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UDC 338 (571.12)

MEASURING CAPACITY FOR INNOVATION IN THE TYUMEN REGION: A GENERAL THEORETICAL FRAMEWORK

SUMMARY. An innovative vector of development and integration of innovative activity into the existing structure of economy are acknowledged to be uncontested. The difficulty of making decisions, choosing priorities in the innovative sphere involve both adoption of international terminology and the quality problems of assessing structural elements of the innovation process. The statistics of innovation, based on international assessment standards, originated in 1989. Measuring innovative activity in Russia dates back to 1994 and is considered to be the process of qualitative interpretation of phenomena in order to establish quantitative methods for determining the quantity, structure, intensity and dynamics of innovation processes. This article proposes an index to assess the innovative capacity of the economy of the Tyumen region and the method of calculation, limited by the actual information array observed by Tyumen Statistics Service. The quantity of the innovation potential of the Tyumen region is appropriate to the developing economy of the region.

KEY WORDS. Innovative potential, methods of assessment, the index of innovative potential.

Introduction of official forms of federal statistical observation of innovation activity of an organization [1], including small businesses [2], by The Federal State Statistics Service of the Russian Federation (Rosstat) intensified theoretical and applied research on the quantitative measurement of basic concepts of "innovation". The volume and quality of statistical science, new technologies, and innovation can be considered satisfying only with respect to generalized, gross indicators, in particular, "the number of organizations engaged in the training of scientific personnel involved in scientific research and development, expenses for research and development, and innovation costs" [3], [4], [5]. The above-mentioned figures do not reflect generally accepted principles for determining the efficiency of economic activity in general and innovation in particular.

Moreover, grouping innovative phenomena in typologically homogeneous cost categories and agglomerations and periodization of dynamic rows (in monetary

equivalent) provide unwarranted increase of resources and have tinges of an arbitrary interpretation of what is actually happening. Effectiveness of innovation activity of an organization remains low. The share of innovative products in total sales of organizations implementing innovations, i.e. the degree of innovation of organizations is an unmet trend.

In the Tyumen region (excluding the autonomous regions) for the in period from 2005 to 2009 the degree of innovative activity decreased significantly organizations from 19.5% to 0.4 % due to the growth in the number of innovation-active organizations by 22 units (18-40). In 2012, the degree of innovation within organizations amounted to 4.6 % while increasing innovation-active organizations by 20%. Real differences of degree of innovation and the number of innovation-active organizations inadvertently provoke a preconceived idea of innovation in the region's economy; give emotional nuance to the assessments of foreign experts and investors.

It is logical to assume that economic actors vary by the degree of willingness to achieve an innovative goal due to a different set of the composition, structure, and quality of innovative resources. Therefore, we can talk about the innovative potential of the economy of a company, a region, and a country. Consequently, the definition of innovative capacity as a necessary and sufficient set of different kinds of resources that meet eligibility criteria, is a measure of readiness of an entity to implement innovation and achieve innovative goals. Innovation potential (IP), substantially limits the choice of a strategy, a program, a project of innovations in production, consists of a set of resources or capabilities of its generators and reflects innovative component built into economy of organizations. Recognizing a synthetic integrating approach to the formation of IP, it should be noted that the question of components does not have a single solution and often remains aside from the assessment of IP value. The tasks specified in measuring IP, are not mapped to the structural component of multidirectional influence on the integral value of IP.

Despite the fact that the problem of the economic content of "innovative potential" does not have a single solution, innovative potential is measured by international organizations involved in constructing various indices and ratings for positioning and comparison of countries in dynamics. The World Bank, RAND Corporation, The world Economic Forum (WEF), UN Development Program (UNDP), UN Industrial Development Organization (UNIDO), EU Commission European Innovation carry out observations and calculations in terms of major international investors, governments of national states to determine financial assets (loans and investments), and making management decisions in the area of innovation policy.

Calculation of the innovation potential of countries all over the world is based on the existing theories of innovation systems, socio-technical analysis, system analysis, and system dynamics. Differences in the values of the index for the same country in the world are due to a different set of variables to be included in indexes, grouping algorithm and integrating information in the index, and the method of its calculation. In statistics of science, technology, education, culture a set of integrated indicators on innovation capacity is employed.

For example, the sub-indices: WEF Technology Index, Science and Technology Capacity Index RAND, Corporation Global Creativity Index, Innovative Culture Index, Green Innovation Index, are used to measure the index of Ecoinnovation Development (innovation and environmental development). In EU countries the Summary Innovation Index (innovative potential) is calculated.

