ИНСТИТУТ ЗА ИКОНОМИЧЕСКИ ИЗСЛЕДВАНИЯ
ПРИ БЪЛГАРСКАТА АКАДЕМИЯ НА НАУКИТЕ

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ИНСТИТУТ ЗА ИКОНОМИЧЕСКИ ИЗСЛЕДВАНИЯ НА БЪЛГАРСКАТА АКАДЕМИЯ НА НАУКИТЕ

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ИКОНОМИЧЕСКИ ИЗСЛЕДВАНИЯ
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COMPREHENSIVE TARGET PROGRAM TO IMPROVEMENT OF COMPANY'S INNOVATION ATTRACTIVENESS

Providing companies with competitive advantages requires the implementation of innovative solutions, which is particularly topical in the context of the world market globalization. Using the innovative resources, which allow to enhance productivity while reducing costs, in the production process as well as increasing their share in the total value of the company is a difficult and complex task. According to the authors, currently the most important issue is the development of the unified system, which allows to choose the way of innovative development for companies of any branch without any additional costs to create of specific strategies. Complex target program is the hierarchical structure based on expert opinions, which enables to determine the impact of easy-to-realize projects on main target and so to choose the most effective way of further development under limited financial resources. Authors believe that the most intelligent way of solving this problem is through using latter day computer-assisted decision support systems (DSS). Comprehensive Target Program (CTP) can help to choose the most effective innovation strategy development direction and achieve business success.

CTP development includes implementation of three main steps: decomposition of the main goal, determination of the partial coefficients of influence, and evaluation of the CTP projects' efficiency. Those projects that have the highest value, considering the abovementioned parameters, determine the priority directions of CTP implementation. Thus, the promising directions of implementation of the "Improving of the company's innovation attractiveness" comprehensive target program and the method of efficient allocation of limited resources between them are provided in this article.

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The Basic Results of Research

Under current economic conditions innovations come to the front as determining factor of economy's competitiveness. Using innovative resources in the production process and increasing their share in the total value of the enterprise is a difficult and complex task.

In the authors' opinion the most reasonable way of solving this task lays in using the sophisticated computer decision support system (DSS). The practical part of the study the authors conducted on the base of computer DSS "Solon 2" because this program provides hierarchical approach to decision support system. According to the authors, hierarchical approach is the best solution for solving non-trivial problems, because an objective tree is a visual representation of objectives. It is the positive opposite of the problem tree, and helps to give us a clear idea of all objectives, which are more important, which need to be achieved first and the relationship between them all. The problem and objectives trees provide a simplified, but comprehensive, view of cause and effect relationships.[3] This can help to make the process of creating innovation strategy more accessible to any manager of small and large companies, making it easier to detect really important and affluent projects, and involve them in implementation of the innovative way of growth.

Due to development of a complex target program (CTP) it becomes possible to choose the most effective course for building innovation strategy and achieving success in every enterprise of Ukraine.

Such a unified hierarchical approach to solving complex economic problems can be found in a number of scientific papers, such as mentioned in bibliography list under numbers 3, 4, 6 and others.

Authors believe, that development of CTP allows to determine the most effective way of main target achieving, such as innovation attractiveness improvement under the lowest costs. Thus, the aim of the paper is to justify the efficient allocation of limited financial resources, aimed at enterprise's innovative development, by designing a comprehensive target program of innovation attractiveness improvement. Described method of hierarchical structuring is general and can be used to provide efficient allocation of limited financial resources while aiming another global targets at the macro- and micro level. Special contribution of the authors lays in the development of the unique CTP to innovation attractiveness improvement.

To achieve the above goal the following tasks should be solved:

- Improve of innovation attractiveness through development of CTP based on hierarchical targeted approach;
- Determine of the projects PCI to their direct over-targets;
- Determine of the projects' potential effectiveness by using the "Solon 2" software;
- Justify the allocation of limited financial resources among the most effective projects.

[3] Development Cooperation Handbook // by Stefano de Santis and Vrinda Dar [Electronic resource]: Kautilya Society, 2014

Partial coefficient influence (PCI) – coefficients that indicate how much each project or subtarget work on it's direct overtarget. PCI sum of all projects and subtargets to each overtarget is equal to 1. Project potential effectiveness – coefficient that shows how the implementation of each project may potentially affect the realization of it's overtarget. For example, total realization of the project $x_{6.4}$ "Provide the modern information computer systems" may realize it's overtarget maximum on 5.7%. The potential effectiveness differs from actual in that convention. It is caused by presence of qualitative projects, which as opposed to quantitative can't be implemented in 100%. These projects include, for example, the project $x_{8.2.1}$ "Implement the modern financial management approaches to the company's financial performance control".

