

# About the Development of the Algorithm to Evaluate the Efficiency of ICT Techno Parks

Alovsat Aliyev<sup>1</sup>, Roza Shahverdiyeva<sup>2</sup>

Institute of Information Technology of ANAS, Baku, Azerbaijan  
depart8@iit.ab.az

**Abstract**— The paper displays the relevance, objectives of ICT techno parks emergence with the innovative structure, and the calculation properties of its activity efficiency. The indicators characterizing ICT-techno park activities have been identified and appropriate methods for its activity evaluation proposed. Some work on the calculation algorithm has been carried out for the realization of this method.

**Keywords**— innovation structure; special economical zone; ICT-techno park; efficiency; evaluation algorithm

## I. INTRODUCTION

Recently, the formation of innovation policy in the development of economy, analysis of innovation processes and regulation have become one of the important issues in advanced countries. The significance of innovations, innovation processes and innovation structures for the society, as well as their economical essence and content, results and effectiveness of their activities need to be evaluated.

In order to create alternative development sources in the economy, to increase an attractiveness of local markets for foreign investment, as well as to provide uninterrupted development of non-oil sector and ICT sector the creation of techno parks, which is a key element of innovation structure for ICT and electronic products and services, is considered to be one of the most important factors. The creation of ICT techno parks is a priority in the economic development of Azerbaijan. The law adopted on special economical zones has created an opportunity to regulate their establishment and management relations, and to define organization rules for relevant business activity [1].

Therefore, the development of the algorithm to evaluate the effectiveness of ICT techno parks is one of important and urgent issues.

## II. ABOUT OBJECTIVES AND CRITERIA OF ICT TECHNO PARK ACTIVITY

The major criteria characterizing ICT techno park activities is the efficiency. The effectiveness of ICT techno park should be approached from two positions: 1) as a majority of indicators characterizing the activities of each resident of techno park; 2) as a majority of indicators characterizing its efficiency as an economic system, taking

into account the impact of the techno park on the economy of the region where it is located, and on the development of national innovation system and on the country's economy, as a whole.

It has been defined, that forming the majority of indicators in accordance with the sub-sections for each mentioned criteria somehow specifies and systemizes the approaches to the establishment of ICT-oriented techno park and assessment of its operation. The state does not set quality criteria of ICT-techno park operation. However, the followings are selected as the main criteria [2]: 1) the number of functioning companies; 2) the share of successful projects; 3) the increased revenues of the companies in the techno park; 4) an employment rate of high qualified personnel; 5) the volume of innovation projects aimed at mass production; 6) the number of patents and inventions; 7) the volume of innovative products; 8) the volume of new investment projects.

## III. ESSENCE AND NATURE OF THE EFFICIENCY PROBLEM OF ICT TECHNO PARK ACTIVITY

Actually, economical efficiency is a coefficient of the final useful results of the operation of economical innovation system to the spent resources. It acts as an integrated indicator of efficiency at different levels and represents the final indicators of the performance of the analyzed system. The main criterion of social-economic efficiency of the system is a satisfaction rate of the society.

Economical efficiency is not absolute, but a relative quantity. The most common method to define it is to divide the value of the effect to the value of the expenditures. Therefore, if the other terms are the same, the more is an economical efficiency and the less are resources spent for it, the higher is the system efficiency. The efficiency rate is the most important indicator of the system quality. The performance variant, which provides the highest efficiency of the economical innovation system in certain conditions, is an optimal variant.

The efficiency is distinguished by economical, social, environmental and other aspects. At different levels of economic system economical efficiency is measured by the indicators in accordance with the same levels. Production efficiency is the generalized evaluation means and the facility for production functions. Quantitative indicators of economic and social efficiency enable to define quantity of

the efficiency and to choose the best options for economic problem solution. They are divided into value and natural indicators. Value indicators are used to measure exact different types of indicators of expenditures and outcomes, and to define the total volume of the effect. And natural indicators are mainly applied to evaluate the effect types which can not be measured with the value indicators.

