

E. A. Podsolonko,
Dr. Hab (Economics),
A. V. Murava-Sereda,
Simferopol

HUMAN RESOURCES FOR KNOWLEDGE ECONOMY

In modern context a considerable portion of GDP in developed economies is generated in intellectual sector of production. According to UNESCO in 20 countries with 95% of the world's scientists involved, per capita income is annually increasing by \$ 200; in other countries with the rest 5% - the growth is only 10 dollars per year [1]. Ukraine has accumulated significant amounts of intellectual property. However, the proportion of knowledge-intensive goods and services in Ukraine's GDP is extremely low [2].

According to numerous researchers and analysts one of the reasons for the situation is insufficient security of Human resources in innovation economic development in Ukraine. In the countries with high rates of Knowledge Economy development the costs of Human resources are continuously increasing. It is being done to maintain the security of knowledge-based industries and sectors. These funds are being spent on the formation of a national innovation ideology as a worldview: a system of continuous training of employees of industries and knowledge-oriented sectors is underway, the concept of lifelong learning (LLL) for the wider population has been formed, public contract is formed for professionals representing post-industrial specialties, training of highly qualified personnel is being conducted [3].

Each of the developed countries has chosen its own way of Human resource formation, however, all countries in this group are investing considerable resources in HR security of Knowledge Economy. For the majority of the countries which are at the beginning of building Knowledge Economy a mechanism for selection of potential „growth points” to determine the priority funding in the context of limited resources is essential. Ukraine falls into this category. To select an effective HR security strategy for innovation development of national economies it is essential to have accounting instruments and tools for predicting resource availability in accordance with the relevant structure. Urgent is the development of methods for evaluating and predicting the need for Human resources in Knowledge Economy. As of today an open issue is the structure and regulatory proportions between elements of Human resource structure of Knowledge Economy. An answer to this question will expand the theoretical base of organizational and economic support for building and developing Knowledge Economy.

Thus, the purpose of this paper is to develop theoretical and methodical approaches to improve the organizational and economic support of Human resource security for innovation development of national economies.

The following issues are being solved in this study:

- formalization of Human resource elemental structure for innovation development of economy;
- formation of a system of regulatory relationships between elements in the structure of Human resources for innovation development of economy;
- development of a technique to determine the required total HR security, taking into account the sources of formation and fields of application.

The object of the study is a system of HR security in innovation development of national economy. The subject of the study is the organizational and economical support of national economic innovation development. The works of Ukrainian and foreign [4,5,6,7,8,9] scientists in the sphere of innovation development of economy constitute methodological and theoretical basis of this study. To achieve the objectives of the work common scientific and special methods of research have been used. In the world today the most common method of assessing the level of innovation development of economy is the practice of the World Bank KAM [10] and the methods used to generate reports of the European Innovation Board – „INNO-Policy Trendhart”[11]. The set of indicators used in these methods is as follows:

- Adult literacy rate (% aged 15 years and older),
- The share of professional and technically skilled workers against the total workforce (%),
- The level of training in Math (Grade 8),
- The level of training in Natural Sciences (Grade 8),
- Average duration of training,
- Complete secondary education,
- Higher education,
- Quality of education (Natural Sciences and Math),
- Trained personnel ratio,
- Business education, availability of primary business courses.

This set of indicators sufficiently reflects the current situation, however it is somewhat redundant, and somehow insufficient for management decisions. The indicators of „The level of training in Math (Grade 8)”, „The level of training in Natural Sciences (Grade 8)”, „Average duration of training” provide information about the quality of potential personnel rather than a quantitative assessment of the current situation. The indicator of „Quality of education (Natural Sciences and Math)” is a weakly formalizable parameter. There has to be more research devoted to the quality of HR security, formalization of criteria of quality, converting them into value form for inclusion into the methods for assessing and predicting HR security. Since these issues are not in

the focus of this study, the analysis conducted by the authors is based on the assumption that the quality of all elements of HR security structure is maximal.

