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TASKS PRIORITIZATION OF STRATEGIC PLANNING OF CITIES DEVELOPMENT: EXPERTS' APPROACH

ABSTRACT. This paper explores the strategic planning of city development, especially in small communities, proves practical utility of presented ranking methods. Identification of mean is also an important part of most of experts' thoughts evaluation methods

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Introduction

The rapid pace of cities development, quality shifts in their economics, the urgent need to improve efficiency of city administration's activities, all these factors make high demands of local administrations. It causes that problems of choice methods between a quantity of alternative development projects become especially important, because managers suffers imperfectness of existing methods in this sphere. Many of these problems can be solved using mathematical methods and models. Unfortunately, their accent on quantitative characteristics is significant disadvantage that sometimes causes complications in decision making concerning quality characteristics. That is why experts' methods of decision choice from bounded set of alternatives become widespread.

Usually experts use such qualitative and quantitative criteria and principles for alternative evaluation of strategies, goals, objectives, tasks, and projects (in alphabetical order):

1). Capital investments. The lower costs for task realization — the better.

2). Consistency. Tasks, suggested by new strategic plan of city development, are consistent to city self-government' current activities.

3). Coordination / integration with development strategies of the region, state. Preferable strategy takes into account the necessity of coordination and integration with region, state development strategies.

4). Efficiency. One of the main tasks of city self-government is to provide cost-efficient services and administration. Preferable strategy allows chances to municipal services improvement and administration within current budget or lower spendings in long-time perspective.

5). Flexibility. The stability of principal strategy tasks is to be guaranteed in case of probable future environment changes.

6). Focused on problems. The city problems are first to be solved, the consideration of different opportunities is a secondary step if only they are not related to each other.

7). Long-lasting impact. The main attention in strategic planning is paid to prevention of problems that could possibly arise in a city, and how effectively respond to them. Preferable strategy proposes efficient usage of city development resources with taking into account the interests of all social groups and future generations.

8). Personnel requirements. Preferable strategy allows solving problems through more efficient use of present in the city personnel, rather than invitation of new specialists.

9). Positive impact on customers. If some parts of city development strategy devoted to municipal services then preferable strategy should have positive impact on big group of customers.

10). Public recognition. Strategies, goals, and tasks have to be oriented on consideration and coordination of all citizens' interests and interests of other city development subjects. The most preferable is a strategy that is best approved of by community.

11). Social orientation of development. Tasks should reflect inhabitants' interests and consider ecological criteria in order to improve the well-being of citizens.

12). Sources of financing. Preferable strategy shows alternative sources of finance and / or does not need to impose additional taxes and duties.

13). System approach. The best strategies and tasks are based on identification, consideration, and efficient usage of existing relationships of cities with surrounding settlements for the system solving of their common development problems.

14). Timeliness. Preferable strategy provides in time solution of strategic problem.

15). Usage of local resources. The base of this principle is that goals, objectives, tasks, and ideas need to be adequate to the real opportunities of their resource support.

Undoubtedly, resources of any organization are always limited. It seems that identification of priorities is becoming the main managerial task. It is generally agreed that simultaneous undertaking of several parallel big projects that implement strategic tasks usually does not only help to fulfil an organization mission, but can often cause many problems. That is why all goals and tasks in strategic plan have to be ranked, put in time scale and tried checked on contradiction.

These thoughts can be found practically in any book on strategic planning, a large number of authors suggest some methods of strategic goals and tasks prioritization, but usually it is done as if their readers are excellent in statistics and sociology.

For such big and informal organizations as communities (towns, villages) the problem of prioritization may become very complicated. It is practically impossible to get all necessary data for accurate evaluation; all main stake-holders tend to be experts in all issues. This is why experts' methods of ranking are becoming wide-spread. We would like to draw your attention to the hidden dangers of one of the simplest ranking method based on experts' thoughts.

