“Influence of network organizational structures on innovation activity of industrial enterprises”

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INFLUENCE OF NETWORK ORGANIZATIONAL STRUCTURES ON INNOVATION ACTIVITY OF INDUSTRIAL ENTERPRISES

Abstract

The interrelation between the innovation activity of enterprises and various types of network cooperation is of practical importance for the effective strategic management of network structures. In the present study, on the basis of indicators that measure innovation and technological effects and are adapted to the standards of statistics of the EU countries, the weighted aggregate innovation index of light industry companies in Ukraine and the EU countries is justified and calculated. On the basis of correlation and regression analysis, the relationships of varying strength are established between the integrated innovation index and different types of network innovative cooperation of light industry companies of the EU countries. The high-strength relationship is revealed between the innovation index of light industry and the indicators of the share of companies that had partners within their group of companies; that were involved in any type of network innovation partnership; that had partners in innovative cooperation among universities; that were involved in any type of partnership with a foreign partner from the EU countries, the EFTA countries or the candidate countries for accession to the EU. The construction of a correlation-regression model of the dependence of the innovation index of light industry on the share of innovation-active companies involved in any type of network innovation partnership and the share of innovation-active companies involved in network cooperation with a foreign partner from the EU countries, the EFTA countries or the candidate countries for accession to the EU given the possibility to predict the level of innovation of domestic companies of light industry depending on the level of their involvement in different types of network innovative cooperation.

Keywords innovation activity, network structure, innovation partnership, light industry, European Union, innovation index

JEL Classification D85, O14, O52

INTRODUCTION

The effective development of modern economy is impossible without the constant development and introduction of new products and services. The quality and volume of innovation activities of national companies determine the competitiveness of the economy as a whole, its ability to meet the growing consumer needs in ecological balance with the natural environment. The domestic practice knows many methods of stimulation of innovation activity, however, as a rule, they are ineffective. The causes of innovation inferiority of Ukrainian companies lie in using the organizational structures, which are inadequate to the current economic environment. Their problematical nature lies in the inability to provide the integrity and continuity of the innovation process: from generating an idea to its commercialization. Internationally, this problem is solved by the use of various types of network structures and network cooperation as effective tools for pro-

viding the innovative development. In the global competitive environment with high uncertainty and constant innovative changes, the network structures demonstrated a unique property to support both flexibility and stability.

The activation of innovative development of companies based on the formation of network structures takes place simultaneously in two aspects: managerial and financial. The first aspect involves establishing and maintaining by network structures of the closed innovation chain, which significantly reduces expenses and accelerates the innovation process. In the network structures, a unique ecosystem is created for the exchange of experiences, mutual learning and development of innovative ideas, and also the cross-sector interaction is the most effectively provided, which is the basis for generation of "breakthrough" innovations.

The second aspect is provided by the emergence of additional opportunities for the financing of innovation activity, in particular, due to the savings on all types of costs; the reduction of risks of uncertainty of business environment; the increased profitability through the production and sale of values corresponding to the consumer needs; the development of mechanisms of the partner co-financing of projects; the creation of a favorable investment climate through the formation of a set of affiliated and active companies.

1. LITERATURE REVIEW

In the majority of scientific works, network organizational structures are considered on an interdisciplinary basis, which facilitates the allocation of common features and problems, as well as the achievement of consensus in issues that generate the network mode of organization, but there remains the need to choose each theoretical platform that will be taken as a basis.

Studies carried out in the theory of social capital and industrial marketing have proven that the basis of network structures is the network cooperation, which significantly differs from the traditional business cooperation by the number of participants, the type and duration of interaction, the presence of common goals, the coordination and control mechanism, the generation of synergy, the presence of common ethical norms of business conduct.

Several researchers (Blois, 1972; Sheresheva, 2010) of the network structures note that they are based on the quasi-integration, which is a combination of economic entities on the basis of stable long-term relationships and the delegation of control over the management of common activity in the absence of legally registered transfer of property rights. The awareness of the threats of market uncertainty and the benefits of reducing competition encourages economic entities to introduce the elements of hierarchy into the market exchanges. The result is the creation of a network structure.

Thus, the network form of coordination refers to the mixed, hybrid form, which occupies an intermediate position between market and hierarchical structures and is based on interactive coordination, which has a leading role.

On the basis of generalization of theoretical and empirical material, it can be argued that the network structure is a form of voluntary partnership of legally independent economic entities on the basis of mechanisms of control and coordination, based on contracts, social ties and trust, with the purpose of shared use of complementary resources and competencies to get synergy effects.

Researchers, for example, Lombardi and Randelli (2012), indicate that the main reason for the formation and intensive development of network structures is the desire of industrial companies to intensify their innovative activity, as well as to obtain significant advantages from cooperation of various economic entities in areas representing areas of common interest.

Whittington and Mayer (1997) proved the existence of a correlation between the innovative forms of company organization and the results of their

operation. Tretyak and Rumyantseva (2003) also pointed to the existence of a relationship between the network organizational forms of enterprise organization and their competitiveness. In particular, they noted that competitiveness is being achieved today in the process of persistent innovation competition in the broadest sense, including in the forms of business organization, where inflexible and bureaucratic forms have no chance of success.

For Ukraine, the development of network structures and the network principle of organization of economic activity is considered by Sichkarenko (2015) as a new driver for innovation, capable of giving impact to innovative transformations at all levels and breaking the impermeability of the domestic economy to innovation.

