



Information and Innovation Technologies in Economics and Administration

edited by Olena Chukurna
and Magdalena Gawron-Łapuszek

**Series of monographs Faculty
of Architecture, Civil Engineering
and Applied Arts**

Katowice School of Technology

Monograph 27

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ul. Rolna 43 40-555 Katowice
tel. 32 202 50 34, fax: 32 252 28 75
www.wst.pl / www.wydawnictwo.wst.pl

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1.6. Development of innovation processes in agriculture

Scientific and technological progress and the introduction of new information technologies are prerequisites for ensuring the sustainable development of agroindustrial complex. The acceleration of scientific and technological progress is provided by innovative processes aimed at ensuring continuous production updating based on the latest achievements of science and technology. The innovation process in agriculture has specific features, due to higher than in industry, the influence of natural factors, different levels of organizational, economic conditions and other factors on the results of scientific and implementation activities of organizations operating in the innovation field. After all, the innovative development of agroindustrial complex is a set of measures aimed at the systematic updating of financial, technological, organizational, economic, legal, technical, marketing, management, logistical components, which are focused on increasing the quality and competitiveness of agricultural products.

Today, the situation of the agricultural industry poses a serious threat to the food security of the country, which forces to develop and implement a set of measures, including the application of a new strategy in the domestic agricultural market, the development of agricultural machinery, breeding, seed production, improvement of scientific support and special education.

Compared with other EU countries, Ukraine lags behind the first group of "Innovation Leaders" more than 4 times (the first place in the ranking is Sweden with an indicator of 0.796), the second group "Strong innovators" – 3 times (Ireland, 0.5843), from the third group of Moderate Innovators – 1.6 times (Estonia, 0.4161). It should be noted that in 2016 the value of the European Innovation Index of Ukraine increased slightly compared to the previous year (0,1783). It is worth noting that the highest value of this index in Ukraine was observed in 2013, when it was 0.1893⁶⁴

During 2018, 950 organizations performed research and development in Ukraine, 48.1% of which belonged to the public sector of the economy, 37.0% – entrepreneurship, 14.9% – higher education. At the enterprises and organizations that carried out the research, the number of contractors at the end of 2018. 88.1 thousand people (including part-time and civil servants), of whom 65.4% are researchers, 9.7% are technicians, 24.9% are support staff. In 2018, the total cost of research and development by organizations on their own accounted for UAH 16773.7 million (25% more than in 2017), including the cost of labor – UAH 8553.0 million, other current expenses – 7456,3 million UAH, capital expenditures – 764,4 million UAH, of which expenses for the purchase of equipment – 588,0 million UAH. According to preliminary estimates, the share of total expenditures in GDP was 0.47%, including at the expense of the state budget – 0.17%. According to 2017 data, the share of R&D expenditure in EU-28 GDP averaged 2.06%. The average share of R&D expenditure in Sweden was 3.4%, Austria – 3.16%, Denmark – 3.05%, Germany – 3.02%, Finland – 2.76%, Belgium – 2, 58%, France – 2,19%; lower in Romania, Latvia, Malta, Cyprus and Bulgaria (from 0.5% to 0.75%)⁶⁵.

Innovative activity is a defining characteristic of modern scientific and technological, industrial, socio-economic and all social processes. In order to study the innovation rating on the basis of international indicators, an objective assessment of the state of innovation development of Ukraine can be made by determining its relative position within the EU countries using the Global Competitiveness Index.

⁶⁴ European Innovation Scoreboard 2016. URL:

<http://ec.europa.eu/growth/industry/innovation/facts-figures/scoreboards>.

⁶⁵ Ofitsiyniyi sait Derzhavnoi sluzhby statystyky Ukrainy. Elektronnyi resurs. — Rezhym dostupu:

<http://www.ukrstat.gov.ua/>.