Description of the method

Representative theory of evaluation (further RTE) is one of the components of non-quantitative objects statistics. In our case RTE is interesting in the sphere of theory and practice of experts' evaluation, e.g. aggregation of experts' thoughts, building of aggregated indexes and rankings.

Experts' thoughts are often expressed in ordinal scale, i.e. an expert can say and prove that one index of product quality is more important than another, the first technological object is more dangerous than the second one, and so on and so forth, but he or she will not be able to say in how many times or in what quantity this quality is more important or dangerous then another. Experts are often asked to rank the objects of examination, i.e. to grade characteristic's intention in descending or ascending order. A rank is the number of an object of expertise in ordered series. Nominally, ranks are expressed with numbers 1, 2, 3…, but we cannot perform general arithmetic operations with them. For instance, 1 + 2 = 3, but we cannot say that the intensity of studied characteristic of the object with rank 3 is equal to the sum of intensities of objects, which ranks are 1 and 2. The example of such an expert evaluation is pupils' marks. When I was a pupil I could get "5" as the best mark and "1" as the worst one for my knowledge. No one will say that the knowledge of a pupil who usually gets "5" equals to the sum of knowledge of two pupils who usually get "2" and "3" respectively (though 5 = 2 + 3), or the difference between pupils who get "5" and "3" is the same as between pupils who get "4" and "2" (5 – 3 = 4 - 2). That is why for such types of evaluation something else but arithmetics should be used. Right here we can use RTE. We also have to mention that the term "theory of evaluation" is used in metrology, RTE, algorithmic theory of evaluation etc. [1]

According to RTE, during mathematic modelling of real phenomena or process we should first define with what types of scales indexes are evaluated.

It is generally agreed that we can use all relatively equal transformations (i.e. numbers are used only as labels, e.g. telephone numbers) in the scale of names (nominal scale); all steadily increasing transformations in the ordinal scale; linear increasing transformations in the interval scale; similar transformation (changing only scale) in the ratio scale; and only identical transformations in the absolute scale.

The identification of a scale type, i.e. identification of the group of allowable transformations, is a task of the experts in certain sphere of activities. For example, evaluations of profession attractiveness are believed to be measured with the ordinal scale. But some sociologists insist that graduates use a scale with narrower group of allowable transformations, e.g. interval scale [2]. This problem must definitely be solved with sociology, not with mathematics.

Such problems happen when evaluating characteristics of objects, but not the objects themselves. Most of the measuring tasks create problems because, usually, they are connected with complex situation or complex evaluation where variables form a great number of factors that influence the complex evaluation of object characteristic, which quality is examined. It seems that evaluations may differ because of:

1) really great differences in technical characteristics of the evaluated object;

2) differences in perception and some other relatively stable characteristics of the person who evaluate;

3) differences, caused by short term individual characteristics;

4) differences, caused by the situation in which the evaluation is carried out;

5) differences, caused by deflections in the process of research;

6) differences, caused by disagreement with chosen indexes of an investigated object.

The most reasonable in this situation is to use ordinal scale to omit possible mistakes. Many experiments have shown that a person can define more precisely and easily quality than quantity. For example, it is easier to identify which one of the dumb-bells is heavier than their weight in grams [1].

Ordinal, interval, ratio, and nominal scales are scales of quality characteristics. The coordinate of the point, placed on the straight line with no beginning and scale unit, is defined with interval scale. Most of physical units (solid mass, length, charge, and prices in economics) are measured with ratio scale. It is widely accepted that time is measured with ratio scale, if a year is taken as natural scale unit, and with interval scale in general. The type of scale can be changed in the process of development in the certain sphere of knowledge. For instance, temperature at first was measured with ordinal scale (warmer - colder), later with interval scale (Celsius, Fahrenheit, Reomure scales), and after the discovery of absolute zero of temperature — with ratio scale (Kelvin scale). We should remember that there are disputes between some scientists concerning the question about what scale that or another real characteristic was evaluated.