The final list of HR security indicators has been formed by the authors from the standpoint of the process approach – „from the producer to the consumer through the intermediary”. It is known that in Knowledge Economy most of the GDP is generated in the intellectual sector, and its growth correlates with an increase in the number of knowledge-intensive goods and services. Thus, formation of innovative economy involves formation of Human resources not only of producers but also of consumers and intermediaries of qualitatively new goods and services. The consumer in terms of Knowledge Economy must get a complete secondary, and still better, a higher education, have a minimum competence in information technology for knowledge-intensive consumer goods and services [12].

A necessary point in Knowledge Economy is the availability of highly qualified intermediaries between the producer and the consumer of knowledge. The function of these intermediaries is Scientific Management, and their task is assessment of commercial potential of industrial and technological projects, proper management of the portfolios. Innovation development of economy is impossible without specialized personnel capable of carrying out professional management of innovation process. In the countries with leading positions in the rankings of Knowledge Economy [8, 10], the training of such specialists started over 12 years ago. A distinctive feature of such specialists is complete training in Natural Sciences, which allows a specialist to evaluate technological, programmatic etc. innovation in terms of its technical and quality characteristics, to determine its place among the analogs on the market; quality business training, which allows to organize the process of commercialization. Employers formed their need for relevant specialists through the government agencies or organizations responsible for the support of innovation

processes at the national and regional levels through outreach activities [13].

Manufacturers of innovative products and services are highly skilled personnel, inventors and skilled workers in high-tech industries. At present there are no methods to clearly answer the question - how many highly qualified personnel are necessary for manufacturing of sufficient innovation product in the period of Knowledge Economy formation. However, there is no doubt that the existence of a „crucial mass of knowledge generators” is a prerequisite for the formation of Knowledge Economy. With this in mind the final list of indicators was formed (Table 1).

There is a number of methodological approaches to assessing the resource potential of various nature, Human resource included [14]:

- Resource-based approach – Human resource is seen as material content of the body of interest
- Cost approach – determining the amount of conformity of available economic resources and the necessary investment costs for implementing the strategy of innovative development.
- Economic approach – based on the cost estimate used in all spheres of public production.

In our opinion the resource-based approach is closer to the purposes of this study. The aggregate necessary HR is the sum of own HR and the HR drawn from the outside:

$$HR_{agg} = HR_{own} + HR_{out} \quad (1),$$

where HR_{agg} - the aggregate HR.

Own HR is composed of that used for own purposes and the imported components:

$$HR_{own} = HR_{ins} + HR_{out}, \quad (2).$$

To meet the challenges of the present study it is necessary to develop this approach in relation to the element composition, sources of formation and field of applications of Human resources. Table 2 shows the element structure of the Human resource in accordance with the field of application and sources of formation. Rij – quantitative assessment of Human resource

Table 1

The list of indicators for assessment the Knowledge Economy HR security

Field of application	Levels of training (quantitative characteristic)
Knowledge generators	- highly qualified personnel - inventors and researchers - highly qualified employees of knowledge-and science-intensive industries
Intermediaries	- Entrepreneurs with specialized training in the field of innovation - Persons with higher business education of relevant profile - Persons with natural sciences and technical education and retraining in economics and innovation management
Knowledge consumers	- Persons with complete secondary education - Persons with higher education - Persons with competence in information technology

Table 2

The element structure of the Human resource in accordance with the fields of application and sources of formation