1st Stage. Main Target Decomposition

During the 1st stage we have to decompose the main target into the sets of lesser subtargets, each identifying some subproblems of the main target. In turn every subtarget has its own set of subtargets, which are to identify it. And so way, at the lowest level of the target hierarchy we can represent the simplest inseparable subtargets which are called projects. The realization of all such projects allows us to reach the main target of our hierarchy. Note that one target can be a subtarget for some different overtargets. For example, target $x_{6.1}$ "Keep storage areas in proper condition" (table 2) is the subtarget for both g_6 "Improve logistics" and g_7 "Improve the organizational structure of the company's management" overtargets. This target has the positive influence to both of these overtargets. The process of such hierarchy development requires one to have expert knowledge in different fields (Totsenko, 2002).

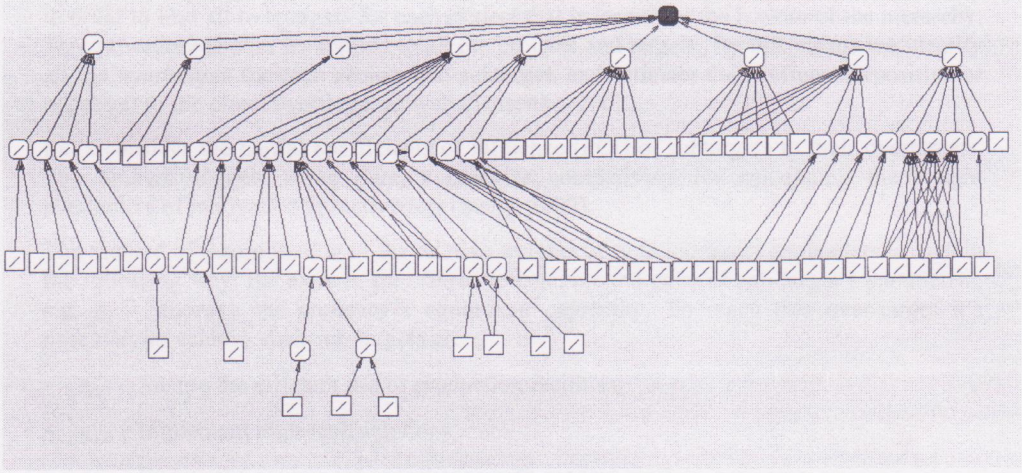
It is clear that the target hierarchy should be developed by the experts who have special knowledge in the field the main target belongs to. Thus, the knowledge of qualified experts and theoretical materials listed in the bibliography (Pachunska, 2008; Dudar, 2009) were used to design the CTP of innovation attractiveness improvement. Complex target program development has been made via use the expert estimations method applied to each target. We used knowledge of 4 experts and authors themselves in the process. Experts with many years' experience in the engineering enterprise "OVIS" assisted in the work. Nowadays innovations come to the fore in this field. And so, we'll give some in information about the experts:

- Vdovenco Oleg – chief of the company, an engineer – developer with 25 years experience.
- Zverhovskaya Julia – Chief Accountant with 29 years experience;
- Alex Moldovan – Head of Production Department with 34 years experience;
- Strizheus Vladimir – Head of Supply Department with 36 years experience.

Despite the fact that the hierarchy of objectives (see figure 1) was developed on the base of expert's knowledge in engineering sphere, it can be used in any other company and field and has no direct reference to the enterprise's sector.

Figure 1

Graph of CTP Innovation Attractiveness Improvement



Experts were asked: "What goals have to be realized for achieving the main target of innovation attractiveness improvement". The list of all experts' responses is enclosed: Increase the company's equipment capability, Improve the company's image, Ensure the parallel development of each integral indicator element, Improve the company's human resources management, Increase the innovation product attractiveness, Improve logistics, Improve the organizational structure of the company's management , Improve the company's financial position, Improve consumer properties of the product, Improve technological properties of the product, Improve design properties of the product, Ensure enterprise for highly educated and qualified staff, Improve abilities and skills of the staff, Improve the organizational culture of the company, improve PR-manager's attitude to customers, Improve employees' attitude to work, Develop recommendations to Parliament about education system improvement, Establish communications between staff. Targets, the achievements of which really affect the achievement of the main goal, were identified by the method of expert benefits. Each target of the second level was divided into subtargets in the same way. This procedure has to be repeated until the objectives will be fully defined. These targets are called projects.

