yields pairs of vector estimates and the order of their comparison by a decision-making person.

The DM preferences elicited in every operation of pairwise comparison of vector estimates (including one-criterion estimates) are checked for agreement (consistency), and an attempt is made to determine a subset of the best alternatives. If the inconsistency of estimates is observed, its cause is determined and eliminated. This is made by showing the DM his/her previous estimates and their logical consequences. The DM may indicate the wrong answer or disagree with some intermediate result. In the first case, the DM corrects his/her estimate. In the second case, the hypothesis about the independence of the criteria of preference and/or transitivity may be violated.

Therefore, the DM may require problem restructuring. If any disagreement has not been found or has been already eliminated, and a subset of the best alternatives has been determined, this subset is presented to the DM, and the procedure of eliciting the preferences is completed. In comparing arbitrary vector estimates, the derivation of the formulas in the logic of the 1st-order predicates by means of the rule of derivation – modus ponens – is performed.

In the method UniComBOS, an individual mechanism of controlling the reliability of information about the comparisons of vector estimates is offered for each criterion. The number of criteria is increased until the proportion of the DM estimates, leading to disagreement, exceeds the specified threshold value, or the set of the best alternatives is determined. A large number of contradictory judgements, exceeding the threshold value elicited from the DM, indicates that a comparison of the vector estimates based on the given number of criteria is too difficult for the DM. Therefore, further increase of the criteria number will make the information obtained unreliable.

In Fig. 1, a block-diagram of the procedure used for structuring the problem of determining the subset of the best alternatives and the procedure of eliciting the DM preferences is provided.

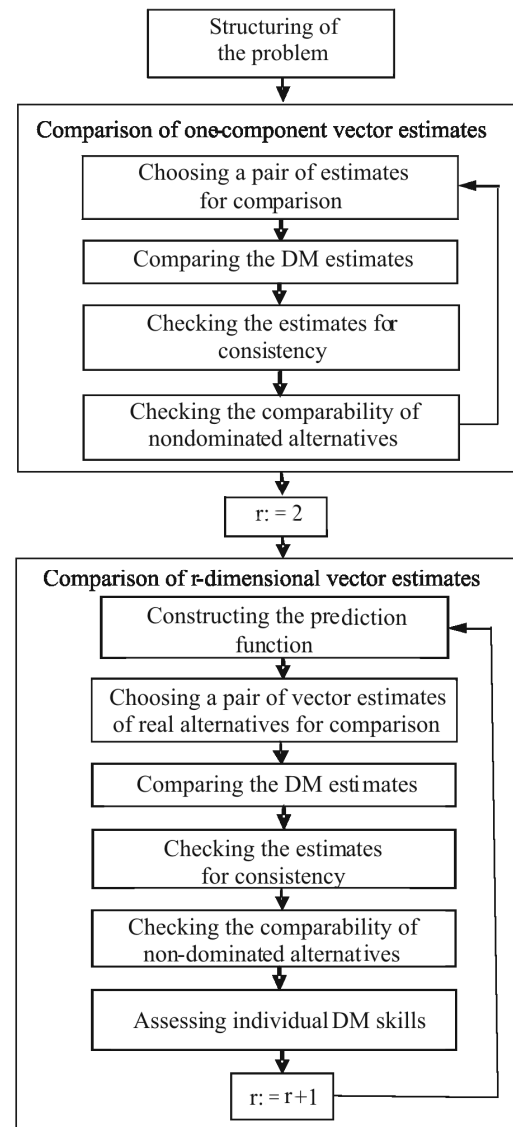


Fig. 1. A block-diagram of the procedure for eliciting the DM preferences

5. The analysis of the models based on the use of a verbal decision support system

The problem of comparing the models of territory planning is referred to the class of non-structured problems with qualitative variables. Since the essential characteristics of such problems are qualitative, they can hardly be used in the analysis. On the other hand, the quantitative models are not sufficiently reliable.