Element structure and levels of training		Fields of application and sources of formation			Total
		For own needs	Import	Export	
Generators	- highly qualified personnel	R_{11}	R_{12}	R_{13}	$n \cdot R_{1j}^{j=1}$
	- inventors and researchers	R_{21}	R_{22}	R_{23}	$n \cdot R_{2j}^{j=1}$
	highly qualified employees of knowledge- and science-intensive industries	R_{31}	R_{32}	R_{33}	$n \cdot R_{3j}^{j=1}$
Intermediaries	- Persons with higher business education of relevant profile	R_{41}	R_{42}	R_{43}	$n \cdot R_{4j}^{j=1}$
	Persons with natural sciences and technical education and retraining in economics and innovation management	R_{51}	R_{52}	R_{53}	$n \cdot R_{5j}^{j=1}$
	- Entrepreneurs with specialized training in the field of innovation	R_{61}	R_{62}	R_{63}	$n \cdot R_{6j}^{j=1}$
Consumers	- Persons with higher education	R_{71}	R_{72}	R_{73}	$n \cdot R_{7j}^{j=1}$
	- Persons with complete secondary education	R_{81}	R_{82}	R_{83}	$n \cdot R_{8j}^{j=1}$
	- Persons with competence in information technology	R_{91}	R_{92}	R_{93}	$n \cdot R_{9j}^{j=1}$
.....					
	Other	R_{m1}	R_{m2}	R_{m3}	$n \cdot R_{mj}$
Aggregate Human Resource e''		$m \cdot R_{i1}$	$m \cdot R_{i2}^1$	$m \cdot R_{i3}$	$m \cdot \sum_{i=1}^n R_{ij}$

i- element in j – field of application/source of formation. As quantitative assessment the absolute values for the population older than 18 are. The final table allows to determine proportions between the components of the available Human resources according to both field of applications/sources of formation, and element structure and levels of training. The n-width and m-length of the matrix can be resized.

To solve the problem of determining the necessary aggregate Human resources, regardless of industry sector, the use a system of regulatory proportions of the structural elements of HR for innovation development of economy is suggested. To obtain regulatory relations it is necessary to make a table similar to Table 2 which will contain the average quantitative values of each indicator S_{ij} in the reference group (for example, leading countries, rapidly developing countries, etc.), where S_{ij} – quantitative assessment of the regulatory Human resources of i-element in j-field of application/source of formation. As a quantitative assessment the absolute values for the population older than 18 is used.

The choice of a reference group can be carried out flexibly in accordance with the given parameters of the analysis. For example, you can form a reference group from among the countries that have achieved high results of innovation development in economy with low domestic purchasing power.

For making management decisions about Human resources for the development of Knowledge Economy, on the basis of tables containing data on the existing and the reference HR, the final table, filled with the planned values for HR P_{ij} , is suggested. The values of the final table are suggested to be formed:

- taking into account the useful effect of the available Human resources A_{ij}^R and the expected useful effect A_{ij}^P , calculated in a standard way, namely the valuation of the resource normalized by the valuation results,
- on the basis of regulatory relations

For regulatory proportions the following recommendations have been laid down:

* in $(A_{ij}^R \leq A_{ij}^S) \cup (R_{ij} \leq S_{ij})$ case $P_{ij} \geq R_{ij}$ is recommended,

* in $(A_{ij}^R \geq A_{ij}^S) \cup (R_{ij} \geq S_{ij})$ case $P_{ij} \geq R_{ij}$ is recommended, but the decision requires further analysis,

* in $(A_{ij}^R \leq A_{ij}^S) \cup (R_{ij} \geq S_{ij})$ case $P_{ij} \leq R_{ij}$ is recommended,

* in $(A_{ij}^R \geq A_{ij}^S) \cup (R_{ij} \leq S_{ij})$ case $P_{ij} = R_{ij}$ is recommended,

In these proportions A_{ij}^R is a useful effect of available Human resources, A_{ij}^S is regulatory useful effect, R_{ij} – quantitative assessment of Human resources of i-element to j-field of application/source of formation, S_{ij} – quantitative assessment of the regulatory Human resources of i-element in j-field of application/source of formation.

If it is not possible to calculate the useful effect for some indicators the formula collapses to a single inequation. As an additional analysis calculation of unit costs per unit of outcome, based on the resulting matrix in value terms, is suggested. The proposed approach, the indicators in the elemental structure and regulatory proportions extend the theoretical and methodological basis of organizational and methodical support of innovative development of national economies. Consideration of the recommendations in the development of strategies and operational plans of innovation development of economy will make it possible to achieve an optimal result. Using the methods of calculation of staffing innovation development of economy will help make justified management decisions and choose areas of concentration of resources for a particular component of Human capacities in terms of the targets and objectives.