According to the above approach a hierarchy of targets, aimed to improvement of the company's innovation attractiveness, was developed. All targets and projects of the CTP are shown in table 2 (Boyarinova, 2009), where **g** stands for targets, and **x** stands for projects. The number of each target consists of its direct overtarget number and its order number in the subtargets set of its direct overtarget. E.g., $x_{1.2.1}$ is the first subtarget of the $g_{1.2}$ overtarget.

2nd Stage. Determination of Subtergets' Partial Coefficients of Influence

During the 2nd stage we have to move from the lowest to the highest level of the hierarchy in order to find all overtargets for each project that is located at the bottom of the hierarchy. This procedure should be applied to all the projects and targets. By this means we identify all the overtargets for each project and subtarget, and estimate their influence (positive or negative) to the direct overtarget as well (Totsenko, 2002).

Let's consider the partial coefficients of influence (PCI) of subtargets to their overtargets. The authors suggest using Saaty's pairwise comparisons for calculating the weight parameters of innovation attractiveness (Saaty, 2002).

The method of determination of the relative weights of strategic target parameters is used in the following way: the experts are offered to compare the pairs of sub-target's parameters, e.g. g_1 – Improve the company's equipment capability. To reach this over-target it's necessary to achieve such sub-targets as:

- $g_{1.1}$ – Ensure the efficient use of production facilities;
- $g_{1.2}$ – Implement high-tech solutions;
- $g_{1.3}$ – Ensure the equipment compliance with modern market requirements;
- $g_{1.4}$ – Increase the product's performance level.

As a result of pairwise comparisons the experts have assembled a matrix of parameters of the corresponding sub-plurality (table 1).

Table 1

Matrix of Subtarget Parameters

Parameter	g_{12}	g_{13}	g_{14}	g_{15}
g_{12}	1	7/20	9/16	8/25
g_{13}	20/7	1	19/13	23/25
g_{14}	16/9	13/19	1	3/5
g_{15}	25/8	25/23	5/3	1

This matrix satisfies the condition $d_{ij} = d_{ih} \cdot d_{hj}$, where d_{ij} is the degree of i-th alternative preference over the j-th, so the matrix is fully correlated. The system of linear equations that corresponds to the characteristic equation of the matrix is given as a formula:

$$d_j = \begin{cases} (1-\lambda)w_1 + 7/20w_2 + 9/16w_3 + 8/25w_4 = 0; \\ 20/7w_1 + (1-\lambda)w_2 + 19/13w_3 + 23/25w_4 = 0; \\ 16/9w_1 + 13/19w_2 + (1-\lambda)w_3 + 3/5w_4 = 0; \\ 25/8w_1 + 25/23w_2 + 5/3w_3 + (1-\lambda)w_4 = 0. \end{cases} \quad (1)$$

After simple transformations we obtain the characteristic numbers of the, where $\lambda_{max} = 4$. In addition CI = (4-4) / 3 = 0, CR = 0, which proves that comparisons matrix is fully correlated.

λ_{max} should be substituted in (1) and normalizing equation ($w_1 + w_2 + w_3 + w_4 = 1$) should also be added to the system. By solving this system we obtain the relative weights of parameters that provide financial stability of the enterprise: $w_1 = 0.1132$; $w_2 = 0.32$; $w_3 = 0.21$; $w_4 = 0.35$.

Developed CTP and calculated subtarget's and the project's PCI are shown in table 2.