Rating and consulting agencies of different countries take active steps to develop different innovation potential indices. In this context, they employ different mathematical methods to calculate statistical indicators that in a more or less degree reflect the thematic content and affect the value of the innovation capacity. Each index is a numerical result, depending on which a country or a region is rated in terms of its innovation activity.

Domestic statistics recently began systematically fix indicators that characterize the innovative development of a country or a region. At the same time scientists and researchers actively develop and construct various integral models, indicators, indices for quantifying the innovation activity, development capacity, and research intensity of products. Further, the above-listed figures are equated to innovative development of the economy as a whole.

Since the process of innovation is embedded in traditional production, in practice the innovative potential is usually measured in accordance with the results of innovative activity. Herewith, the substitution of potential as the set of feasible options for performance innovation is accepted, or full use of innovative potential is admitted. If the latter is possible, then the organization of innovation processes, thus, ensures economic contents of compared values.

The arguments given above are the basis for compiling quantitative estimation of the innovative potential in unity with its qualitative definition. In general, IP value is in functional dependence on the value of the private part, introduced into its composition and determining the structure (1): IP = f (P_1, P_2,..., P_n), (1) where IP is the value of the innovation potential of an economic entity; P_1, P_2,..., P_n are private components that make up the innovative capacity (subpotentials); n is the number of subpotentials included in the innovative capacity of an economic object. Joint influence of subpotentials on the integral value of innovative capacity is 1, or $\sum_{i=1}^{n} d_i = 1$.

Qualitatively and quantitatively different subpotentials have different impact on the overall value of *IP*, consequently, *IP* index can be represented as (2),

$$I_{IP} = \sum_{i=1}^{n} (I_{Pi} * d_i) \qquad (2)$$

where *IP* – Index of innovative capacity of an entity; I_{Pi} – index of the i – subpotential P_i, i = 1, 2... n, describing the share of influence, weight, and contribution.