The main requirement to algorithms of analysis in RTE is that the conclusions made on the basis of the data, measured with one type of scale, should not change after allowable transformation of the evaluation scale for this data (i.e. conclusions must be invariant to allowable transformation of the evaluation scale). The main goal of RTE is to eliminate subjective attitude of a researcher during the assignment of quantitative values to real objects. For example, length can be measured in meters, microns, miles, kilometres, parsecs, and other scale units. The choice of scale units depends on a researcher thus it is subjective. Statistical conclusions can be adequate to reality only when they do not depend on the researcher's choice of scale units.

For instance, let us analyze the handling of experts' thoughts, evaluated with an order scale. Let $Y_1, Y_2, ..., Y_n$ be equal to the totality of expert evaluations, given to one object of an expertise (e.g. priorities of one of the independent tasks of strategic plan of city development), $Z_1, Z_2, ..., Z_n$ — experts' evaluations, given to another object of the expertise (priorities of another independent task of the strategic plan of city development).

How should we compare these totalities? The simplest way is to calculate means. But how should we calculate means? There are different types of means: arithmetic, median, mode, geometric, harmonic, and square. Synthesizing of several from these means is Kolmogorov mean. Kolmogorov mean for numbers $X_1, X_2, ..., X_n$ is calculated with the formula:

$$\mathbf{G\{(F(X1)+F(X2)+...F(Xn))/n\}} \qquad (1)$$

where F — strict monotone function, G — function, inverse to F.

If $F(x) = x$, then Kolmogorov mean is an arithmetic one; if $F(x) = \ln x$, then geometric mean; if $F(x) = 1/x$, then harmonic mean etc. Median and mode cannot be Kolmogorov mean.

Mean, by French scientist Cochi, is any function $f(x_1, x_2, \ldots, x_n)$ which value is not smaller than the minimal number among $x_1, x_2, \ldots, x_n$ and not bigger than the maximal of these numbers for all possible values of arguments. Kolmogorov mean is separate case of Cauchi mean. Median and mode are not means by Kolmogorov, but they are ones by Cauchi.

During allowable transformation of scale the value of mean changes as well. But the conclusions about which totality mean is greater or smaller must not change according to RTE requirement of invariance. Let's form the mathematical problem of means type search, the comparison result of which will be stable after any allowable scale transformations. Let $f(x_1, x_2, \ldots, x_n)$ is Cauchi mean. Let

$$\mathbf{f(Y1, Y2...,Yn) < f(Z1, Z2...,Zn)} \qquad (2)$$

Then for stability of comparison results it is necessary that for any allowable transformation *g* from group of allowable transformations in the scale the following inequality is allowable

$$f(g(Y1), g(Y2)..., g(Yn)) < f(g(Z1), g(Z2)..., g(Zn)) \quad (3)$$

Thus mean of transformed values from the first totality will be smaller than the mean of the second totality as well. According to RTE only such means can be used for experts' thoughts evaluation.

Using mathematical theory we can identify type of legitimate means of experts' thoughts using main scales:

- mode is suitable for nominal scale;
- for ordinal scale by Cauchi only the term of variational series can be used, i.e. a median for odd number of series terms and one of the central terms of series (sometimes they are called left and right median);
- only arithmetic mean can be used for interval scales by Kolmogorov;
- geometric and power means are suitable for relative scale (Table 1).

Here we have an example that shows us incorrect usage of arithmetic mean for $f(x_1, x_2) = (x_1, x_2)/2$ in ordinal scale. Let assume that $Y_1 = 1$, $Y_2 = 11$, $Z_1 = 6$, $Z_2 = 8$. Then $f(Y_1, Y_2) = 6$ that is smaller than $f(Z_1, Z_2) = 7$.