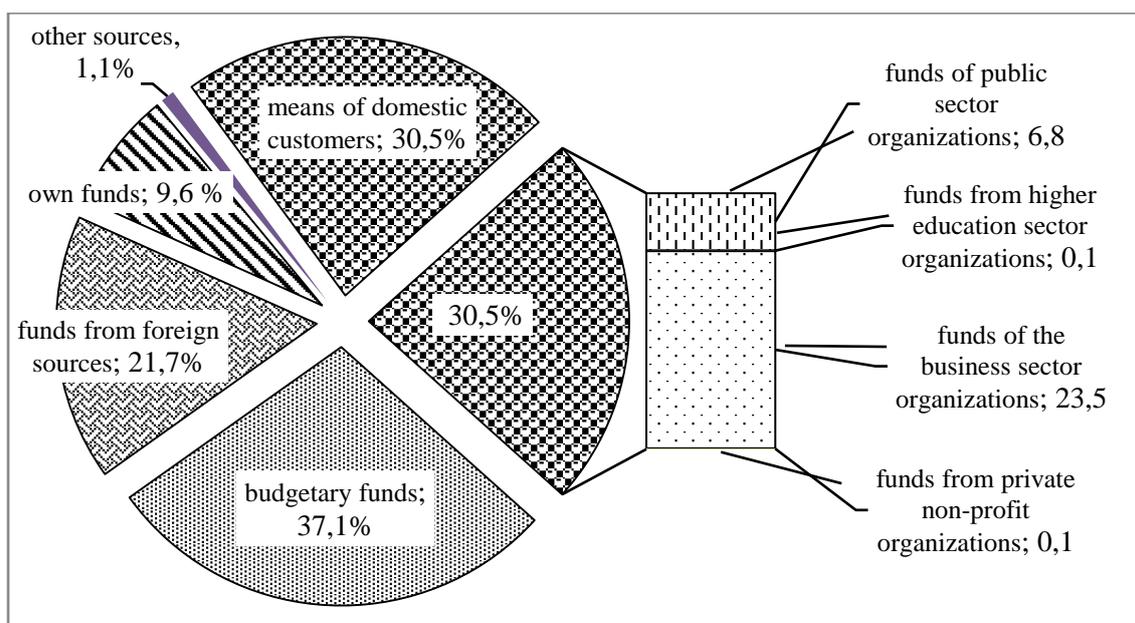


Fig. 1. Distribution of total R&D expenditures by funding source, %

According to Table. 1 we see that in the Global Competitiveness Rating of the Innovation Index in 2018 there was a decrease from 52 to 61 compared to last year, which indicates a low level of technological readiness of Ukraine for innovations⁶⁶.

Table 1. Innovation Index and its components for Ukraine for the period 2013-2018.

| Indicator | 2013- 2014 | | 2014-2015 | | 2015-2016 | | 2016-2017 | | 2017-2018 | |
|---|------------|-----|-----------|-----|-----------|-----|-----------|-----|-----------|-----|
| Innovation | 93 | 3.0 | 81 | 3.2 | 54 | 3.4 | 52 | 3.4 | 61 | 3.4 |
| Capacity for innovation | 100 | 3.2 | 82 | 3.6 | 52 | 4.2 | 49 | 4.4 | 51 | 4.3 |
| Quality of scientific research institutions | 69 | 3.6 | 67 | 3.8 | 43 | 4.2 | 50 | 4.2 | 60 | 3.9 |
| Company spending on R&D | 112 | 2,7 | 66 | 3.1 | 54 | 3.4 | 68 | 3.3 | 76 | 3.2 |
| University-industry collaboration in R&D | 77 | 3.4 | 74 | 3.5 | 74 | 3.5 | 57 | 3.5 | 73 | 3.4 |
| Gov't procurement of advanced technology products | 118 | 3.0 | 123 | 2.9 | 98 | 3.0 | 82 | 3.1 | 96 | 3.0 |
| Availability of scientists and engineers | 46 | 4.5 | 48 | 4.3 | 29 | 4.7 | 29 | 4.7 | 25 | 4.7 |

Generalized rating was downgraded by all indicators except Company Availability of Scientists and Engineers, the largest deviation being observed in Company spending on R&D and Gov't procurement of advanced technology products. The downgrade is due to an outdated production method and a small proportion of upgraded production facilities. Despite some of the subjectivity that traditionally accompanies peer review, it can be seen from the ratings that the multifaceted crisis that Ukraine is going through is definitely (and expectedly) reducing its global competitiveness.

In the world literature, the innovation process is seen as the embodiment of scientific and technological progress in the creation of new products and technologies. The innovation process in agriculture is a system of organizational and technological solutions aimed at creating new or improving existing technologies for agricultural production. Innovative technologies in agriculture are formed into groups: agro-technical, technological, managerial and economic.

⁶⁶ Source: The Global Competitiveness Report 2017–2018 URL <http://www3.weforum.org/docs/GCR2017-2018/05FullReport/TheGlobalCompetitivenessReport2017%E2%80%932018.pdf>.