References

1. **Martin Andersson** and **Charlie Karlsson**. Knowledge Accessibility and Regional Economic Growth // Working paper of the Department of Economics & CESIS, Jonkoping International Business School. – 2006. – P. 26. 2. **Schwab K.** The Global Competitiveness Report 2009 / K. Schwab // World Economic Forum – 2009. – 516 p. 3. **Jan Fagerberg**, **Martin Srcholec**, **Bart Verspagen**. Innovation and Economic Development // United Nations University Working Paper Series #2009-032 4. **Mindeli L. E.**, **Pipia L. K.** Conceptual aspects of the formation of Knowledge Economy// The problems of prognostics. – 2007. – #3. – pp.115 – 136. 5. **Untura G. A.** Future investments in the development of Knowledge Economy: All-Russian and regional trends // Region: economics and sociology. – 2009. – #1 – pp.64 – 84. 6. **Ivanov V. V.** Innovation policy in the transition to a Knowledge Economy// Economic science of modern Russia. – 2006. – #1 – pp.47 – 58. 7. **Ilyin N. I.** The formation mechanism of the reproductive structure of the national economy based on knowledge// Vlast – 2006. – #7. – pp.69 – 71. 8. **Measuring Knowledge in the World's Economies** // The World Bank Institute's: Knowledge for Development Program (K4D). – 2009. – P. 12.

9. **Sustainable economic development in the context of globalization and knowledge economy: Conceptual foundations of management theory and practice** // edited by V. Popkov – M.: Economy, 2007. – P. 295. 10. **KEI and KI Indexes (KAM 2009)** – [http://info.worldbank.org/etools/kam2/kam_page5.asp] 11. **INNO-Policy TrendChart annual country reports** [<http://www.proinno-europe.eu/trendchart/annual-country-reports>] 12. **Chen Derek**, **Gawande Kishore**. Underlying Dimensions of Knowledge Assessment: Factor Analysis of the Knowledge Assessment Methodology Data // World Bank Policy Research Working Paper 4216, April 2007. – P. 49. 13. **Lee T.** Reflections on the Knowledge Economy. The search for reform and policy of transparency: Publishing documentation of the social sciences, 2002 – V.2. – p. 503. 14. **Trifilova A. A.** Management of innovative development of enterprises, 2003 – M.: Finance and Statistics. – p. 176

Подсолонко О. А., Мурава-Середа А. В. Кадровий потенціал економіки знань

У статті досліджують джерела формування та направлення використання кадрового потенціалу економіки знань. Сформульовано систему нормативних співвідношень для елементів кадрового забезпечення. Запропоновано методіку оцінки та управління кадровою забезпеченістю в умовах інноваційного розвитку економіки.

Ключові слова: інноваційний розвиток економіки, організаційно-економічний механізм, економіка знань, кадровий потенціал.

Подсолонко Е. А., Мурава-Середа А. В. Кадровый потенциал экономики знаний

Исследуются источники формирования и направления использования кадрового потенциала экономики знаний. Формулируется система нормативных соотношений для элементов кадрового обеспечения. Предлагается методика оценки и управления кадровой обеспеченностью в условиях инновационного развития экономики.

Ключевые слова: инновационное развитие экономики, организационно-экономический механизм, экономика знаний, кадровый потенциал

Podsolonko E. A., Murava-Sereda A. V. Human resources for knowledge economy

Sources of formation and fields of application of Human resources of Knowledge Economy are investigated. A system of regulatory relations for elements of Human resources is being formulated. Methods of assessment and management of personnel security in terms of innovation economic development is suggested.

Key words: innovation development of economy, organizational and economic mechanism, Knowledge Economy, Human resources.

Received by the editors: 11.09.2012
and final form 20.11.2012