Taking into account all of these, it is possible to note that the efficiency of ICT techno parks depends on the efficiency of their performance and management. The effectiveness of each of these spheres is determined by the coefficient of the obtained results to the spent expenses and defined by a majority of quantitative indicators. In order to determine the effectiveness of innovative production, labor productivity, fund payments, profitability, meeting all the costs and etc. indicators can be used. Organization of production innovative, different solutions ways of the structural problems are compared with the help of them [3].

Evaluation of the effectiveness of the social problems and the management of ICT techno parks requires using the specific quality indicators of the development of each these spheres. Each sphere should have special relevance criteria of expenditure and performance. Overall, the effectiveness of the performance of innovation structures consists of the sum of the effectiveness of its functioning objects. And the efficiency of each object is characterized by the opportunity to spend less money for product and service manufacture. This is an ability to spend minimum amount of money and to produce maximum products with the reasonable quality, and to sell this product with minimum expenses. The economical effectiveness of the innovation structures depends on the conformity of its products with the requirements of the market and consumers.

As ICT techno parks are the special subjects of innovation infrastructure, their development and evaluation of the efficiency rate can not only be realized on the basis of the principles of the commercial outcome. Thus, their activity considers establishment of absolutely new relations among scientific and technical product employees, investors and customers. Therefore, taking into account the characteristics of its position, role and objective in the socio-economic system plays a role of base for assessment rate of efficiency of proper activity.

The process of efficiency evaluation of ICT-techno parks also covers efficiency indicators, as coefficient of the objectives to demands and norms, as well as coefficient of the useful results to the targeted goals, and coefficient of the expenses to the obtained results. Each of these methods has their advantages and shortcomings in efficiency evaluation. This proves that there isn't a solely adopted approach to the efficiency evaluation. Under such conditions, ensuring regulation of interests of innovation of the groups, such as investors, managers and working personnel of the innovation structure in the selection of existing approaches is of great importance [4].

In this case, compliance rate of interests of above-mentioned groups with can be considered as an indicator of the efficiency indicator. Therefore, selecting the method of

efficiency evaluation, specific situation of the innovation structure should be taken into consideration and more optimal approach should be selected or the best features of some approach should be used simultaneously.

#### IV. INDICATORS CHARACTERIZING PERFORMANCE OF ICT TECHNO PARKS

Common spectrum of indicators of the performance of ICT techno parks varies depending on the activities, which techno park engaged in. Therefore, the common indicators for the various activities will have different efficiency coefficients.

Performance indicators of ICT techno parks can be as the following blocks:

1) the area allocated to the techno park, 2) investments and credits, 3) the structure of expenses spent for the implementation of innovation projects, 4) the structure of expenses spent for the research, design and experimental work, 5) innovative products, 6) the budget and funds payments, 7) work places, 8) labor activity, labor resources and wages in techno parks, 9) funding sources and structure of techno parks, 10) human and technical potential of techno parks, 11) ICT indicators of techno parks, 12) commercial and other service activity of techno parks, and 13) practical and experimental production activities of techno parks, and etc.

The common criteria of assessment of ICT techno parks activities are the followings: the specific share of small enterprises in the techno park structure with regard to the total number of techno park enterprises, the specific share of newly established enterprises, the specific share of new enterprises developing in the structure, the specific share of small enterprises outgoing from the structure, the area of activity of small enterprises in the establishment process within the structural framework, average wages, the total number of employees, the number and specific share of chief specialists, structure of employees according to the education, the list of the services provided in the structure, the average level of rent in the structure, the specific share of expenditures spent for equipment in general expenses, the average productivity, the volume of innovative products, a stock capacity of an employee, structure profitability, investing efficiency; the average term of investment to cover its expenses, the specific share of investment projects in the total number of designed projects, and so on.