Table 1. The mane types of evaluation scales and respective for them groups of transformations [3, 4]

Scale	Comparative characteristics	Typical examples	Average value measures
Nominal	identification	man / female used / unused	mode
Ordinal	order	social group quality category of an object	median
Interval	comparison of intervals	temperature scale attitude toward an object	arithmetic mean
Ratio	comparison of interval values	number of sold goods probability of purchase weight	geometric mean, harmonic mean

Source: own compilation based on [3, 4]

Let steadily increasing transformation *g* be $g(1) = 1$, $g(6) = 6$, $g(8) = 8$, $g(11) = 99$. Then $f(g(Y_1), g(Y_2)) = 50$ that is greater than $f(g(Z_1), g(Z_2)) = 7$. As we can see the order of means has changed after transformation of the scale.

Now let's analyze the usage of this theory for ranking of tasks priorities for city development strategic plan.

Prioritization of city development strategic plan tasks

During the process of city strategic planning many experts, marketing, sociological and other surveys are wide-spread. During surveys respondents are asked to give points for objects, goods, technological processes, enterprises, projects, ideas, problems, politicians, programs etc. and then mean points are calculated and treated as integral evaluations that represent the respondents' opinion. We need to consider now which formula is to be used for calculation of these means. Usually arithmetic mean is used. But this method is incorrect because these points are measured with ordinal scale. According to the previous ideas of this article we have to use median.

Let's analyze an example of above proposed method for prioritization of city development strategic plan's tasks.

Let's evaluate priority of the eight tasks, proposed by a city development strategic plan. Denote these tasks as *A, B, C, D, E, I, J, K*. All tasks were sent for evaluation to 12 experts, appointed by the authority that implements this strategy. The ranks assigned by the 12 experts to all eight tasks are shown in Table 2. The experts ranked tasks according to their ideas of priority task fulfilment for the city development (rank 1 — the most important task that have to be realized first; rank 2 — the secondary by the importance task...; rank 8 — the least important task that have to be completed the last).

Analyzing the experts thoughts, members of the authority that implements the strategy had to state that there is no absolute agreement between experts in the tasks' priorities. Therefore we have to use additional mathematical analysis for data from Table 2.

First we use the simple method of arithmetic mean. In order to do this we should sum tasks' points (Table 3). Then this sum must be divided into the number of experts. This way we get arithmetic mean rank. Using these ranks we can build final ranking, based on the principle — the smaller average rank, the higher priority of the task. The task *D* has the smallest average rank, equal to 2.625.

Table 2. The example of the ranks of eight tasks by their importance and priority

Expert's #	**Tasks**							
	A	**B**	**C**	**D**	**E**	**I**	**J**	**K**
1	5	3	1	2	8	4	6	7
2	5	4	3	1	8	2	6	7
3	1	7	5	4	8	2	3	6
4	6	4	2,5	2,5	8	1	7	5
5	8	2	4	6	3	5	1	7
6	5	6	4	3	2	1	7	8
7	6	1	2	3	5	4	8	7
8	5	1	3	2	7	4	6	8
9	6	1	3	2	5	4	7	8
10	5	3	2	1	8	4	6	7
11	7	1	3	2	6	4	5	8
12	1	6	5	3	8	4	2	7

Note. Expert #4 considers tasks C and D to be equal and yield in priority only to task I. That is why tasks C and D have to get second and third ranks and receive points 2 and 3. Because they are equal they get average points (2+3)/ 2 = 5/ 2 = 2.5.

So this task gets the rank 1 in the final ranking. The task *C* has the next sum, equal to 3.125, and it gets final ranking 2. Tasks *B* and *I* have the same sums (equal to 3.25). It means that they are equivalent for experts and have to get places 3 and 4 in ranking and receive average rank (3+4) /2 = 3.5. The ranks of other tasks are shown in Table 3.