Agrotechnical innovation processes include the use of the latest farming systems, technology for growing new varieties of crops, animal and poultry species, new ways of caring for plants. Technological innovative solutions are formed on the basis of automated systems, advanced intensive technologies, new ways of transportation. Management and economic innovation decisions include new forms of agricultural production organization and the use of effective management methods. The structure of introduction of innovative technologies in the agrarian sphere of economy is formed in the form of three groups: technological, production, organizational and management technologies (Table 2)⁶⁷.

In the total number of implemented innovative technologies implemented by domestic agricultural enterprises, the vast majority account for industrial innovative technologies (68.1%), which include the introduction of new methods and methods of using fertilizers and plant protection products.

During the last 20 years, during which the agrarian-developed countries in agriculture made the transition to the use of new generation equipment, science-intensive technologies, the domestic fleet of tractors and basic agricultural machines has been systematically reduced. The number of tractors decreased 2.6 times, combine harvesters – 3.3 times, forage harvesters – 3.3 times, potato harvesters – 6.9 times and beet harvesters – almost three times. All this indicates that, despite periodically optimistic assessments, domestic tractor and agricultural machinery are in crisis. Experts note a sharp decline in the use of mineral and organic fertilizers, which are active components of the logistics base of agriculture. The introduction of basic production capacities is systematically reduced. Declining and reclamation logistics.

So, it can be argued that with the transition to market-based management methods, the introduction of intensive resource-saving technologies in agriculture has been suspended.

The introduction of new technologies is not only a matter for farmers, but also for the state. By providing financial and logistical support, the state is obliged to orient agricultural producers to the introduction of conservation farming technologies

We agree with the opinion of scientists, priority directions of innovative development of agriculture are:

- market formation of new products and high technologies (newest resource-saving systems of machines and mechanisms, application of biotechnologies and information systems in production processes and in the sphere of their maintenance);
- the organization of integrated production, the subjects of which are carriers of innovation, have the conditions of scale and expansion of the sphere of innovative activity, distribution of income, costs and risks, increase of efficiency of the motivational mechanism, etc.;
- formation of an adequate level of human capital (comprehensive development of the person, preservation of his health, effective use of intellectual potential, education of high moral and spiritual qualities), which is conditioned by the need to observe the law of preservation of society, awakens the potential of the individual, forms a higher level of productive human activity and the progress of society as a whole⁶⁸.

Strategic innovation management of the agrarian economy combines technical development and investment, and the result of such integration is new technology. The practical implementation of innovative measures by agricultural entities is determined by two components, namely: the volume and level of use of resources available at the enterprise (including information resources); the enterprise's market position (market share, degree of access to raw material resources, competitive position, etc.).

⁶⁷ Savitsky E. E. (2014) Innovative technologies in agrarian sphere: nature, classification and Ukrainian realities. Agrarian economy. No 2. P. 110-115.

⁶⁸ Berezina L. M. (2013) Agroindustrial complex Enterprise Innovation Policy: Tactical and Strategic Aspects. Marketing and Innovation Management. No 4. URL: <http://mmi.fem.sumdu.edu.ua/> 122-132.

Table 2. Structure of innovative technologies implemented by domestic agricultural enterprises

| Categories of innovation | Varieties of innovative technologies | Number of projects | Share in number of projects, % |
|-------------------------------|--|--------------------|--------------------------------|
| Technological | Improvement of ways of growing new varieties of plants | 45 | 6.0 |
| | Improvement of breeding technology for new breeds of animals | 20 | 2.7 |
| | Technologies for growing organic products | 9 | 1.2 |
| | Together in a group | 74 | 12.5 |
| Production | New industrial technologies in animal husbandry, science-based systems of agriculture and animal husbandry | 58 | 14.4 |
| | New tillage technologies | 11 | 2.7 |
| | New methods of fertilizer application and plant protection | 320 | 79.2 |
| | New resource-saving technologies in agriculture | 15 | 3.7 |
| | Together in a group | 404 | 68.1 |
| Organizational and management | Development and formation of integrated structures | 45 | 6.0 |
| | New forms of service and provision of resources | 40 | 5.4 |
| | New forms of work organization and motivation | 25 | 3.4 |
| | Creation of innovation-consulting systems in the field of scientific and technical and innovative activity | 5 | 0.7 |
| | Together in a group | 115 | 19.4 |

The main reasons hampering scientific and technological progress in agribusiness at the level of enterprises and regions, according to scientists and experts, are:

- the difficult financial situation of most agricultural organizations;
- problems of personnel support of agricultural industry;
- low level of profitability of agricultural production;
- concentration of investment resources in the agro-industrial complex of the region mainly in its separate branches and in large, stable operating enterprises;
- insufficient use of depreciation as a source of investment in fixed assets of agricultural organizations;
- lack of government funding.