Some indicators on ICT techno park activity may be as follows [2]: 1) the number of newly established scientific enterprises through the business incubator; 2) the number of enterprises released from the business incubator of techno park; 3) the total number of enterprises within the techno park; 4) the number of foreign firms and enterprises involved from other regions through the techno park; 5) percentage of covering the expenses of small enterprises within techno parks and its business-incubator; 6) the volume of investment of small scientific business aimed at financing the region through the techno park; 7) an average volume of investment per capita in a techno park; 8) the volume of products produced by techno park companies in

local, regional, national and international markets; 9) sources and amount of financing in techno park; 10) bonus, aid and supporting projects in techno parks; 11) grant projects of different rate in techno park; 12) the volume of innovation fund of techno park.

The head of ICT techno park structure can analyze the dynamics of changes in the structure performance through these indicators. This can be achieved by the comparison of the value of the indicators of reporting period with the previous or any other period. In the case of achieving positive dynamics of all indicators, it is possible to infer some results about improvement of the techno park activities during the reviewed period.

The indicators system of assessment of ICT techno park activities is divided into two groups: 1) internal (efficiency indicators of the techno park as an independent entity - technical, financial, innovation, human resources etc.), and 2) external (characterizing the effect of techno park on innovative, socio-economic and ecological environment of the region).

In terms of the second group of indicators of ICT techno park activity, its efficiency is determined by the compliance rate with the objectives of its stable development approved in the strategic plan of the region.

Efficiency indicators characterizing ICT techno park activity have certain requirements and these requirements are as follows [5, 6]: 1) the system of indicators must be flexible, i.e. it should detect changes rapidly; 2) the system must be integrated, i.e. should be able to provide description of the inter-system and intra-system mutual relations of business processes, as well as the characteristics of its integral outcome; 3) the system of efficiency indicators must be dynamic, i.e., process of development must be considered under the influence of internal and external factors; 4) it must have characteristics, which enables reflection of the results of technical and organizational improvement of the production.

Actually, it is possible to note that the efficiency indicators of ICT-techno park performance can be grouped according to the different types of effectiveness achieved as a result of techno park performance (economical, social and scientific-technical).

#### V. EVALUATION ALGORITHM OF THE ACTIVITY OF ICT TECHNO PARKS

Many factors influence obtaining any outcome, as well as the evaluation of ICT techno park performance. Both the hierarchy of indicators and purpose criteria are set in accordance with the issues against the technopark for detailed analysis of this process. Summarized indicators and purpose criteria are set in accordance with the main action directions at top level, and relatively concrete indicators and objectives - sub-criteria at low levels.

The information groups from both top and low levels are used for comparative assessments and analysis of the performance of ICT-oriented technopark. The proportion of

the indicators is set in the analysis and evaluation table in accordance with the relevant formulas. Those objectives are ranked in accordance with the power affecting the main result, in order to evaluate the effectiveness of techno park performance. Relevant importance coefficients are determined for them. This process is carried out by the expert group by the following stages.

At the I stage, the rank of each criteria is determined. For this purpose, the following expression can be used.

$i$  - top level criteria index,  $(i = \overline{1, n})$ ;

$j$  - an expert index in the relevant expert group,  $(j = \overline{1, m})$ ;

$K^i$  - an effectiveness indicator of the  $i$ -th criteria;

$b_{ij}$  - the points of the  $j$ -th expert given to  $i$ -th criteria,  $(i = \overline{1, n}), (j = \overline{1, m})$ ;

$S_i$  - the sum of the points given to the  $i$ -th criteria by

the experts, 
$$S_i = \sum_{j=1}^m b_{ij} \quad (i = \overline{1, n})$$

$r_i$  - the average  $i$ -points given to the  $i$ -th criteria by

the experts, 
$$r_i = \frac{S_i}{m}, \quad (i = \overline{1, n})$$

At the II stage,  $k_i$  - relative importance coefficient of each  $K^i$ -th criteria is determined.

$$\sum_{i=1}^n k_i = 1$$
 condition should be provided.