Non-structured problems have the following common characteristics. They are unique decision-making problems, i.e. every time a decision-maker is faced with an unknown problem or the one having new features compared to the previously considered case. These problems are associated with uncertainty of the alternatives to be evaluated, caused by the lack of information for making a

decision. The evaluation of the alternatives is of qualitative nature, being usually expressed verbally (in statements). Very often, experts cannot measure qualitative variables against the absolute scale, where quality does not depend on the alternatives (Ustinovichius 2004; Ustinovichius *et al.* 2008a, b, 2007, 2009). When the uncertainty is high, experts can only compare the alternatives qualitatively, based on particular criteria. First, experts use the extended verbal evaluation, and then make the comparisons in terms of 'better-worse'; 'nearly equal'.

Verbal methods of decision-making include the following issues (Korhonen *et al.* 1997; Larichev 1992; Furems and Gnedenko 1992; Larichev and Moshkovitch 1996):

- qualitative measurements allowing adequate description of an unstructured problem;
- formulation of final decision making rules according to data processing principles of humans allowing us to explain the methods psychologically;
- the procedures used to screen the conflicting data, ensuring the reliability of the information obtained and allowing the DM to formulate final rules.

The suggested method is required for arranging a number of alternatives according to the DM preferences. First, the preferences are stated based on qualitative parameters and then a logical scheme for comparing the alternatives is developed. The criteria are considered against the scales, with the estimates expressed verbally by statements. A survey may be conducted to elicit the DM preferences and to eliminate the dependence of the criteria.

Some special procedures are suggested to identify and eliminate the criteria dependence, which could make the use of the obtained information more effective. The problem is solved by applying the verbal analysis of territory planning systems. To develop the effective model of territory planning, a decision-making matrix is constructed (Table 2), where evaluation criteria are formed and the alternatives are analysed. For this purpose, the data given in the table are used and a verbal decision making system *UniCombOS (Unit COMparison for the Best Object Selection)* (Ashikhmin *et al.* 2003) (Fig. 2) taken from the Internet <http://iva.isa.ru>, is applied.

6. DM survey procedure and decision-making

Fig. 3 presents a block-diagram of a dialogue with the DM. When the data are entered, a survey of the DM is conducted by asking him/her some particular questions. This procedure is aimed at pairwise comparison of the available alternatives.

Some comments on the elements of the diagram are given below:

Comparing the estimates based on one criterion. Pair wise comparison of estimates based on a particular criterion.

Inconsistency. The consistency of the DM preferences is checked.

Eliminating inconsistency. It is the dialogue between the DM and a system aimed at identifying the wrong answer or contradictory DM estimates and their elimination.

Are all estimates compared? It is checked if the estimates correspond to DM evaluation based on all particular criteria.

Creating the prediction function. The system of linear inequalities is solved and the prediction function is chosen.

Choosing the vector estimates $a', b' \in A$ of the alternatives for comparison. Pairs of vector values $a', b' \in A$, are chosen, so that the vector a' has the highest possible value of the prediction function $P(a')$, while vector b' has the highest possible value of the prediction function $P(b')$ among the alternatives remained. Besides and a' and b' cannot be compared based on the available information at this stage.

Searching for another question based on not more than \bar{k} criteria for comparing a' and b' . A pair of vectors is sought whose comparison (based only on some DM estimates) will allow the vectors' estimates a' and b' to be compared. If in comparing a particular pair of vectors an estimate is obtained, which along with the estimates of other pairs of the set does not allow a' and b' to be compared, another set of vector pairs should be

Table 2. The original decision-making matrix

Criterion \ Alternative	Compulsory or optional planning?	Publicity	Approving institution	Plan coordination	Legislative effect	Indemnities for damages	Report on plan implementation	Changing of the plan	Requirement for approval	System of spatial planning
Lithuania	Compulsory	Time-consuming process	Seimas	It should agree with other plans	Restricting effect on construction	May be required	The report of the government to Seimas	A new plan	Should be coordinated with regional and special plans	Centralized
Germany	Compulsory	None	Respective ministry	In the responsible ministry	Integrating effect on planning	None	None	Regulated by law	Should be approved by the state Parliament	Decentralized
Poland	Optional	None	Council of Ministries	In the respective ministry	No direct effect	None	Not regulated	Not specified by law	Should be approved by the state centre	Centralized