So, ranking by the sum of ranks (or, in other words, by arithmetic mean rank) look like:

$$\mathbf{D < C < \{B, I\} < A < J < E < K} \quad (4)$$

Here an entry like *"N<M"* means that task *N* has to be accomplished before task *M* (i.e. task *N* more prior then task *M*). Tasks *B* and *I* received the same sum of points, that is why they are equivalent by this method of ranking and grouped in a cluster, marked with braces. As we have already mentioned answers of experts are measured in ordinal scale and the usage of arithmetic mean ranking is not correct for them. So we have to use method of medians.

Table 3. Results of data calculations from Table 2 using method of arithmetic mean and method of median

Index	Tasks							
	A	**B**	**C**	**D**	**E**	**I**	**J**	**K**
Sum of ranks	60	39	37,5	31.5	76	39	64	85
Arithmetic mean rank	5	3,25	3,125	2,625	6,333	3,25	5,333	7,083
Final rank by arithmetic means	5	3,5	2	1	7	3,5	6	8
Median of ranks	5	3	3	2,25	7,5	4	6	7
Final rank by medians	5	2,5	2,5	1	8	4	6	7

Source: own compilation

We have to take experts' answers, corresponding to one of the tasks, for example task *B*. These are ranks 3, 4, 7, 4, 2, 6, 1, 1, 1, 3, 1, 6. Then we have to arrange them in ascending order. We will get: 1, 1, 1, 1, 2, 3, 3, 4, 4, 6, 6, 7. We can find in the central places (the sixth and the seventh) 3 and 3. So, the median is equal 3.

Median of group of 12 ranks, which correspond to the tasks, presented in last but one row of Table 3. To calculate medians we have used general rules of statistics — as arithmetic mean of central terms of variational series. The final ranking with method of medians is presented in the last row of the Table 3. Ranking by medians look like:

$$\mathbf{D < \{B, C\} < I < A < J < K < E} \qquad (5)$$

Tasks *B* and *C* have the same medians of points that is why they are equivalent by this method of ranking and grouped in a cluster.

The comparison of ranking (4) i (5) shows their similarity (near resemblance). We can draw conclusion that tasks *C*, *B*, *I* are ranked like *C* < *B* < *I*, but because of errors of experts evaluations tasks *B* and *I* are ranked as equivalent with one method (ranking (4)), and tasks *B* and *C* — with another method (ranking (5)). The substantial divergence can be found only in ranking of tasks *E* and *K*: in ranking (4) *E* < *K*, but in ranking (5), vice versa, *K* < *E*. In our case these two tasks are of the last priority, so we can leave their order of fulfilment to the authority that implements strategic plan of city development, though it is better to rank them according to ranking (5) as more suitable for experts' thoughts evaluation.

Some restrictions

The accuracy and reliability of a ranking procedure considerably depends on the number of objects that have to be ranked. The smaller is the quantity of such objects, the bigger is their difference for experts and the more reliable ranks will be produced. In any case the usage of this method is pointless if the number of object is more than 20 and the most reliable results can be obtained if the number of objects for ranking is less than 10.

Analysed methods of ranking are not the only available and self-sufficient. There are many other methods that can guarantee more accurate ranking, i.e. the method of direct evaluation and its modifications, the method of sequential comparison, the method of paired comparison, Delphi method etc. To make our choice more efficient we can use, for example, Diagram of Joint Evaluation [5].

Unlike simple ranking of tasks priorities, this method takes into consideration that strategic tasks do not simply divide into better, average, and worse, but they also differ at least in two parameters.

1). Strategic tasks have different importance for the future of the city. Suggesting that a strategy has no insignificant or little importance tasks, these tasks could be divided into three groups:

a) *important*, but their unfulfilment will not significantly slow down local development;

b) *very important*, their unfulfilment will significantly slow down local development or undesirably change its direction;

c) *especially important*, their unfulfilment can cease local development.