Table 2

All Targets and Projects of the CTP and Their Corresponded PCIs

Target name and number Direct name and number of target's subtargets and projects	PCI
g_0 – Increase the company's innovation attractiveness	
g_1 – Increase the company's equipment capability	0.14
g_2 – Improve the company's image	0.07
g_3 – Ensure the parallel development of each integral indicator element (direct target)	0.04
g_4 – Improve the company's human resources management	0.12
g_5 – Increase the innovation product attractiveness	0.19
g_6 – Improve logistics	0.19
g_7 – Improve the organizational structure of the company's management	0.10
g_8 – Improve the company's financial position	0.15
g_1 – Improve the company's equipment capability	
$g_{1.1}$ – Ensure the efficient use of production facilities	0.12
$g_{1.2}$ – Implement high-tech solutions	0.32
$g_{1.3}$ – Ensure the equipment compliance with modern market requirements	0.20
$g_{1.4}$ – Increase the product's performance level	0.36
g_2 – Improve the company's image	
$x_{2.1}$ – Struggle for market leadership	0.50
$x_{2.2}$ – Develop the corporate identity	0.12
$x_{2.3}$ – Improve the customer service quality	0.38
g_3 – Ensure the parallel development of each integral indicator element (direct target)	
$x_{3.1}$ – Ensure the minimum influence of negative factors on enterprise's innovation activities	0.70
$x_{3.2}$ – Equivalent development of both undeveloped and developed factors	0.30
g_4 – Improve the company's human resources management	
$g_{4.1}$ – Provide the company with qualified administrative personnel	0.20
$g_{4.2}$ – Provide the company with qualified production personnel	0.20
$g_{4.3}$ – Provide all the necessary conditions for improvement of personnel professional skills	0.11
$g_{4.4}$ – Ensure the full load for the company's current personnel	0.24
$g_{4.5}$ – Create mobile teams for innovations development	0.10
$g_{4.6}$ – Provide the democratic style of management	0.10
$x_{4.7}$ – Create the personnel reserve	0.05
g_5 – Increase the innovation product attractiveness	
$g_{5.1}$ – Create an innovative product model	0.30
$g_{5.2}$ – Launch the manufacture of innovative product	0.25

Target name and number Direct name and number of target's subtargets and projects	PCI
$x_{5.1.1.3}$ – Organize the collection of scientific and technical information	0.25
$g_{5.1.2}$ – Organize technical feasibility of the innovative product	
$x_{5.1.1.2}$ – Develop technical documentation and schedule of work	0.55
$x_{5.1.2.1}$ – Develop the innovative product design	0.45
$g_{7.1}$ – Provide a minimum-cost production scheme	
$x_{7.1.1}$ – Eliminate the unsteady production	1.0
$g_{7.2}$ – Implement the decentralized management	
$x_{7.3.1}$ – Ensure constant leaders change depending on the task set	0.35
$x_{7.3.2}$ – Ensure delegation of authority	0.65
$g_{8.1}$ – Ensure the attraction of venture capital for innovations development	
$x_{8.1.1}$ – Organize the replenishment of production development fund through allocation of a share of profits	0.5
$x_{8.1.2}$ – Implement the optimum scheme of allocation of funds to the depreciation fund	0.5
$g_{8.2}$ – Ensure the company's financial independence	
$x_{8.2.1}$ – Implement the modern financial management approaches to the company's financial performance control	0.15
$x_{8.2.2}$ – Minimize waste production	0.25
$x_{8.2.3}$ – Increase the efficiency of the financial resources use	0.22
$x_{8.2.4}$ – Develop the budgeting system	0.2
$x_{8.2.5}$ – Innovate the cash flow management	0.18
$g_{8.3}$ – Ensure the high level of liquidity	
$x_{8.2.1}$ – Implement the modern financial management approaches to the company's financial performance control	0.2
$x_{8.2.2}$ – Minimize waste production	0.35
$x_{8.2.3}$ – Increase the efficiency of the financial resources use	0.15
$x_{8.2.4}$ – Develop the budgeting system	0.10
$x_{8.2.5}$ – Innovate the cash flow management	0.20
$g_{8.4}$ – Ensure the high level of financial solvency	
$x_{8.2.1}$ – Implement the modern financial management approaches to the company's financial performance control	0.22
$x_{8.2.2}$ – Minimize waste production	0.25
$x_{8.2.3}$ – Increase the efficiency of the financial resources use	0.20
$x_{8.2.4}$ – Develop the budgeting system	0.10
$x_{8.2.5}$ – Innovate the cash flow management	0.23
$g_{8.5}$ – Pursue a balanced policy regarding the proper use of funds	
$x_{8.5.1}$ – Conduct transparent open tenders	1.00
$g_{4.4.1.1}$ – Ensure a high level of financial incentives	
$x_{4.4.1.1.1}$ – Regulate wages depending on the results achieved	1.00
$g_{5.4}$ – Develop the feasibility study of the innovative project	
$x_{5.4.1}$ – Calculate the payback period of innovation project	0.25
$x_{5.4.2}$ – Provide the effective pricing policy	0.45
$x_{5.2.3}$ – Optimize the range of innovative products	0.30

3rd Stage. Evaluation of the Projects' Relative Efficiency

The potential efficiency indicators are calculated to evaluate the projects' relative efficiency. All the calculations for this stage were performed by using "Solon 2" DSS. The calculation results are displayed in a list, giving the names of the projects and corresponding numeric values that identify the indicators of the projects' potential efficiency. Figure 1 displays some of the indicators that were calculated by using "Solon2" DSS.