Objects	Criteria	Estimate table	Comparisons	Results
Alternatives	obligatory plan ...	publicity	approving institut...	coordinating pro...
Lithuania	Obligatory	Long-lasting	Seimas (the Par...	Commensurate ...
Germany	Obligatory	Absent	Responsible mi...	Ministries
Poland	Not obligatory	Absent	Government, i.e...	Ministries

Fig. 2. The original matrix of decision-making

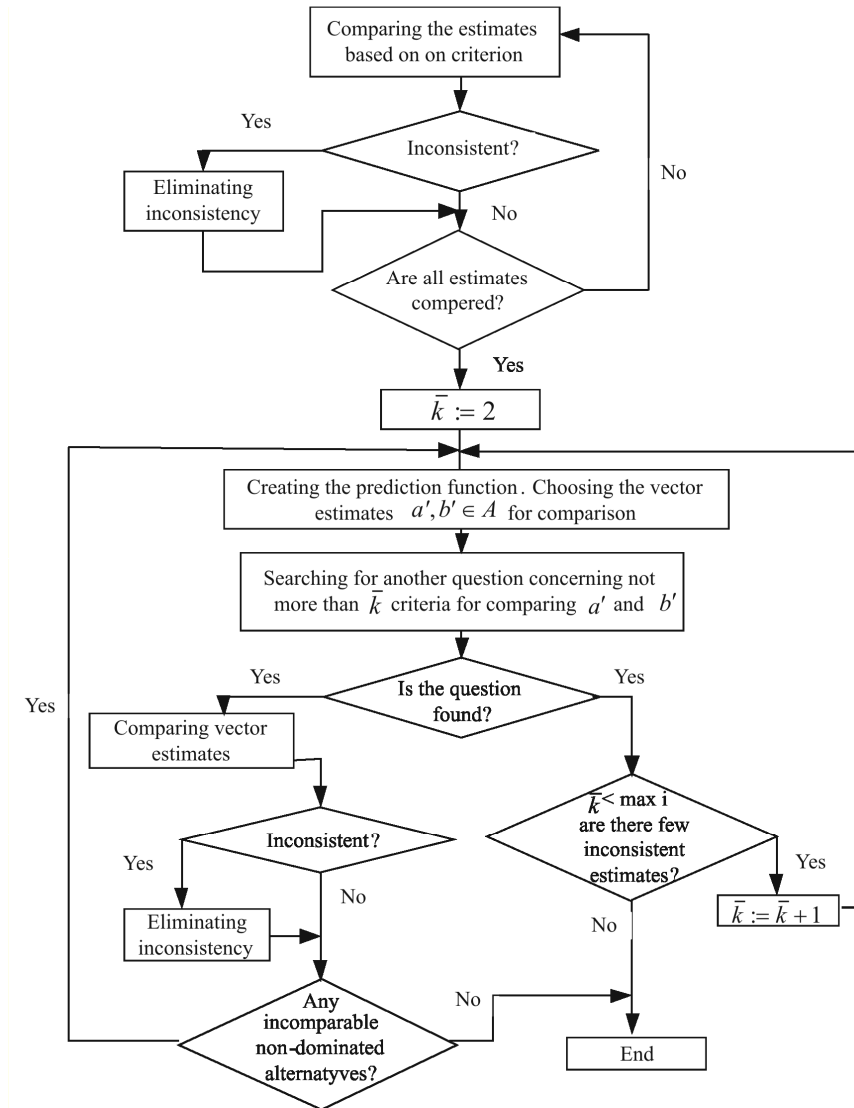


Fig. 3. A flow diagram of DM survey

sought. In fact, it may share vector pairs with the earlier generated set. A survey begins with the comparison of the pairs of vector estimates having the slightest difference in the prediction function values. Then it moves towards a comparison of the pairs of vector estimates with the highest difference in the prediction function values.

Is the question found? If the next question has not been found in the procedures performed, the number of the criteria used for comparing the vectors is increased.

Are there few inconsistent estimates? At this stage, it is determined if it was easy for the DM to provide the

estimates. If the estimates (~ 10%) are inconsistent, the conclusion is made that the evaluation of vectors, differing in \bar{k} criteria, presents difficulties for the DM, and if the questions become more complicated, the information obtained will be unreliable.

Comparing vector estimates. The DM compares pairs of vectors, and the provided estimates show his/her preferences.