However, the study of the interconnections between the network forms of the organization of industrial enterprises and the level of their innovation development was mostly general and did not have empirical justification based on a clearly established correlation relationship. The above did not allow to reveal the most effective forms of network cooperation of enterprises and to predict the results of their application.

Thus, the effective management of formation and development of the network structures in the economy involves the establishment of functional dependence between the innovation activity of companies and their participation in various forms of cooperation suggested by the network structures. Therefore, the aim of the present study is to formalize this dependence to enable modelling of the innovation dynamics and the establishment of the most promising forms of network cooperation.

2. METHODS

Predicting the effectiveness of influence of the network structures operation in the economy on the innovative development of companies involves the definition of initial level of their innovation activity prior to the formation of a network structure. The method of assessing and measuring the state of innovation activity of companies in terms of regions of Ukraine, types of economic activity both countrywide in Ukraine and in its specific regions is developed by specialists of the State Statistics Service of Ukraine. However, to calculate the relative level of innovation, it seems appropriate to use the Summary Innovation Index – a weighted aggregate indicator composed of a set of indicators reflecting the structure of companies that were engaged in innovation activity in terms of the nature of innovation activity, the structure of innovation costs, the type of innovations, as well as specific indicators of innovation performance.

This methodology has several advantages, in particular: the openness of the system of basic indicators, which allows to adjust their set depending on the purpose of the assessment; their suitability for the identification of general trends in the development of innovation activity; the possibility to make interregional and intersectoral comparisons. However, an integrated indicator calculated in this way reflects more the scope of innovation activity, its main components (internal and external research and development, acquisition of machinery, equipment and software, external knowledge, training for the introduction of innovation activity, etc.) and the structure of innovation costs.

In the context of the present study, it seems appropriate to focus on the indicators that allow to assess the scale of financing of innovation activity and its effectiveness in terms of novelty and attractiveness of the results for the market. In the structure of the Summary Innovation Index, such indicators are: the share of companies with new-to-market products in the total number of surveyed companies; the share of sold products, that were new to the market, in the total volume of sold products (goods, services); the share of sold products that were new to the company in the total volume of sold products (goods, services). To identify the interrelation between the operation of network structures and the innovation activity at the entrepreneurial level, of the number of heterogeneous indices reflecting the innovation activity of domestic companies in Ukraine, the indicators that better reflect innovation and technological effects have been distinguished and studied in detail. To carry out practical calculations, as an empirical basis for the research, the light industry of Ukraine was chosen, which includes the sectors of

tailoring, textile and knitwear production, manufacture of leather clothes and footwear.

Given that the main source of data is the summarized information obtained as a result of carrying out the state statistical observation according to the form No INN "Survey of innovation activity of enterprises", the following indicators have been identified:

- the share of light industry companies that were engaged in innovation activity in the total number of surveyed companies of the light industry, % (I_1);
- the volume of financing of innovation activities of light industry companies that were engaged in innovation activity, thousand euros (I_2);
- the costs of internal research and development of light industry companies that were engaged in this type of innovation activity, thousand euros (I_3);
- the costs of external research and development of light industry companies that were engaged in this type of innovation activity, thousand euros (I_4);
- the costs of acquisition of machinery, equipment and software of light industry companies that were engaged in this type of innovation activity, thousand euros (I_5);
- the costs of acquisition of external knowledge of light industry companies that were engaged in this type of innovation activity, thousand euros (I_6);
- the share of light industry companies with new-to-market products that were engaged in innovation activity in the total number of light industry companies, % (I_7);
- the share of sold innovative products of light industry companies, which were new to the market, in the total volume of sold innovative products of light industry companies, % (I_8);
- the volume of sold innovative products per 1 company of the light industry engaged in innovation activity, thousand euros (I_9);
- the profitability index of innovation activity of light industry companies as a correlation between the volume of sold innovative products of light industry companies and the volume of innovation costs (I_{10}).

In the selection of indicators, their compliance with the criterion of comparability with the EU countries was also taken into account, which is of particular importance in the context of the Association Agreement between Ukraine and the EU and particularly the Deep and Comprehensive Free Trade Area. Taking into account these changes, domestic companies, including the light industry ones, should adapt their operations to the new institutional and market environment. In addition, the involvement in European value chains and the development of inter-company cooperation with companies of the EU member states should become an additional impact for the economic development (Gurova & Efremova, 2012).

In connection with the above, to identify the functional dependency, calculations have carried out on the basis of statistical indicators adapted to the standards of statistics of the EU countries. This gave an opportunity of using the Eurostat database to compare Ukraine with the EU countries that were included in the survey of innovation activity of companies according to the methodology of the Community Innovation Survey (CIS). Based on the aggregation of the above indicators, the Innovation Index of light industry can be calculated $\left(I_{IA}^{LI}\right)$ – the integrated indicator, which is a comprehensive assessment of the innovation activity of companies of the given sector of economic activity in terms of the influence of innovation and technological effects of the network cooperation on it. The logical sequence of calculation of I_{IA}^{LI} is presented in Figure 1.

Since the selected indicators are heterogeneous, not directly comparable elements, it's necessary to eliminate the influence of their dimension by normalizing or reducing their set to dimensionless indices. In the present study, the normalizing is proposed to be made according to the formula:

$$z_{ij} = \frac{x_{ij}}{x_i^{em}}, \quad (1)$$

Source: Developed by the authors.