The improvement of the performance indicators of the agroindustrial complex in recent years is poorly supported by scientific, technical and organizational-economic improvements, and therefore not sufficiently sustainable. Scientific and technological progress in the agro-industrial complex involves the development of agrarian research and the mass use of their results in production, which requires an increase in agricultural scientific potential and an increase in the level of basic and applied research, as well as solving the problem of providing agriculture with qualified personnel.

The problem of development and introduction into agriculture of new mechanized technologies of production of agricultural products with the transition to a market economy has been significantly exacerbated. Without technical re-equipment of agricultural production, optimal supply of all its branches with new modern technology, development of resource-, energy-saving technologies, availability of skilled personnel in the conditions of globalization it is impossible to produce competitive products, to ensure the food security of the country, to increase the welfare of the population.

Due to the lack of conditions for development of production of new types of products at domestic agricultural machinery factories, a number of scientific and technological developments

of Russian Agroengineering have previously been adopted in other countries. The indispensability of the results of scientific and technical research, the low level of remuneration of scientists and the lack of technical equipment of research and design and technological institutes violate the continuity of generations of researchers and designers: the cadres are aging, and the influx of young people is insufficient to reproduce intellectual potential.

Successfully competing in market conditions is only economically feasible by choosing an innovative development strategy. There are three types of innovative strategies: upcoming, defensive and imitation⁶⁹.

The upcoming strategy is typical of firms that base their activities on the principles of entrepreneurial competition (small innovative enterprises). Defense – aimed at maintaining the competitive position of the company within the already conquered markets. The main goal of such a strategy is to optimize the cost-performance ratio in the innovation process. Private capital should be the financial basis of modernization, but with the obligatory support of the state.

The modernization of the agrarian sector also requires the establishment of educational infrastructure by the state. The transition of the agricultural sector to a new technical basis cannot be accomplished without the transition to an innovative model of development. In highly developed countries, this model is already being implemented. It envisages the systematic integration of the scientific and technological sphere in the process of economic and social development of society, which requires clear and consistent actions for the management of the industry, as well as incentives for the development of innovative detail and support of a steady flow of effective innovations. The component of the innovative model of development is the innovative infrastructure, which includes scientific, scientific-technical and scientific-technological centers, technoparks, technopoles, scientific-industrial associations and systems, specialized formations for the production of high-tech products. A special place in the innovation model is the organization of information and consulting services to assist agricultural producers in the development of innovations and good domestic and foreign experience.

As you know, production can be increased by extensive or intensive technologies. Extensive technologies are based on the people's experience of agriculture, and intensive – based on complex scientific knowledge, supported by practice: cultivation of more advanced varieties of agricultural crops and animal species, the application of laws of productive processes management in plant and animal husbandry, effective technical support climate conditions. The prevalence of extensive production methods used in agriculture does not allow it to double its production volume in 10 years.

Technological modernization of agricultural production involves the transition from extensive methods of agriculture based on the use of natural resource potential, intensive, high technology, based on the use of more efficient methods of production, new technology, labor stimulation, optimal investment and human resources.

All innovations are the result of scientific activity, best practices of farms in different regions of the country, as well as world practice. The process of innovation development in agriculture has its specificity, due, first of all, to the features of agricultural production. Such features are:

- variety of agricultural products, differences in technologies for their cultivation and production;
- dependence of production technology in agriculture on the created natural and weather conditions;
- high degree of territorial division of agricultural production and significant differentiation of individual regions in terms of production;

⁶⁹ Tsallagova E. A., Karaeva Z. V., Ananiadi A. K. (2009) Integration processes as a fundamental basis for the implementation of innovative and information technologies in agriculture TERRA ECONOMICUS Economic Bulletin of Rostov State University. Volume 7. No. 4. (Part 3). P. 105-108.

- social level of agricultural workers, which requires much greater attention to training and skills development.