Are there any incomparable non-dominated alternatives? To answer this question, it is not necessary to compare all available pairs of alternatives. It is sufficient to

show that the alternatives chosen are preferable, and there are no preferable variants among the remaining ones. This approach implies that, at the beginning when the information about preferences is lacking, all the alternatives are chosen, and this set is getting smaller, when the DM preferences are becoming clear. The suggested procedure allows the above set to be reduced as much as possible, taking into account the restricted number of criteria used in comparison. Further reduction of the set of non-dominated alternatives is hardly possible if the alternatives are equivalent or cannot be compared without asking the DM more complicated questions.

The presented system is organized as follows:

1. The questions involving a larger number of criteria are not asked until all possibilities of comparing the vectors *a* and *b* based on a smaller number of criteria are exhausted.

2. When an estimate is elicited from the DM, all his/her estimates are checked for consistency. The inconsistency identified is eliminated in the dialogue with the DM.

3. The selection of the questions to the DM is aimed at obtaining a subset of the best alternatives (based on the smallest number of questions) in a short time, avoiding the comparison of the alternatives, not included in the subset considered.

The number of questions, which the DM should answer to show his/her priorities, is decreased by using the model of priorities' predictions.

Based on the DM comparative evaluation of vectors, a prediction function is constructed in the model, which interpolates the DM priorities on vectors' estimates not compared by him/her directly. In this way, the estimates obtained in the comparison may be predicted. The above information is then used for selecting pairs of vectors provided to the DM. These pairs are chosen so that their comparison could help to compare vectors' estimates of real alternatives.

The algorithm of the program allows the DM to choose one of the four estimates (Fig. 4):

- The first alternative is more preferable than the second one;
- Both alternatives are equally preferable;
- The first alternative is less preferable than the second one;
- Do not know.

When the DM determines which estimate is more significant, the program chooses the estimates of the alternatives based on two or three criteria and makes their combinations.

When the DM evaluation is completed, the program provides the table of intermediate estimates, with the estimates of particular alternatives shown by different colours (more preferable alternatives are given in green colour, while less preferable variants are painted blue) (Fig. 5).

When the DM answers all the questions and chooses the best alternative, the program provides the table of the results obtained (Fig. 6).

Fig. 4. A query for comparing the criteria based on the estimates of alternatives

prerequisites for approval	spatial planning structure
Approval of the land parliament	Decentralized
Approval of the Government Centre for Strategic Studies	Centrally
obligatory plan making	publicity
Not obligatory	Absent
Obligatory	Long-lasting
legislative influence	indemnity for damages caused by planning restrictions
Absence of direct legal obligations to third parties	Absent
The binding effect for planning	Title apply for indemnity

Fig. 5. The table of intermediate survey results

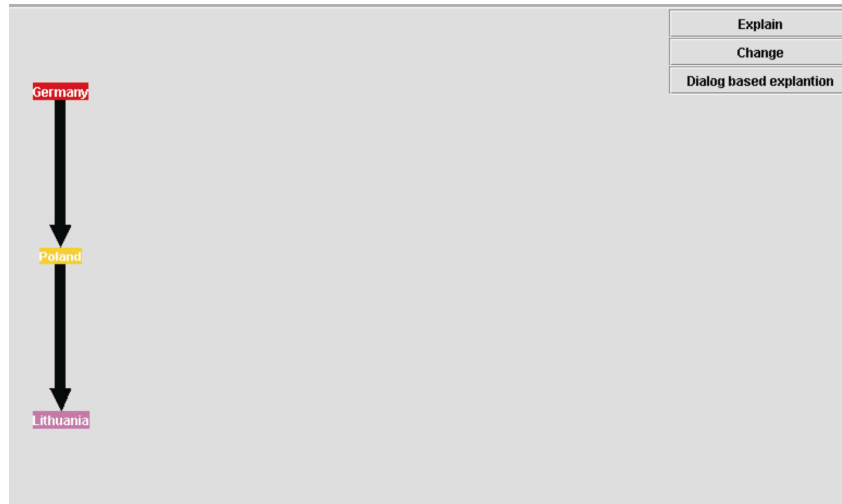


Fig. 6. The results obtained by comparing the estimates of alternatives

Object	obligatory plan making	publicly	approving institution	coordinating procedures	legislative influence	indemnity for damages caused	report on implementation	plan alterations	prerequisites for approval	spatial planning structure
Germany	obligatory	Absent	Responsible ministry	Ministries	The binding effect for planning	Absent	Absent	By law	Approval of the land Decentralized parliament	
Poland	Not obligatory	Absent	Government, i.e. Council of Ministers	Ministries	Absence of direct legal obligations to	Absent	Not established	Not stated by the law	Approval of the Government Centre	Centrally