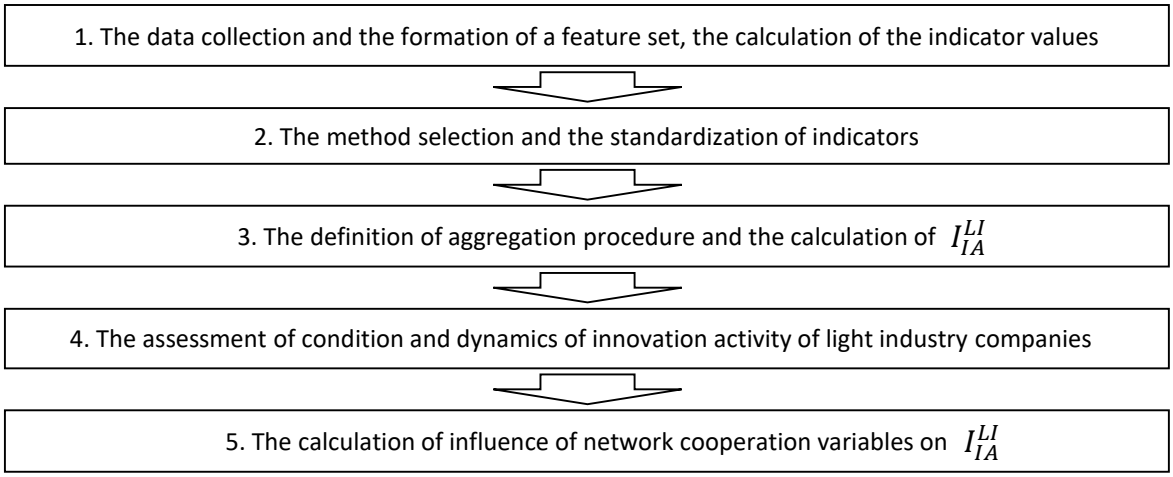


Figure 1. The sequence of calculation of the Innovation Index of companies taking into account the influence of network cooperation variables

where z_{ij} is a dimensionless (standardized) value of the i-th indicator of innovation activity of light industry companies in j-th year; x_{ij} is an actual value of the i-th indicator of innovation activity of light industry companies in j-th year; x_i^{em} is a reference value of the i-th indicator of innovation activity of light industry companies. As reference values of the indices x_i^{em}, the average values of the respective indicators for the EU countries for the period 2006–2015 were used. The integrated assessment of innovation activity is proposed to be determined as the arithmetic mean of standardized values of the indices Z_{ij}^{LI} (Tunzelmann & Acha, 2005). The formula for the calculation of I_{IA}^{LI} for the j-year is as follows:

$$I_{IAj}^{LI} = \frac{1}{n}\sum_{i=1}^{n} z_{ij}, \qquad (2)$$

where z_{ij} are standardized indicators of innovation activity of light industry companies in j-th year; n is the number of indicators of innovation activity of light industry companies. Calculated according to the formula (2), the indicator I_{IA}^{LI} allows to demonstrate the average assessment of the level of innovation activity of light industry companies in Ukraine for a specific time period, to analyze the dynamics and identify trends in the field of innovation activity of companies of this type of economic activity taking into account the effects of network cooperation.

3. RESULTS

Considering the innovativeness of light industry companies, it is advisable to focus on two aspects. On the one hand, light industry belongs to the group of "low-innovation" industrial activities by the indicators of intensity of research and development, output of innovative products, professional level of employees and the like (Harris & Halkett, 2007; Hirsch-Kreinsen, 2008). On the other hand, the challenges of globalization stimulate the light industry companies to invest significant amounts of money in the development of new materials or new combinations of existing materials, the improvement of production technologies, to look for new ways of commercialization of products, new markets, new schemes of cooperation with suppliers and buyers.

In the domestic light industry, the challenges of globalization have resulted in the domination of tolling schemes. The light industry of the EU countries in the 90-s of the XX century has also undergone significant structural shifts. They were connected with the increased competition from Asian and African producers, which has resulted in the reduction of almost one third of the total number of the employed in light industry of the EU and the migration of a large proportion of production capacities to the countries with low labor costs. However, in contrast to Ukraine, in response to the competitive pressure, the EU countries have

Table 1. The actual values of indicators of innovation activity of light industry companies in Ukraine

Source: State Statistics Service of Ukraine (2018).

Indicator name	Year					
	2010	2011	2012	2013	2014	2015
I. 1	9.8	13.4	13.6	11.7	13.2	13.2
I. 2	80.4	36.5	79.3	112.3	73.4	41.8
I. 3	11.2	2.4	127.8	116.3	304.8	197.8
I. 4	0.0	14.3	14.8	76.5	1.6	0.0
I. 5	115.3	43.0	92.0	159.5	66.5	48.0
I. 6	0.2	0.4	0.5	0.4	0.1	0.3
I. 7	4.8	4.9	3.7	5.6	3.7	5.0
I. 8	3.3	3.2	1.5	4.4	10.5	50.1
I. 9	192.2	163.3	228.0	202.3	220.3	116.4
I. 10	2.392	4.476	2.874	1.801	2.999	2.788

Note: The survey of innovation activities according to legal acts is carried out by the State Statistics Service of Ukraine once in three years.

focused on the innovation-oriented strategy vector, which was based on the qualitative diversification of light industry products on the basis of automation and computerization of the management of value chains.

The actual values of innovation indicators of light industry companies in Ukraine and the EU are presented in Tables 1 and 2.