Among the most characteristic features of the development of innovative activity in agriculture include:

- isolation of the majority of agricultural producers at all levels: from organizations producing scientific and technical products to enterprises that implement it;
- the lack of a clear and scientifically sound organizational and economic mechanism for transferring the achievements of science to production and, as a consequence, a significant lag of the industry in the development of innovation, even in comparison with the industry, where innovation activity is not yet high.

Organizational and managerial factors related to the presence of a developed innovation infrastructure (Agrotechnopark, business incubators, innovation and technology centers, technology transfer centers, consulting services), developed to support innovative enterprises, are influenced by the innovative development of agro-industrial complex. reliable working information system.

In agriculture, technoparks are most needed for the development of technologies for growing crops, new machinery, plant varieties, animal breeds, chemicals, with a view to comprehensively assessing and adapting new technological processes to production conditions and further replicating them at enterprises with the same economic and climatic conditions.

Business incubators play a special role in the development of innovative activities of agribusinesses. They are designed to create a more conducive environment for small business start-ups and can provide them with the following services:

- individual consultations between small business founders, senior executives, managers and staff;
- training (including internships at other companies), improving the competence of managers and specialists;
- conducting trainings on various topics: drawing up a business plan, increasing the attractiveness of their business to investors, setting prices for their services and products, finding new markets;
- conducting various events and business fairs to help start-ups establish contacts and develop new businesses;
- organization of office infrastructure (premises, furniture, office equipment, computers, internal network, external communication, Internet access, conference rooms);
- legal and accounting services.

Reserve of innovative development is also financing through non-traditional (alternative) instruments: venture funds, private investor, crowdfunding (Table 3). Developed countries draw on financial resources for innovation from both public and private sources: most Western European countries and the United States have an equal allocation of R&D financial resources between public and private capital⁷⁰.

In Ukraine, the agricultural advisory system is a set of interconnected and cooperative information-consulting, training and implementation structures, providers of information and innovations that fulfill certain tasks in order to achieve a common goal – informational-consulting provision of agricultural entities and rural population.

The demand for consulting services is caused by:

1. Upgrading of production, introduction of innovative technologies and projects for increasing the competitiveness of agricultural enterprises.

⁷⁰ Kolodaznaya I. V., Borblik K. E. (2017) Sources of financing of innovative activity of enterprises of Ukraine. Economy and society. No 17. P. 448-453.

At present, the level of innovation development in the industry remains rather low. According to the Research Institute of Agricultural Economics, most of the development (60-70%) after two or three years becomes unknown to both customers and developers and consumers of scientific and technical products. This situation can be changed, first of all, with the help of agricultural consultants, who are the link between science and production, facilitate the rapid development of innovation through demonstration, training and individual consultations.

2. Poor performance of agricultural producers compared to the world level and the best farms in the country. At the same time, the results of the best farms are proof that, despite the difficulties of development and unequal market conditions, the conditions of obtaining market income are an effective, profitable area of investment, and with a reasonably qualified approach to business organization it can bring small profit. The profitability of production in these farms is 16-48% points higher than in other agricultural organizations.

3. The problem of staffing of agricultural production. In 2018. the number of managers and specialists of agricultural production was 61% to the level of 2012, of which only 37.9% with higher education, 9.9% aged 30 years. Counseling can fill the lack of knowledge of specialists who have no special education, help them in solving complex problems, provide the necessary information.

4. Rural unemployment and low income of rural residents. Therefore, one of the tasks of the consultants is to assist in the development of small businesses in rural areas, the organization of non-agricultural activities, which will increase the employment and income of the rural population.

5. The legislative framework (especially in the field of taxation, land law) is changing, requiring regular monitoring and clarification.

6. Lack of information necessary for timely management decisions.

Table 3. Comparative analysis of non-traditional sources of financing

| Form of investment | Characteristic | Advantages | Disadvantages |
|---------------------|---|--|---|
| Venture Form | Selection of projects based on business projects | Activities are aimed at riskier investing | Possibility of losing control of an innovative project to an enterprise |
| Business incubators | Mentors of small and medium business | Investing in intellectual property | There is no search for direct investors |
| Private investor | Investing capital and returning a part of newly created capital | Optimize the current business model, determine the location and prospects of the project in the market | Insignificant contribution to capital |
| Crowdfunding | The choice is through the Internet or social networks | Attracting investment while promoting an innovative product | An alternative way to attract non-repayable investment in the project |

An increasing role in promoting innovation from science to production is played by exhibition and demonstration activities and holding short-term seminars and scientific and practical conferences. These forms of work are promising, as they allow to show and promote among a large number of agricultural producers innovative technologies in the field of plant and animal husbandry, promising varieties of crops, breeds of productive animals, new machines and equipment, advanced production experience.