Additional details from the diagram:

- A zoomed-in view of 'obligatory plan making' shows 'Obligatory' and 'Not obligatory' options.
- A zoomed-in view of 'prerequisites for approval' shows 'Responsible ministry. The binding effect for planning' and 'Approval of the land Decentralized parliament'.
- A zoomed-in view of 'spatial planning structure' shows 'Government, i.e. Council of Ministers', 'Absence of direct legal obligations to', 'Not established', 'Not stated by the law', 'Approval of the Government Centre', and 'Centrally'.

Fig. 7. The program's explanation of the use of particular criteria and estimates for choosing the best alternative

Unlike the methods used for operational research, the methods of decision making are oriented to modelling the subjective DM approach to the problem being solved. Therefore, the assessment of possibilities and limitations of human information processing system (Ustinovichius and Zavadskas 2004) is of great importance for decision making as a branch of research. When the calculations are made in the DM decision support system, the analysis of the explanations about the use of criteria and estimates for determining the best alternative may be performed with the help of *UniComBOS* (Fig. 7). At the next stage of investigation, the influence of the criteria used on the system of territory planning will be determined.

7. Conclusions

1. Based on the study of the literature on the problem, key criteria were identified for the analysis of effectiveness of territory planning models in three countries. The analysis has shown that Lithuanian policy of territory planning is less effective than that pursued in other countries. Therefore, more detailed calculations should be made and the criteria, their interrelationship and influence on the effectiveness of territory planning system should be determined to increase it.

2. It has been shown that territory planning system in Lithuania is

- ineffective;
- inflexible;

- centralized;
- based on time consuming procedures of planning;
- besides, the functions of the institutions engaged in territory planning are duplicated.

3. DSS *UniComBOS* is designed to solve discrete multi-criteria choice problems based on DM preferences. The validity of the procedure implemented in the considered system for preference elicitation has been proved by psychological studies. The rule of combining the relations has good resolution, thereby allowing the users to choose the best alternative in most cases. Qualitative information on preferences of each decision maker helps to achieve consistency of their estimates.

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TERITORIJŲ PLANAVIMO SISTEMOS MODELIŲ DAUGIATIKSLĖ VERBALINĖ ANALIZĖ TEISINIU ASPEKTU

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S a n t r a u k a

Teritorijų planavimo dokumentų (planų) rengimo procesas šiuo metu yra sudėtinga, daug laiko, pastangų, žinių bei įgūdžių reikalaujanti procedūra. Todėl svarbu nustatyti veiksnius, darančius įtaką teritorijų planavimo procesui, išanalizuoti minėtų veiksmų svarbą teritorijų vystymo bendrajai erdvinei koncepcijai, žemės naudojimo prioritetams, aplinkosaugai, paminklosaugai, žemės, miškų ir vandens naudojimams, gyvenamosioms bei gamybinėms teritorijoms, infrastruktūros sistemos formavimui, gyventojų užimtumo reguliavimui fizinių ir juridinių asmenų veikloje. Nagrinėjami Lietuvos,

Lenkijos ir Vokietijos nacionalinio lygmens teritorijų planavimo principai. Straipsnio uždavinys – atlikti teritorijų planavimo sistemos modelių Lietuvoje, Lenkijoje ir Vokietijoje analizę bei nustatyti pagrindinius efektyvumo rodiklius, darančius įtaką teritorijų planavimo procesams minėtose šalyse. Modeliai lyginami taikant daugiatislį verbalinį metodą (sistemoje *UniComBOS*).

Reikšminiai žodžiai: teritorijų planavimas, darni urbanistinė plėtra, daugiatislė verbalinė analizė, sprendimą priimančias asmuo (SPA).

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