From the comparison of data from Tables 1 and 2, it is obvious that there is a significant gap between the indicators of Ukraine and the indicators of the EU. In 2015, the share of light industry companies that were engaged in innovation activity in the total number of surveyed domestic companies of the light industry amounted to 13.2% compared to 9.8% in 2010. For the EU countries, this indicator was 2.6 times higher and amounted to 35.3% on average for the period 2006–2014.

The normalized values of indicators of innovation activity and the Innovation indexes of light industry companies in Ukraine and the EU countries are presented in Tables 3 and 4 and Figure 2.

The integrated indicators of the domestic light industry proved to be expectedly lower compared to the European ones. In 2010, I_{IA}^{LI} in Ukraine amounted to 0.2186, which is 4.3 times lower than the indicator of the EU (0.9436). In 2012, the Innovation Index in Ukraine increased by 26% to 0.2764. In the EU, I_{IA}^{LI} also increased and amounted to 1.102. The value of the Innovation Index of light industry of the EU countries (1.1285) exceeded 3.4 times the value of the Innovation Index of Ukraine (0.3318).

Summarizing the results of a comparative assessment of innovation activity of light industry companies in Ukraine and the EU countries, we can note the following:

Table 2. The actual values of indicators of innovation activity of light industry companies in the EU

Source: Eurostat (2018).

Indicator name	Year					Average value
	2006	2008	2010	2012	2014	
I. 1	24.0	39.4	40.0	38.5	34.7	35.3
I. 2	155.7	155.2	158.4	149.9	235.0	170.8
I. 3	123.4	200.7	224.2	245.0	383.0	235.3
I. 4	50.1	89.4	84.5	130.9	74.4	85.9
I. 5	120.7	137.5	92.2	137.7	181.1	133.8
I. 6	17.0	41.2	39.0	45.4	33.7	35.3
I. 7	29.3	27.2	27.3	28.7	26.1	27.7
I. 8	50.1	40.3	46.9	46.9	40.3	44.9
I. 9	2228.2	1916.9	1711.1	2126.0	2862.9	2169.0
I. 10	14.313	12.354	10.803	14.184	11.711	12.673

Note: The current data on the innovation activity of European companies, which are provided by Eurostat.

Source: Constructed by the authors according to the data of Tables 1 and 2.

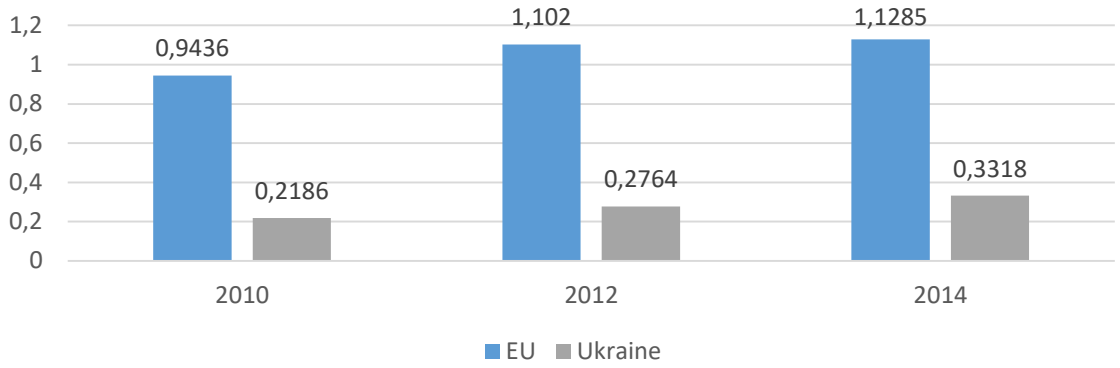


Figure 2. The Innovation Indexes of light industry of Ukraine and the EU countries

- the effectiveness of innovation activity of light industry companies in Ukraine, at least at the average level, remains significantly lower than in the EU countries;
- the indicators of innovation activity of the domestic sector of light industry correspond to the least forward-looking type of innovation strategies "Adaptation of technologies", which

Table 3. The normalized values of indicators of innovation activity and the Innovation Indexes of light industry companies in Ukraine

Source: The calculations are based on the data of Table 1.

Indicator name	Year					
	2010	2011	2012	2013	2014	2015
I. 1	0.2777	0.3786	0.3859	0.3310	0.3731	0.3724
I. 2	0.4705	0.2136	0.4644	0.6577	0.4299	0.2445
I. 3	0.0477	0.0104	0.5432	0.4943	1.2954	0.8409
I. 4	0.0000	0.1662	0.1723	0.8906	0.0185	0.0000
I. 5	0.8618	0.3214	0.6872	1.1919	0.4966	0.3587
I. 6	0.0069	0.0100	0.0141	0.0105	0.0021	0.0092
I. 7	0.1717	0.1759	0.1335	0.2031	0.1319	0.1803
I. 8	0.0735	0.0713	0.0334	0.0980	0.2339	1.1160
I. 9	0.0886	0.0753	0.1051	0.0933	0.1015	0.0537
I. 10	0.1874	0.3506	0.2251	0.1411	0.2349	0.2184
Innovation Index of light industry companies	0.2186	0.1773	0.2764	0.4112	0.3318	0.3394

Table 4. The normalized values of indicators of innovation activity and the Innovation indexes of light industry companies in the EU countries

Source: The calculations are based on the data of Table 2.