2). Strategic tasks have different probability of their realization. That is why we may divide them into another three groups:

a) *in danger*, when our uncertainty about probability of task' fulfilment is bigger than our confidence in its realization;

b) *stable*, their future fulfilment is very probable;

c) *successful*, real fulfilment of which in future is guaranteed.

Using these two criteria it is possible to build the matrix consisting of nine cells, according to importance and fulfilment probability of strategic tasks (Figure 1).

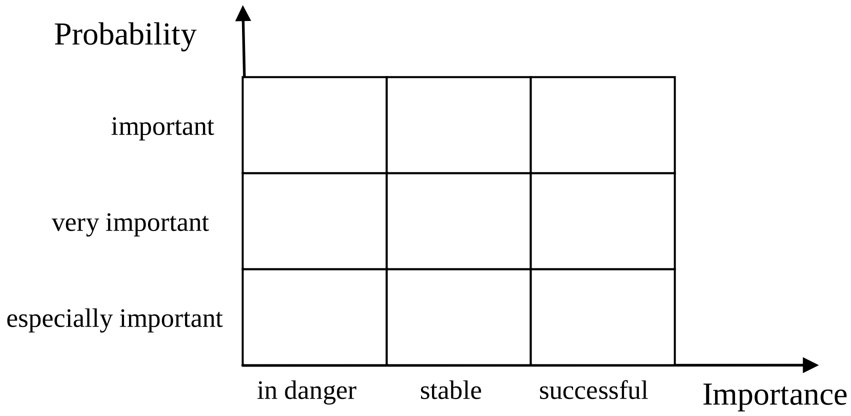

Figure 1. Diagram of Joint Evaluation [source: on the bases of 5]

The task fulfilment probability is marked on ordinate axis. The importance of a task for city development is marked on abscissa axis. The joint evaluation of a particular task is marked with the tick in the corresponding cell. “The best” tasks are in the top right cell. In their turn "the worst" tasks are in the left bottom cell. Between these two extreme cells there is a complex totality of evaluations that can not be arranged in linear series. The further selection of priority tasks is generally made according to our disposition to taking risks.

Conclusions

Strategic planning requires system analysis that can be made with wide range of methods, relatively simple or very complicated. Work on a city development strategic plan is usually made by many people with different professional background and knowledge. Although many books on methodology of system analysis are available, people, involved in the process of strategic planning, do not use suggested methods correctly. This article illustrates the necessity of correct usage of such comparatively method as evaluation of experts' thoughts on the basis of their ranking. We proved what kind of mean have to be used in this situation — median. Here we want to emphasize that we do not completely ignore the usage of wide-spread arithmetic mean. As research shows, it is reasonable and not difficult to use both methods — arithmetic mean and median. Such an approach meets the requirements of the conception of steadiness that recommends usage of different methods for processing of the same data in order to identify results that were obtained simultaneously with all used methods. The proposed example demonstrates similarity and difference of ranking with method of arithmetic mean and method of median and the utility of their joint usage.

There are many other methods of experts' thoughts evaluation that can produce more accurate results. Nevertheless the authors' experience of strategic planning of city development, especially in small communities, proves practical utility of presented ranking methods. Identification of mean is also an important part of most of experts' thoughts evaluation methods.

REFERENCES:

1. Orlow, A.I. "Reprezentativnaja teorija izmerenij I jejo primenenije." Zavodskaja Laboratorija Vol.3 1999:40-50
2. Orlow A.I. Ustojchewost w sotsyalno-ekonomicheskih modeljah. — Moscow: Nauka, 1979.
3. Cherchill G.A. Marketingowyje issledowanije. — Sankt-Petersburg: Piter, 2001.
4. Statystyka: teoretychni zasady i prykladni aspekty. Navchalnyj posibnyk. R. Feshchur, A. Barvinsky, V. Kichor ta inshi. — Lviv: INTELEKT-ZAHID, 2003.
5. Kłosowski W. Wyspy Szans: jak budować strategie rozwoju lokalnego. Bielsko-Biała, 2001.