There were 60 projects developed within this particular target program. Let's consider the first eight projects that have the potential efficiency indicator of more than 3.0% (see figure 1), and are regarded to be the potentially most effective.

The allocation of financial resources r_i is evaluated by formula 1.

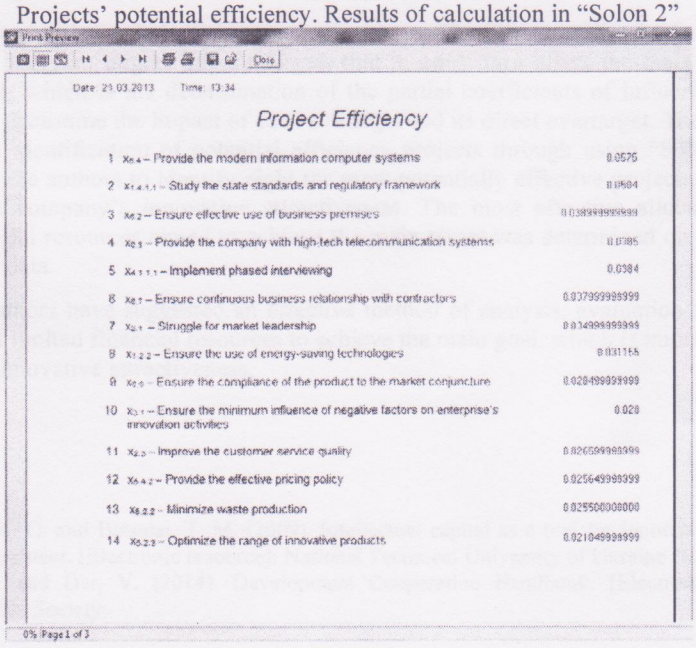
$$r_i = \frac{\vartheta_i^{e\phi}}{\sum_{i=1}^{k} \vartheta_i^{e\phi}} \cdot 100\% \quad , \tag{1}$$

where $\vartheta_i^{e\phi}$ is the potential efficiency of the i-project,

$\sum_{i=1}^{k} \vartheta_i^{e\phi}$ is the total of the potentially most efficient projects.

Figure 1

Projects' potential efficiency. Results of calculation in "Solon 2"



Let's consider a specific calculation example of the project $x_{6.4}$ "Provide the modern information computer systems".

$$r_{6.4} = \frac{0,0575}{0,0575 + 0,0504 + 0,0389 + 0,0385 + 0,0384 + 0,0379 + 0,0349 + 0,0312} \cdot 100\% = 17,55\%.$$

Having performed similar calculations we have identified the following main areas of the offered projects allocation: 17.55% of allocated funds will go for "Provide the modern information computer systems " project, 15.38% for "Study the state standards and regulatory framework", 11.87% for "Ensure the efficient use of production facilities", 11.75% for "Provide the high-tech telecommunication systems" project, 11.72% for "Implement phased interviewing", 11.56% for "Ensure continuous business relationship with contractors", 10.65% for "Struggle for market leadership", and 9.52% will go for "Ensure the use of energy-saving technologies" project.

Conclusion

To improve the company's innovation activities a comprehensive target program was developed by the means of "Solon-2" DSS. Theoretical basis of the problem solving approach, which arises during comprehensive target program development, defines the decision support technology that lies in evaluation of the CTP projects implementation priority through determination of their efficiency indicators.

CTP development is carried out in three main stages. The first stage lies in decomposition of the main program targets into subtargets that in ones' turn affect the main target. The second stage, which is the determination of the partial coefficients of influence, helps to numerically determine the impact of each subtarget and its direct overtarget. The third stage includes the identification of potential efficiency projects through using "Solon 2" DSS, which helps the authors to identify eight the most potentially effective projects intended to increase the company's innovative attractiveness. The most effective allocation of the scarce financial resources aimed to achieve the main target was determined on the basis of the received data.

Thus, the authors have suggested an effective method of analysis, evaluation and rational allocation of limited financial resources to achieve the main goal, which is improving of the company's innovative attractiveness.

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