Indicator name	Year				
	2006	2008	2010	2012	2014
I. 1	0.6804	1.1161	1.1161	1.0895	0.9833
I. 2	0.9014	0.8984	0.9171	0.8678	1.4154
I. 3	0.5246	0.8532	0.9528	1.0414	1.6280
I. 4	0.5835	1.0411	0.9836	1.5247	0.8671
I. 5	0.9017	1.0272	0.6891	1.0290	1.3530
I. 6	0.4830	1.1689	1.1056	1.2870	0.9555
I. 7	1.0560	0.9815	0.9858	1.0361	0.9406
I. 8	1.1154	0.8978	1.0441	1.0450	0.8978
I. 9	1.0273	0.8838	0.7889	0.9802	1.3199
I. 10	1.1294	0.9749	0.8524	1.1192	0.9241
Innovation Index of light industry companies	0.8403	0.9843	0.9436	1.1020	1.1285

causes low indicators of effectiveness and commercial attractiveness of innovative products compared to the EU countries;

- by the values of most analyzed indicators Ukraine tends to the level of the countries that joined the EU in 2002 and later (Bulgaria, the Czech Republic, Estonia, Greece, Lithuania, Hungary, Poland, Portugal, Romania, Slovakia). In the pan-European dimension, they form the group of "low cost countries". Compared to the so-called "high cost countries", the latter are characterized by more competitive (lower) salaries and at the same time by a skilled labor force. The profitability of their light industry is also provided by the proximity to large consumer markets. Among the factors that undermine the competitiveness of "low cost countries" are the weak market positions of producers, the low level of innovation culture, the lack of skilled specialists, the high transport costs. To preserve and strengthen the positions, the countries of this group require developing and implementing a clear strategy for the development of light industry on the innovation basis with the active use of promising and mutually beneficial forms of network cooperation.

The analysis of industry market environment in the light industry showed that the companies, which adhere to the innovation strategy that consists in the openness to innovation, are characterized by the high level of involvement in partnership with various actors of the market: suppliers, customers, service providers and even competitors. This allows these companies not only to achieve higher levels of intensity and profitability of innovation activity, but also increase the probability of production of innovative products, attractive for the market (Chesbrough, 2003; Laursen, Salter, 2006). Obtaining relevant information from external sources is a particularly important factor for all companies, regardless of the type of innovation strategy, that have to operate in a changing environment of demand and technological shifts with a high level of uncertainty. Predicting the consumer demand is of paramount importance for the light industry, because its changes are happening faster than in the other sectors of industry.

According to the EU data (such data are not available for Ukraine), the indicators of participation of light industry companies in the networks of innovative cooperation correspond to the average in industry (Table 5). The largest difference was observed in the indicators of cooperation with universities and other institutions of higher education (in 2006, this indicator amounted to 67.8% of the average value in industry, in 2014 – to 85.7%).

An average of 18.8% of light industry companies interacted with customers and buyers of the business sector compared to an average of 19.61% in all industrial activities of the EU. 24.63% of light industry companies were involved in partnerships on innovative cooperation with suppliers, the average in industry is 25.47%.

As for the dynamics, during the period 2006–2014, the share of light industry companies that had partners on innovative cooperation within their group of companies increased by 44.5% (from 9.9% to 14.31%) and exceeded the average level in industry as a whole (14.18%). The share of companies that interacted on the basis of partnership with clients or customers of the business sector decreased almost by a quarter both in the light industry and in industry as a whole. The negative dynamics also appeared in the indicator of cooperation with competitors. In 2010, the share of companies that had such partners amounted to 11.95% and in 2014 – to 8.68%.

In research on network cooperation in innovations, such a backwardness of the light industry is explained by such specific characteristics as low capacity of application of funds and capacity of management cooperation in time (Abramovsky, Kremp, & López, 2009; Fritsch & Lukas, 2001; Tether, 2002). The lack of these competences is connected with a small size of companies and limited access to financial resources, lack of qualified personnel and problems with observance of intellectual property rights.

In 2014, by the order of importance for light industry companies, the innovation partnerships were distributed as follows: the partnerships within their group of companies had the highest value for 6.07% of the surveyed companies; with competitors, other companies of the same sector – for

Table 5. The indicators of network innovative cooperation of companies in the EU countries

Source: Eurostat (2018).

Indicators	Years									
	2006		2008		2010		2012		2014	
	in the light industry	overall in the industry	in the light industry	overall in the industry	in the light industry	overall in the industry	in the light industry	overall in the industry	in the light industry	overall in the industry
The share of innovation-active companies that had partners:										
within their group of companies, %;	9.90	12.71	13.34	13.28	11.70	14.23	11.95	14.51	14.31	14.18
suppliers of equipment, materials, components, software, %;	24.96	28.06	25.84	24.75	24.89	24.94	23.34	24.59	24.11	25.00
customers or buyers of the business sector, %;	20.78	23.06	20.57	20.62	19.56	20.33	17.77	18.62	15.26	15.42
competitors, other companies of the same industry, %;	11.95	14.54	14.03	12.06	9.73	11.88	8.18	11.00	8.68	7.96
consultants, commercial laboratories, %;	12.44	15.63	15.28	15.14	13.67	15.82	n/a	n/a	12.39	13.28
universities and other institutions of higher education, %	9.86	14.55	13.23	14.08	12.77	14.39	13.67	13.89	12.40	14.05
customers or buyers of the public sector, %.	9.37	9.62	n/a	9.33	9.95	9.23	6.23	7.02	6.14	5.12
The share of innovation-active companies involved in any type of partnership, %	28.3	35.19	34.06	34.13	32.4	34.65	32.3	34.32	35.4	35.34
The share of innovation-active companies involved in any type of partnership with a domestic partner, %	26.90	32.82	24.90	29.06	30.48	28.13	28.02	29.71	30.48	30.46
The share of innovation-active companies involved in any type of partnership with a partner from the EU countries, the EFTA countries or the candidate countries for accession to the EU, %	21.10	23.1	23.30	19.54	33.81	20.78	30.41	32.77	33.81	33.90
The share of innovation-active companies involved in any type of partnership with a partner from the US and other countries, %	8.69	8.46	5.80	4.37	4.46	4.92	4.12	4.69	4.46	4.53

