International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878 (Online), Volume-9 Issue-1, May 2020

Substantiation of Interaction Factors in Innovation Processes

Lisovska Lidiya, Liutak Olena, Terebukh Andrii, Mrykhina Oleksandra

Abstract: ***The article is devoted to the problems of establishing interaction in innovation processes. The authors, based on a review of scientific sources and best global manufacturing practices, argue that the formation of systems of interaction is a condition for success and efficiency in today's innovation environment. To conduct the study, a two-stage sociological surveys of businessmen who had or plan to implement an innovation partnership was conducted, which are processed by tools for statistical processing of information Five groups of factors that determine the search for a partner were identified: quality, market, information and communication, cost, property. Each of these groups of factors influences the decision-making on innovation cooperation differently. The authors put forward two hypotheses about the importance of these factors. To substantiate them, a survey of businessmen with experience in innovation partnerships was conducted. The hypothesis was confirmed. The most important factors for the partnership are the cost of innovation. In the second place, property factors were identified. Thus, according to the respondents, the lack of financial resources and own material assets necessitates the search for a partner. The most manageable factors that are easiest to influence are the group of factors information and communication and quality factors.***

Since the most significant factors are considered cost factors and property factors, the density of the relationship between the estimates of these factors for the respondents was estimated and is recognized as significant. So, respondents who value factors highly, tend to value resource factors as well.

Keywords : factors of interaction, innovation process, assessment of the importance of factors, partners

I. INTRODUCTION

Globalization challenges, changes in the way the economy and society function as a result of modern technological transformations have led to a fundamental change in the concept of innovation management, changes in the elements and stages of the process, the role, form and significance of interaction between various components of the innovation process. The quality of innovation is determined by the intensity of interaction processes. The phenomenon of cooperation in the innovation process is reflected in the indicators of competitiveness of countries that assess (or take into account in the process of determining integrated assessments) the innovation of the economies of individual countries of the world, innovation indicators are based on national statistics on collaboration activity [11].

The Global Innovation Index includes indicators of innovative relationships, the state of cluster development and public procurement of new technological products, and "Companies that perceive breakthrough ideas". Global Competitiveness Index takes into account calculations based on the index "Innovation ability" through the indicator "Cooperation with many stakeholders" [27]. Consequently, forms and methods of establishing interaction in innovative processes are becoming more important and improved. However, the question of the nature of the initial conditions that encourage different participants with different interests and goals to work together remains unresolved. The study of the nature of these initial conditions and their correct understanding should be the basis for an effective mechanism for innovative cooperation.

II. LITERATURE REVIEW

The innovation process in modern scientific research is considered as a multi-structural and multi-attributive process, so the management of its components is difficult.

The complexity of management is primarily due to the multi-structured innovation process, which can be viewed from several planes. Lacom, P., Bazzaro, F., & Sagot, J. C. (2017) distinguish in the innovation process four domains (marketing and sales; technology; legal, normative and financial; management and organization), and in four steps (exploration; assessment and decision; management of projects; capitalization) [15].

Török, Á., Tóth, J., & Balogh, J. M. (2019) emphasize the complexity of the innovation process in connection with the allocation of such a component as the innovation production, which is influenced by factors knowledge capital (value added peremployee), R&D, knowledge sharing, cooperation and networks(universities or other research institutions), absorptive capacity, firm's cooperation with suppliers and customers [28]. Onufrey, K., & Bergek, A. (2020) claim that the special complexity inherent in the innovation process in the processing industries with its multiple process stages and intermediate products, implies that product innovation does not necessarily occur in relation only to the final product but can also concern intermediate and primary products.

Manuscript received on April 30, 2020.
Revised Manuscript received on May 06, 2020.
Manuscript published on May 30, 2020.
* Correspondence Author
Lidiya Lisovska, Associate Professor, Department of Management of Organizations, Lviv Polytechnic National University, Lviv, Ukraine. lida_lissovcka@ukr.net
Olena Liutak, Professor**,** Department of International Economic Relations, Lutsk National Technical University, Lutsk, Ukraine. o.liutak@lntu.edu.ua
Andrii Terebukh, Professor , Department of Tourism, Lviv Polytechnic National University, Lviv, Ukraine. andriy_terebyh@ukr.net
Oleksandra Mrykhina, Associate Professor, Department of Business Economics and Investments, Lviv Polytechnic National University, Lviv, Ukraine. oleksandramrykhina@gmail.com

That is why a study of innovation in process industries needs to take into consideration both the primary process stage with its resulting primary product and the final process stage with its resulting final product [21].

Dziallas, M., & Blind, K. (2019) investigated the variety of indicators and factors during the implementation of the innovation process in scientific research for 35 years at the country level¸ at the industry level. The authors highlighted 82 product and process indicators and factors to evaluate innovations throughout the innovation process. Special attention is paid to the early stages of the innovation process, since it is the initial stages of the innovation process that determine the success and quality of innovations [7].