Recently, the role of innovative technologies in consulting has grown rapidly. They help to increase objectivity, accuracy and completeness of information, speed of decision-making and making recommendations. With the help of information technologies large amounts of data are processed, the results of activity of the enterprise are recorded and processed in real time, which

allows: to make adjustments in production management in time. Important role is given to the representation of the system in the Internet, the formation and maintenance of Web sites by all subjects of information and consulting activities. Information technology consultants, on average, have more time than other employees to spend time learning new information and constantly retraining.

In addition to specialist knowledge, consultants must be familiar with the forms and methods of consulting work. The variety of methodological tools is the basis for the competitive advantage of consultants. Dynamic change of environment and conditions of functioning of organizations causes the appearance of qualitatively new problems, which, in turn, stimulates the development of new methods, techniques, approaches. A characteristic feature of solving client problems is their complex nature, which requires, accordingly, adequate approaches to the solution, the combination of different methods.

Thus, a promising direction for the development of the agricultural counseling system should be:

- consolidation of the status of agricultural counseling;
- state support of information-consulting activity by means of program-target method;
- creation of independent consulting organizations that develop information and consulting activity as the main one;
- integration of consulting organizations in the agro-industrial complex for effective use of information, personnel, consulting, financial and material resources;
- formation of a professional staff of consultants specializing in specific areas of information-consulting activities in the agroindustrial complex;
- organization of training and advanced training of consultants;
- improvement of the forms and methods of information-consulting activity;
- development of information technologies and integration of consulting organizations in the system of state information support in the field of agriculture.

Successful implementation of these directions and dissemination of best practices of agricultural consulting will create an effective system of information and consulting services for agricultural producers and the population operating in a single information and legal space, focused on improving the efficiency of production, promoting innovative projects in agriculture. instruments of implementation of the state agri-food policy.

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1.7. Management of activities of enterprises of the tourism industry on the basis of modern informational technologies

A socially oriented market economy contributes to creating conditions for leisure and recreation of the population. Satisfaction of recreational, cognitive, spiritual and other needs of people through their movement in the social space by promoting tourism development ⁷¹.

Today, tourism is one of the most profitable branches of the world economy. In many countries it is the tourism industry is the main source of income of the state. Tourist activity is not only the attraction and effective use of recreational resources. The development of tourism at the regional level promotes the effective use of production, scientific and technical, socio-cultural, and environmental potential of a particular territory. So, the tourism industry acts a catalyst for regional economic development ⁷².

National tourism industry is in the stage of becoming. The number of Ukrainian citizens who traveled abroad has a tendency to increase. One of the factors for this phenomenon is functioning visa-free regime with the EU, which came into force in May 2017. Today, in the conditions of the rapid development of information technologies on the Internet there is a huge amount of available information, which allows ordinary people to independently order a trip, buy tickets for flights, track profitable offers, in the system on-line to make payments for travel services, which partly leads to the elimination of intermediaries in the market of tourist services.

At the same time, the analysis of tourist stream shows that during the years 2000-2017 there were negative trends in the development of tourism, namely, there was a decline in the "Incoming tourist stream".

At the same time, the analysis of tourist stream shows that during the years 2000-2017 there were negative trends in the development of tourism, namely, there was a decline in the Incoming tourist stream. In 2017, the number of citizens of Ukraine serviced by tour operators and travel agents was: 2365424 legal entities and 401397 physical persons; foreign citizens – 38563 legal entities, 1042 individuals ⁷³.

During the specified period also decreased the number of subjects of tourism activity. Thus, in 2011, their number was 4157 (of which 2165 legal entities, 1992 – physical I persons), in 2017 their number decreased by 16.5% to 3469 (1743 legal entities, 1726 individuals).