0.82%; with clients or customers of the business sector – for 3.31%; with suppliers of equipment, materials, components, software – for 10.64%; with universities and other institutions of higher education – for 1.79%; with consultants, commercial laboratories – for 2.96% (Eurostat, 2018).

In Figure 3, the results of ranking the importance of different sources of information and knowledge for innovation-active companies of light industry of the EU countries are presented (Eurostat, 2018). Although they argue for internal communication (49.9% of the surveyed companies noted that such information is very important), external sources of information also play a significant role in the innovation activity of companies in this sector. The sources of such information are primarily customers (for 32.9% of companies) and providers (for 24.7% of companies).

The least important sources of information for light industry companies appeared to be clients or customers of the public sector (very important for 7.6% of companies), professional and industrial associations (for 5.9%), universities and other institutions of higher education (for 4.2%).

At the same time, as shown by the data of Table 6, there is a strong direct relationship between the share of companies that had partners on innovative cooperation among universities and the integral indicator of innovation (pair correlation coefficient $C_{un} = 0.714$). This gives evidence of the popularity within networks of informal ties

Source: The calculations based on the data provided by Eurostat.

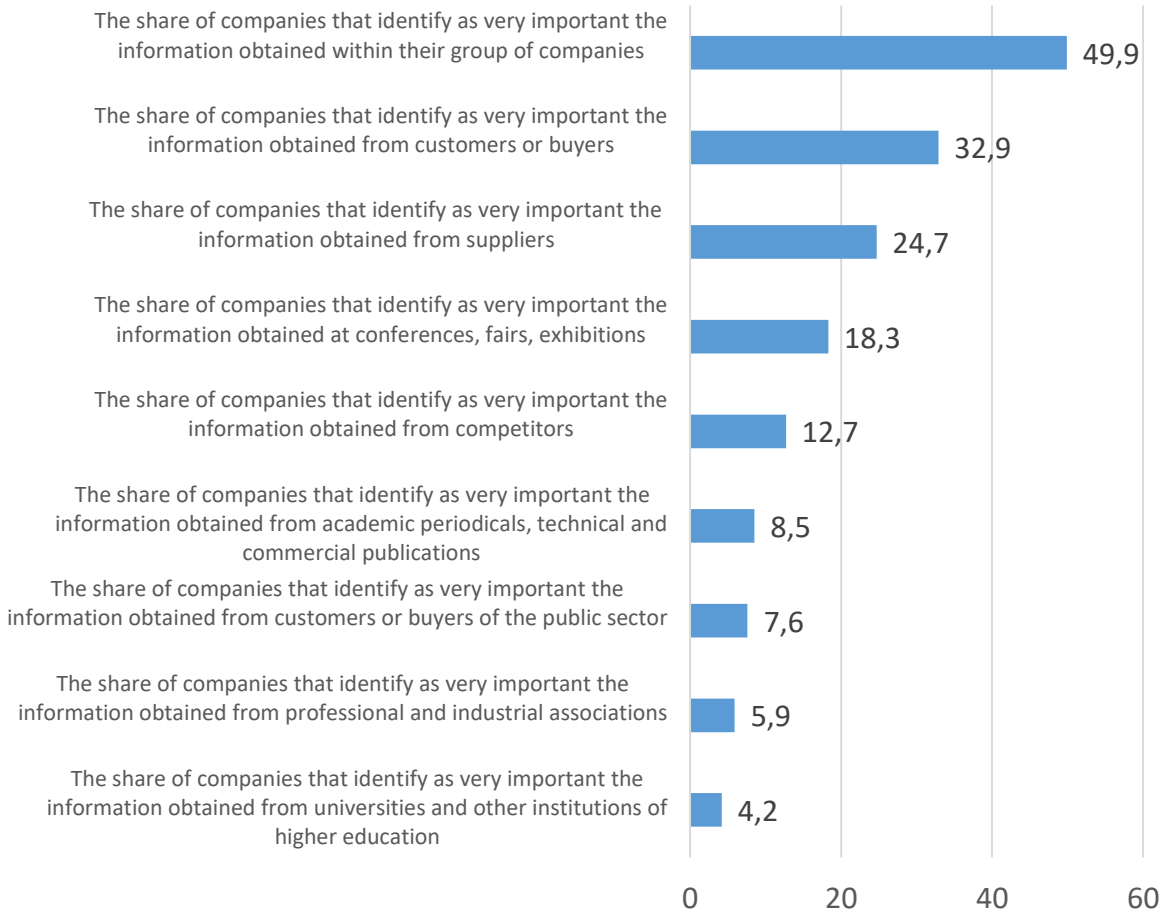


Figure 3. The most important sources of information for light industry companies of the EU (%)

between companies and institutions of higher education. The researchers note that many of these communications are organized and supported by industry associations which act as the driving force behind the upgrade of network structures (Dachs, Zahradnik, & Weber, 2011). Another hypothesis of such a difference in the structure of types of the network innovative cooperation and the sources of relevant information is the presence of negative experience of previous cooperation (Schwinge, 2015).