Miklovda&Latynin& Fialkovskyi, 2019 consider the innovation process at the regional level and identify such factors of development of the regional economy as a synergetic system as antecedents, current and forward. Factors are determined by the stages of the system functioning [19]. Another aspect of the modern innovation process is the growing number of participants. Considering the growing number of stakeholder groups involved in the innovation process Martinez, J. M. G., de Castro-Pardo, M., Pérez-Rodríguez, F., & Martín, J. M. M. (2019) propose Multi-Criteria Decision Making methods (MCDM), that allows us to generate knowledge about the stakeholders' preferences in a protected area and to ensure the knowledge transfer between decisional levels. In addition, the method allows us to identify discrepancies between stakeholders' groups related to the priorities of the management team [18].

The components of the innovation process are highlighted according to Utterback, J. M., & Abernathy, W. J. (1975), will change systematically depending on the firm's environment, competition strategy and growth strategy, as well as on the state of development of technological technologies used by the firm and its competitors [29].

Du Preez, N. D., & Louw, L. (2008, July) in a study of five generations of innovation process models [6], proved this dynamic of innovation process parameters in detail.

Such changes affect the justification of the tasks of the innovation process, which should include a wide range of tasks, as noted by Fingar, P (2012) [9].

Philipson, S. (2020) argues that changes in innovation process models have also affected the sources of innovation. It is necessary to differentiate between the mere competence to find solutions to a needs problem in general, and actually producing innovative knowledge that satisfies needs in radically new ways, and uses a term phenotype here to denote the strategic repertoire of innovation sources available to a firm [22].

Many scientific studies have been devoted to the issues of establishing cooperation. Karyy, O.I., Podvalna, H.V. (2016) highlighted the existence of significant competitive advantages associated with the establishment of long term [13].

Bigliardi, B., Colacino, P., & Dormio, A. I. (2011) note that one of the main obstacles that companies face during the development and implementation of innovations is the difficulty of establishing partnerships with other companies, financial problems and lack of resources in the company [5]. Particularly striking examples of changes in the types and objects of relationships can be traced in the model of "Open innovation". Öberg, C., & Alexander, A. T. (2019) study as a form of interaction between the internal and external processes of knowledge transfer within the innovation ecosystem. Joint implementation of the innovation process to create new value is the task of forming the company-to-company linkages between firms. The authors investigated different forms of interpersonal relations, cooperation, and business relationship connects, along with corporate governance structures to facilitate knowledge creation, transfer, and sharing [20].

Franco, M., & Esteves, L. (2018) aimed to understand the relationship between clusters and how this type of network is seenas a mechanism for the share of knowledge and learning. The authors distinguish six types of cluster by research areas and location [10].

Anzola-Román, P., Bayona-Sáez, C., & García-Marco, T. (2019) investigate the factors of success in establishing joint work in three areas of the innovation process that are important (i.e. research and development, production development and commercialization of innovation). At the stage of research and work, the factor that contributed to the success of the overall development of innovations with an external partner was intra-company collectivism and teamwork. At the implementation stage, the authors highlight the factors of openness and permeability through building relationships and communications with external actors, at the commercialization stage – the factor of focusing on their customers and devoting resources to promote their loyalty [2].

Hosseini, S., Kees, A., Manderscheid, J., Röglinger, M., & Rosemann, M. (2017) note such factors of influence on the success of joint work in innovation as factors of strategic coordination, cultural factors and factors of human resource management [12].

Belderbos, R., Gilsing, V., Lokshin, B., Carree, M., & Sastre, J. F. (2018) studied the problems of R&D and R&D collaboration, recognizing the close relationship between the formation of R&D collaborations and organization of innovative production, and claimed that the adaptation of R&D collaboration portfolios follows distinctly different patterns depending on the type of partner. The authors proved that there is strong heterogeneity in how different partner types influence the formation of R&D collaboration with new partner types [4].

Abbas, A., Avdic, A., Xiaobao, P., Hasan, M. M., & Ming, W. (2019) consider the interaction of universities and government in the knowledge segment where they act as a source of new knowledge generation for industrial innovative product development and regional based research activities [1]. Ryan, J. C., & Daly, T. M. (2019) studied the problems of improving the efficiency of research and innovation processes through investment and expanding support for business and social research [25].

The development of modern models is often viewed from the perspective of the triple helix model. The "Triple Helix of University-Industry-Government Relations" (TH) model based on selection of the three main functions in the innovation process: demand, supply, and technological capabilities. This model is no longer neo-institutional — that is, about networks of agents — but neo-evolutionary, since it is about the interactions among selection environments [16].

Fernández-Esquinas, M., Pinto, H., Yruela, M. P., & Pereira, T. S. (2016) investigate the factors of establishing interaction within the framework of "Triple Helix of University-Industry-Government Relations" (TH) model between universities and firms.