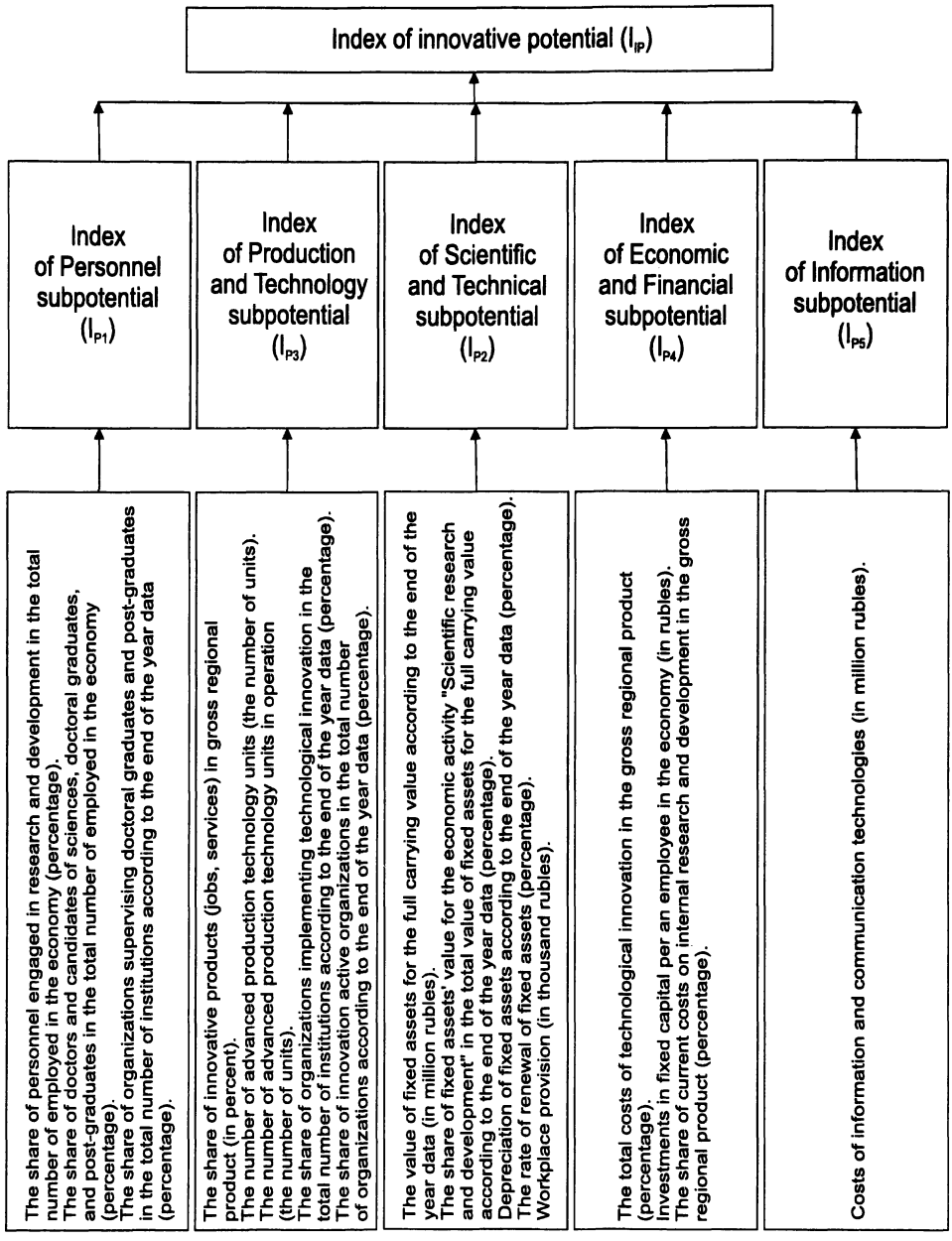

Figure 1. The scheme of designing the index of innovation potential

For comparative evaluation of innovative potential of economic objects we shall introduce the following gradation of innovation development state of economy "leading – sustainable – developing – lagging behind". The terms of scaling quantitative values of innovative potential are presented in Table 1.

Table 1

Correlation of innovation potential value and innovation economy state

Innovation potential value	State of innovative economic development
0.75 – 1.00	leading
0.50 – 0.75	sustainable
0.25 – 0.50	developing
0.10 – 0.25	lagging behind

To standardize the results of calculations we shall use a linear scaling formula (3):

$$I_{Pi} = \frac{P_i^{fact} - P_i^{min}}{P_i^{max} - P_i^{min}} \qquad (3)$$

where P_i^{fact} – the actual index value – the value of i – subpotential;

P_i^{max}, P_i^{min} – reached the maximum and minimum values of the indices – values of subpotentials (reference or bench mark points).

Integral indices of subpotentials are calculated according to the formula (4), proposed in [6, 7].

$$I_{Pi} = \frac{1}{m+k}\left(\sum_{j=1}^{m} P_{ij} + \sum_{j=k}^{k}(1 - P_{ij})\right), \qquad (4)$$

where I_{Pi} – index value of i – subpotential; m – the number of positive indicators; k – the number of negative indicators; P_{ij} – a standardized value of j – positive indicator for i – subpotential, j = 1,2,...,m; P_{ij} – a standardized value of j – negative indicator for i – subpotential, j = 1,2,...,k.

Having calculated the standardized values of the actual value of subpotentials based on the data from [7] by the formula (3) and having calculated the indices of subpotentials by formula (4), we shall determine the impact of each subpotential on the integral evaluation of IIP. Employing the method of expert survey the total importance index value of the innovation potential (which is equal to 1), in its functional dependence is distributed as follows: personnel subpotential (d1) – 25%; science and technology (d2) – 20%; production and technology (d3) – 20%; financial and economic (d4) – 20%; information (d5) – 15%. Thus the index of innovation potential (2) has the following form (5):

$$I_{IP} = 0.25\, I_{P1} + 0.20\, I_{P2} + 0.20\, I_{P3} + 0.2\, I_{P4} + 0.15\, I_{P5}. \qquad (5)$$

Putting in subpotentials' value (defined by the formula (2)) in the model (5) we shall calculate the dynamics of index of innovation potential of the Tyumen region (excluding autonomous regions) for the period 2005-2012 (Table 2) based on the data of Tyumenstat (Tyumen Bureau of Statistics) [7], [8].

Table 2

The dynamics of index of innovation potential of the Tyumen Region (excluding the Khanty-Mansi Autonomous Okrug and the Yamalo-Nenets Autonomous Okrug)

Year / Index	2005	2006	2007	2008	2009	2010	2011	2012
I_{P1}	0.196	0.127	0.116	0.130	0.147	0.149	0.146	0.126
I_{P2}	0.151	0.145	0.121	0.120	0.160	0.247	0.172	0.173
I_{P3}	0.266	0.336	0.376	0.394	0.446	0.501	0.496	0.595
I_{P4}	0.087	0.136	0.156	0.193	0.210	0.235	0.253	0.288
I_{P5}	0.229	0.349	0.462	0.529	0.563	0.656	0.572	0.629
I_{IP}	0.184	0.208	0.229	0.253	0.284	0.332	0.307	0.337

Dynamics of IP index for the period from 2005 to 2012 identified a positive trend and was estimated by the increase of 1.83 index points. Integral assessment of innovative potential (0.337 in 2012, according to the scale (Table 1)) allowed to identify the economy of the Tyumen Region (excluding the autonomous districts) as a developing one: $0.250 < 0.337 < 0.500$.