However, to confirm or to reject it in this study does not seem possible. High strength of relationship combines into a direct proportion the Innovation Index of the light industry and the indicators of the share of companies that had partners within their group of companies $\left(C_{gr} = 0.782\right)$.

The negative values of the correlation coefficients between the integral indicator of innovation and the indicators of involvement in partnerships with suppliers $\left(C_{supl} = -0.637\right)$, customers of the business sector $\left(C_{cust} = -0.868\right)$, competitors $\left(C_{cust} = -0.868\right)$, customers of the public sector $\left(C_{publ} = -0.905\right)$ indicate the presence of significant inverse relationship between the increase in the share of these types of innovative partnerships and the innovation performance of light industry companies. In general, between the share of innovation-active companies involved in any type of partnerships and the Innovation Index of light industry a strong direct relationship has been revealed $\left(C_{partn.gen.} = 0.798\right)$.

Geographically, the multidirectional dependencies have also been discovered between the integral indicators of the innovative light industry and the share of companies involved in innovative partnerships. Provided that between the share of innovation-active companies involved in any type of partnership with a domestic part-

Table 6. The values of correlation coefficients between the indicators of network innovative cooperation and the innovation index of light industry of the EU countries

Source: Calculated according to the data of Tables 4 and 5.

Innovation Index of the light industry	The share of innovation-active companies that had partners, %							The share of innovation-active companies involved in any type of partnership, %	The share of innovation-active companies involved in any type of partnership with a domestic partner, %	The share of innovation-active companies involved in any type of partnership with a foreign partner from the EU countries, the EFTA countries or the candidate countries for accession to the EU, %	The share of innovation-active companies involved in any type of partnership with a foreign partner from the US and other countries, %
	within their group of companies	suppliers of equipment, materials, components, software, %;	customers or buyers of the business sector	competitors, other companies of the same industry	consultants, commercial laboratories	universities and other institutions of higher education	customers or buyers of the public sector				
0.8403	9.90	24.96	20.78	11.95	12.44	9.86	9.37	28.3	26.90	21.10	8.69
0.9843	13.34	25.84	20.57	14.03	15.28	13.23	n/a	34.1	24.90	23.30	5.80
0.9436	11.70	24.89	19.56	9.73	13.67	12.77	9.95	32.4	30.48	33.81	4.46
1.1020	11.95	23.34	17.77	8.18	n/a	13.67	6.23	32.3	28.02	30.41	4.12
1.1285	14.31	24.11	15.26	8.68	12.39	12.40	6.14	35.4	30.48	33.81	4.46
Correlation coefficients (C)	0.782	–0.637	–0.868	–0.618	–0.031	0.714	–0.905	0.795	0.356	0.654	–0.817

ner and I_{IA}^{LI} there is a weak direct relationship $\left(C_{partn.nat.} = 0.356\right)$, and between the share of innovation-active companies involved in any type of partnership with a foreign partner from the EU countries, the EFTA countries or the candidate countries for accession to the EU and the Innovation Index, there is a direct relationship of medium strength $\left(C_{partn.EU} = 0.654\right)$, then between the share of innovation-active companies involved in partnership with a foreign partner from the US and other countries, there is a strong inverse relationship $\left(C_{partn.for.} = -0.817\right)$.

Such contradictions are explained by the complexity and ambiguity of the influence of different types of partnerships on the effectiveness of innovation, in particular, by the negative effects of the formation of network structures. Our conclusions confirm the results of similar subject studies (Lee & Chang-Yang, 2009; Molina Morales & Expósito Langa, 2012). In some studies (Morales, 2012), it is noted that the positive effects of knowledge spillover for innovation network structures decrease as the geography of their location expands. The fact is that advanced technology is characterized by the use of implicit, uncodified knowledge. Their transfer takes place in the course of personal communication or even informal close relationships. This is especially relevant to the early stages of innovation, when it is not even known who will act as a potential beneficiary of the product or service that is being developed. In addition, local networks contribute to the formation of stable formal or informal communications between representatives of individual economic entities, which constantly repeating help to establish trust-based relationships and facilitate immediate knowledge development and transfer, whereas, in contrast, maintaining such a relationship between the geographically remote units is much more difficult and costly (Chell & Baines, 2000; George,Wood, & Khan, 2001; Levin & Cross, 2004).

In this context, special attention should be paid to two aspects of the development of network struc-

tures in the light industry of Ukraine: firstly, to the development of innovative partnerships of various types with a focus on establishing relationships with universities and other institutions of higher education; secondly, to the development of network forms of cooperation with light industry companies of the EU countries, the EFTA countries and the countries candidates to accession to the EU. The correlation-regression models of the dependence of I_{IA}^{LI} on these indicators are as follows:

$$I_{IA}^{LI}\left(X_{partn.gen.}\right) = -0.0402 + 0.0351X_{partn.gen} \quad (3)$$

$$I_{IA}^{LI}\left(X_{partn.EU}\right) = 0.6311 + 0.0129X_{partn.EU} \quad (4)$$

where $X_{partn.gen.}$ is the share of innovation-active companies involved in any type of partnership, %; $X_{partn.EU}$ – the share of innovation-active companies involved in any type of partnership with a foreign partner from the EU countries, the EFTA countries or the candidate countries for accession to the EU, %. High positive values of the coefficients of their correlation with I_{IA}^{LI} $\left(C_{partn.gen.} = 0.7952,\ C_{partn.EU} = 0.6540\right)$ show that the selected indicators sufficiently reflect the influence of network cooperation of light industry companies on their innovativeness.