Table 1. Number of tourists serviced by tour operators and travel agents⁷⁴

| Category of tourists | 2011 | 2015 | 2016 | 2017 | 2017 in % by 2011 |
|------------------------------|---------|---------|---------|---------|-------------------|
| serviced by legal entities | | | | | |
| Citizen of Ukraine | 1441157 | 1800277 | 2216323 | 2365424 | 164,1 |
| Foreigners | 287185 | 14550 | 33784 | 38563 | 13,4 |
| serviced by physical persons | | | | | |
| Citizen of Ukraine | 109912 | 204140 | 298212 | 401397 | 365,2 |
| Foreigners | 2229 | 609 | 1287 | 1042 | 46,7 |

⁷¹ Kryveha, L. D., Holovashenko O. V. Turyzm: problemy vdoskonalennia pravovoho rehuliuвання v Ukraini [Tourism: Problems of Improving Legal Regulation in Ukraine]. *web.znu.edu.ua*. Retrieved from: <http://web.znu.edu.ua/herald/issues/archive/articles/2754.pdf> [in Ukrainian].

⁷² Panukhnyk O. (2015). Innovatsiynyi potentsial rehionalnoho rozvytku turyzmu ta rekreatsii iz zaluchenniam molodizhnogo resursu: peredumovy formuvannia ta vektornist upravlinnia [Innovative potential of regional development of tourism and recreation with attraction of youth resource: preconditions of formation and vectoriality of management]. *Halytskyi ekonomichnyi visnyk – Halytskyi economic Bulletin*, No. 2, pp. 5-12. Retrieved from: http://nbuv.gov.ua/UJRN/gev_2015_2_3 [in Ukrainian].

⁷³ Statystychnyi zbirnyk «Turystychna diialnist v Ukraini u 2017 rotsi» [Statistical collection "Tourist activity in Ukraine in 2017"]. (n.d.). Kyiv : State Statistical Service of Ukraine, p. 90 [in Ukrainian].

⁷⁴ Sait derzhavnoi sluzhby statystyky Ukrainy [The site of the State Statistics Service of Ukraine]. *ukrstat.gov.ua*. Retrieved from http://www.ukrstat.gov.ua/operativ/operativ2007/tyr/tyr_u/potoki2006_u.htm [in Ukrainian].

About the authors:

Part 1. Information Component of Innovative Management of Enterprise and State Economy

- 1.1. Pavlo Horyslavets** – PhD in Economics, Associate Professor,
Nazar Dobosh – PhD in Economics, Associate Professor,
Lviv Polytechnic National University, Lviv, Ukraine
- 1.2. Artem Kazarian** – Postgraduate Student,
Lviv Polytechnic National University, Lviv, Ukraine,
Khrystyna Beregovska – Postgraduate Student, Quality Assurance Engineer,
Infopulse Ukraine, Lviv, Ukraine,
Vasyl Teslyuk – Doctor of Technical Sciences, Professor,
Lviv Polytechnic National University, Lviv, Ukraine
- 1.3. Olha Khaietska** – PhD in Economics, Associate Professor,
Vinnytsia National Agrarian University, Vinnytsia, Ukraine
- 1.4. Mykola Kravets** – Lecturer,
Inna Shramko – Senior Lecturer,
Dnipro State Agrarian and Economic University, Dnipro, Ukraine
- 1.5. Viktoriya Onegina** – Doctor in Economics, Professor,
Olha Kravchenko – PhD in Economics, Associate Professor,
Ihor Babaiev – Postgraduate Student,
Kharkiv Petro Vasylenko National Technical University of Agriculture, Kharkiv, Ukraine
- 1.6. Olena Polova** – Doctor in Economics, Associate Professor,
Vinnytsia National Agrarian University, Vinnytsia, Ukraine
- 1.7. Olena Smihunova** – PhD in Economics, Associate Professor,
Olha Podolska – PhD in Economics, Associate Professor,
Kateryna Bogomolova – PhD in Economics, Associate Professor,
Kharkiv Petro Vasylenko National Technical University of Agriculture, Kharkiv, Ukraine
- 1.8. Lesia Zastavetska** – Doctor of Geographical Sciences, Professor,
Taras Zastavetskyi – PhD of Geographical Sciences, Associate Professor,
Ternopil National Pedagogical University named after Volodymyr Hnatyuk, Ternopil,
Ukraine
- 1.9. Victoria Melnyk** – PhD in Philosophy, Associate Professor,
National Pedagogical Dragomanov University, Kyiv, Ukraine
- 1.10. Yuri Pozdnyakov** – Leading Expert Appraiser,
Ukrainian Appraisers Association Member, Lviv, Ukraine
Maria Lapishko – PhD in Economics, Professor,
Institute of Entrepreneurship and Advanced Technologies of the National University
«Lviv Polytechnic», Lviv, Ukraine