At the III stage, if necessary, sub-criteria of  $L_i$  number shall be determined proper to any  $i$ -th criteria. Afterwards, as in stage I and II, ranks and relative importance coefficients proper to each sub-criteria are determined by a group of experts.

$l_i = \overline{1, L_i}$  - sub-criteria index, proper to the  $i$ -th criteria,  $(i = \overline{1, n})$ ;

$K_{l_i}^i$  - an effectiveness indicator of the  $l_i$ -th sub-criteria, proper to the  $i$ -th criteria,  $l_i = \overline{1, L_i}$ ;

$k_{l_i}^i$  - relative importance coefficient of the  $l_i$ -th sub-criteria, proper to the  $i$ -th criteria,  $l_i = \overline{1, L_i}$ ;

$k_{l_i}^i$  coefficients shall also be defined as the previous ones within the following conditions:

$$\sum_{l_i=1}^{L_i} k_{l_i}^i = 1, \quad (i = \overline{1, n}).$$

In other words, each sub-criteria is given the points by an expert group, the points total is calculated. After that, the proper ranks are defined, the figure inverse to the sum of the points is calculated and obtained results are normalized.

At the IV stage, realization degree or effectiveness indicator of each criteria ( $K_i$ ) and of relevant sub-criteria ( $K_{l_i}^i$ ) is determined. Subsequently, integral efficiency criteria ( $TIS$ ) of the techno park performance can be defined as a function of the same criteria. Thus,

$$TIS = F(K_1, K_2, \dots, K_n)$$

$$K_i = F_i(K_1^i, K_2^i, \dots, K_{L_i}^i)$$

$$(i = \overline{1, n}).$$

In special cases, if we note  $F$  and  $F_i$  functions as the linear function defined as the sum of the relevant criteria values and their relative importance coefficients, then, the result will be as follows:

$$TIS = \sum_{i=1}^n k_i K_i$$

and the result for  $i$ -th criteria separately will be as follows:

$$K_i = \sum_{l_i=1}^{L_i} k_{l_i}^i K_{l_i}^i, \quad (i = \overline{1, n}).$$

## VI. CONCLUSION

The separate and general evaluation of the results of the performance of ICT techno parks for absolute, as well as for the relative indicators is an actual issue. This will enable to identify problems existing in ICT techno parks on time, to define their solution ways and means, to make decisions for scientific companies of the techno park, to determine the development strategy of techno park, and to increase efficiency of the operational and strategic management of techno park as a whole. At the same time, provision of necessary information is required for the proper usage of the results and for the evaluation of the effectiveness of techno park activities. The necessary initial and indirect indicators have been established to achieve this. Other information required to be calculated and the execution procedures of criteria were explained.

The proposed algorithm for the evaluation of ICT-techno park efficiency is an important step in the development of organizational and management mechanisms of ICT techno parks to be developed.

## REFERENCES

- [1] The Law of the Republic of Azerbaijan "About the special economical zones" dated 14.04.2009. <http://www.meclis.gov.az/?/az/legislation/view/1462> (in Azerbaijan)
- [2] Koroleva E.V. Shmigova L.I. Methodological approaches to the evaluation of the functioning of innovation infrastructure subjects. /Bulletin of the Belarusian National Technical University (BNTU), 2010, № 1. (in Russian)
- [3] A.G.Aliyev, R.O.Sahverdiyeva. Scientific and methodological basis for complex evaluation of the performance efficiency of the innovation structures. News of ANAS. Science and Innovation series. Baku, № 1 (5), 2011. P. 23-32(in Russian)
- [4] Miroseidi S.A., Alpatova M.V. On the evaluation of the effectiveness of the company. VPI. 2009.
- [5] Maltseva A. Balanced indicator system for techno park evaluation: micro-economical aspect. J. Problems of the management theory and practice. 2010. <http://www.uptp.ru>
- [6] Makarov A.V., Lugovtsov A.V. Methodological features of evaluating the effectiveness of techno park. Ekaterinburg, 2008.