The coefficients of determination $\left(D_{partn.gen.} = 0.6324,\ \mathrm{D}_{partn.EU} = 0.4277\right)$ show that the change of the level of innovation of the light industry of the country by 63.24% can be explained by the influence of factors affecting the indicator of the share of innovation-active companies involved in any type of partnership, by 42.77% – by the change of the factors that determine the share of innovation-active companies involved in any type of partnership with a foreign partner from the EU countries, the EFTA countries or the candidate countries for accession to the EU. The comparison of the actual values of Fisher criterion $\left(F_{act.partn.gen.} = 2.177,\ F_{act.partn.gen} = 2.242\right)$ to the table one $\left(F_{table} = 10.13,\ \text{if}\ k1 = 1,\ k2 = 3\right)$ allows to recognize the developed models as statistically significant. To determine and compare the influence of factors on the average elasticity, coefficients have been calculated $\left(E\right)$: $E_{partn.gen.} = 1.14,\ E_{partn.EU} = 0.37.$ Their values show that if the indicator of the share of innovation-active companies involved in any type of partnership changes by 1%, the Innovation Index will change by 1.14%. If the share of companies involved in any type of partnership with a foreign partner from the EU countries, the EFTA countries or the candidate countries for accession to the EU changes by 1%, provided that all other factors remain constant, the integral index of innovation will change by 0.37%. This allows to assess the scale of growth of the selected indicators of network cooperation to achieve the reference level of innovation of the light industry. For example, to achieve the level of I_{IA}^{LI} 2014 of the EU countries, domestic companies must increase the level of their involvement in innovative partnerships by 2.9 times. Or they must increase their level of involvement in partnerships with foreign economic entities from the EU countries, the EFTA countries or the candidate countries for accession to the EU by 9 times.

CONCLUSION

The calculations proved the importance of development of network forms of cooperation for the growth of effectiveness of innovation activity of industrial companies not only at the national level, but also at the international level with a focus on the market of European countries. Herewith, the formation of effective network cooperation by domestic companies, in particular of the light industry enterprises will depend on their ability to consider the threats and take advantage of the benefits of three possible development scenarios: 1) "domination of tolling"; 2) "development of the domestic market and the market of post-Soviet countries"; 3) "European integration".

The first scenario does not provide significant changes in the situation which is observed today. Domestic producers will continue to perform the role of the production link in the value chain for European customers. Innovative changes will be reduced to the introduction of imported equipment and technology. Product

innovations will be determined by the developments of European designers and marketers. The domestic consumer market will be dominated by Asian and European producers depending on the customer segment. The demand on the labor market will be determined in favor of industrial working professions.

The second scenario provides the change in current trends towards the exclusion of foreign producers from the domestic market. Considerable attention will be paid to performing innovative tasks, the development of small innovative companies that offer high quality products at affordable prices for domestic consumers who remain sensitive to price levels. The development of domestic brands, which is implemented along with the improvement of specialization of industrial production and the development of certain market segments in post-Soviet countries. The demand for industrial professions will be replaced by significant needs for technical experts and specialists in marketing, design, innovation and network management.

The third scenario provides the broad involvement of the domestic light industry in the European economic space that will lead to the introduction of unified ecological and social standards, regulations and rules of work in the consumer markets. The improvement of environmental and social standards, strengthening of the innovation component of production, extensive use of network forms of cooperation based on information and communication technologies are expected. Domestic producers will get a certain specialization in the global value chains that will be determined by their high level of competitiveness in the domestic and foreign markets. In response to strong negative effects of globalization, especially in terms of reduction of employment in the industrial sector, the integrated strategic programs of revival of industrial jobs will be developed.

According to the characteristics of each scenario, light industry companies need to previously prepare and develop a number of innovative competences, which are able to facilitate the adaptation of existing forms of network cooperation to new conditions.

In particular, the second and third scenarios described above involve significant changes in the development of light industry of Ukraine. The scenario "Development of the domestic market and the market of post-Soviet countries" aims to transform the domestic light industry into a self-sufficient sector with high standards of production that will not depend on tolling agreements.

This will necessitate significant management innovations and the creation of highly specialized networks. Marketing innovations will consist primarily in the creation of new channels of development and promotion of products, which, in turn, should become more socially and environmentally oriented. Research and development should be focused on searching for technologies that meet the criteria of sustainable development and simultaneously take into account traditional production methods. Environmental innovations should be focused on achieving a high level of energy efficiency and emission control. The network structures of domestic companies in accordance with this scenario should develop taking into account the existing competencies of companies to update products and create environmental innovations in collaboration with scientific and educational centres focused on the domestic and partially external markets.

In the scenario "European integration", the organizational and managerial innovations aimed at the creation of a technologically advanced management system in the light industry come to the fore. To ensure them, the staff needs to master interdisciplinary knowledge, multidisciplinary skills and creative abilities. In the field of technological engineering, an important role is assigned to the control of global value chains with the use of diverse standards and meeting delivery deadlines. According to this scenario, domestic producers will be focused only on a certain specialized segment of the market. The network structures should be formed on the basis of European value chains and provide high effectiveness by optimizing costs, sharing innovations, competences and knowledge on the basis of network cooperation between domestic and European companies.

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