If the average annual growth rate, attained during the analyzed period, is preserved, and other conditions remain the same, the innovative potential of the Tyumen region in 2013 will reach 0.367 ip. If the positive trend is preserved in the future, in 2017 the forecast value of innovation potential will reach 0.518 index points, which will enable us to conclude the transition of the economy to sustainable innovative development: $0.500 < 0.518 < 0.750$.

At the same time we should point out the outpacing and sustainable growth of information subpotential by 0.4 i.p. (0.229-0.629) and of industrial and technological – by 0.3 i.p. (0.226-0.595). These subpotentials can be identified as the drivers of innovative economic development of the Tyumen region.

In Table 3 and Table 4 indices of IP economies of the Khanty-Mansi and the Yamalo-Nenets Autonomous Districts are calculated, employing the proposed method.

Table 3

The dynamics of index of innovation potential of the KhMAD

Year / Index	2005	2006	2007	2008	2009	2010	2011	2012
I_{P1}	0.085	0.086	0.109	0.092	0.090	0.078	0.079	0.069
I_{P2}	0.117	0.142	0.123	0.104	0.117	0.137	0.163	0.135
I_{P3}	1.906	2.091	2.237	2.154	2.534	2.575	2.888	2.9854
I_{P4}	0.200	0.336	0.394	0.458	0.458	0.478	0.588	0.619
I_{P5}	1.859	1.254	1.241	1.210	1.300	1.734	1.638	1.601
I_{IP}	0.745	0.723	0.764	0.748	0.839	0.918	0.993	1.00

Table 4

The dynamics of index of innovation potential of the YaNAD

Year / Index	2005	2006	2007	2008	2009	2010	2011	2012
I_{P1}	0.009	0.010	0.007	0.007	0.004	0.001	0.004	0.006
I_{P2}	0.110	0.124	0.147	0.167	0.171	0.253	0.260	0.240
I_{P3}	1.070	1.181	1.287	1.649	1.781	2.075	2.459	2.691
I_{P4}	0.474	0.398	0.630	0.868	0.885	0.903	1.011	1.138
I_{P5}	0.198	0.250	0.370	0.468	0.523	0.627	1.024	1.162
I_{IP}	0.363	0.381	0.470	0.609	0.674	0.740	0.901	0.990

The comparison of the subjects of the Tyumen region unambiguously indicates innovative vector of development of regional economies. However, with the positive dynamics the tempo of growth and the drivers of innovative development differ from the south of the Tyumen region. Innovation potential Index of the KhMAD (1.00) and of the YaNAD (0.99), corresponds to the leading level of economic development and in both economies the driver is production and technology sector of the fuel and energy complex. Overall development of innovative potential of the three subjects, as seen from Tables 2, 3, and 4, was carried out accompanied by outstripping growth of financial and economic subpotential and a simultaneous decrease in personnel subpotential.

Following relatively high collective expert assessment of the importance of personnel subpotential (which reaches 25%), we can formulate two statements requiring explanation and practical verification.

Firstly, the interaction of personnel engaged in scientific research and development (IP1) with organizations engaged in innovation (IP2), is insufficiently institutionalized. The involvement of scientific research staff in the system of coordinated interaction of subjects of innovative activity has not acquired a stable form of partnership.

Thus, it is possible to conclude there are vacant intellectual resources and restrictions for the development of innovative potential in the future. One can assume that the basis for innovative development is either simulation or borrowed innovations [9]. An indirect confirmation of this is the growth of the financial and economic subpotential (IP4).

Secondly, the territorial organization of the single-product model of economic development of parts of the Tyumen region is associated with opportunistic risk of price regulation for fuel and energy resources by international trade and economic blocs, and the shortfall in monopoly rents from investments in financial and economic subpotential (IP4). Summing up, we can conclude that the qualitative assessment of the components of the innovation potential and the integral value are relevant to justify investment options, innovative processes design [10], and diagnosis of the way organizations are ready to innovate.

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