From the point of view of firms, the authors consider three groups of impacts. The first group concerns the so-called structural elements of a firm, such as its size, age, and sector of activity. The second group of factors indicates the importance of strategic search for a firm; the third group is related to the opportunities available to firms to establish relationships with the academic sector. They can be called "situational factors" because they are related to the social and economic structure in which the firm is located. Networks and trust between agents from different sectors are important factors affecting University and industry connections [8].

Expanding the boundaries of interaction systems involves the inclusion of non-classical participants. For example, Mansoori, Y., Karlsson, T., & Lundqvist, M. (2019) study the dynamics of entrepreneur-coach relationships in a university-based accelerator based on the lean startup methodology [17].

Romana Rauter, Dietfried Globocnik, Elke Perl-Vorbach, Rupert J. Baumgartner (2019) focused on the questions of influence of collaboration with external partners influenced a company's economic innovation performance (EIP) and sustainability innovation performance (SIP). The authors insist on the feasibility of attracting of intermediaries or NGOs who might have a mutual interest in improving the outcome of companies, particularly with respect to sustainability. Such participants will help businesses overcome failures in innovation by providing specific information and knowledge beneficial for the firm's innovation activities [24].

III. RESEARCH OBJECTIVES AND HYPOTHESIS

The concepts and types of interaction are studied at different levels of management and types of economic activity in detail. This issue was particularly relevant for studying in innovation processes. However, in order to create effective mechanisms for establishing interaction between potential participants, it is necessary to understand the nature of the problem and the forces that prompt the search for a partner to solve them.

Variables of the study

Despite the results of the theoretical justification and review of scientific sources the factors of interaction should be studied and justified on the basis of the involvement of such variables as

Innovation process is a set of stages of joint work (actions and interactions) of individual subjects or communities on the transformation of new or existing knowledge into innovation, combining efforts and interests on the principles of openness of ideas and knowledge, inter-interpenetration of activities.

Interaction is a set of coordinated relationships between two or more subjects or groups of subjects on the implementation of joint activities for the purpose of achieving common goals based on the principles of mutual benefit, a reasonable form of participation and synergy of efforts.

Interaction in innovation processes is a set of relations between subjects of innovative activity for the creation, development, use and dissemination of innovations, aimed at combining the resources of these subjects to improve the efficiency and effectiveness of the innovation process

Hypothesis of the Study

The original hypothesis was formulated by previous scientists and can be defined as:

To increase the efficiency of innovation processes, subjects establish systems of interaction of various types. Different factors have different power and influence on the interaction processes for different participants

H1a: Value factors are most likely to cause the need for interaction

H2b: Establishing interaction in innovation processes is caused by the lack of own resources to create new value

IV. RESEARCH METHODOLOGY

The proposed study is based on the use of a survey to assess the importance of interaction factors. Grouping and allocation of groups of factors was based on the analysis of scientific works of scientists and a survey of experts in the field of innovation.

The survey tool was a questionnaire that included two parts. The first part provided for the selection of factors that determine or predetermined the search for partners for experts in the past experience.

The second part of the questionnaire was intended to determine the importance of the factors highlighted in the first part for the interviewed experts when establishing interaction.

To determine the factors that cause the search for partners in innovative cooperation, a survey was conducted during face-to-face meetings with respondents. The survey involved businessmen who had experience in innovative partnerships or those businessmen who plan to carry out such a search. The survey involved 25 respondents in the Western regions of Ukraine in 2019-2020.

To confirm the reliability of the obtained estimates, it should be noted that the sample includes only those companies that have experience in partnership activities.

To make sure that our sample of this population is representative, we used a formula for the case when the population is known by researchers:

$$n = \frac{t^2 * V^2 * N}{V_x^2 * N + t^2 * V^2} \quad (1)$$

where n - the size of the training data set, N - the size of the whole data set, Vx - the level of accuracy, t - the level of reliability, V - the variance of the function under study.

The specified confidence level for the normal distribution table is P=0.95, t=1.96. V=0.5, since this gives the maximum variance: 0.5*0.5= 0.25. The resulting indicator for the sample size will be overestimated, which gives additional reliability of the results.

$$n = \frac{1{,}96^2 * 0{,}5^2 * 114}{0{,}25_x^2 * 114 + 1{,}96^2 * 0{,}5^2} = 25$$

The sample of n = 25 respondents is representative of the conditions, taking into account the population of N = 114 events, the confidence level of 95%, which corresponds to the table t-test equal to 1.96, the specified coefficient of change of signs Vx = 0.25, and the confidence interval level of the survey results V = 0.15.

Therefore, according to the calculation below, the sample size is 25 respondents. The research tool was a questionnaire that consisted of 20 closed questions of a meaningful nature and 4 questions of a personal nature.

To perform the research, we used methods and tools for conducting sociological surveys and tools for statistical processing of information.

V. RESEARCH FINDINGS

As a result of studying the practical experience of forming effective business models of innovation and the analysis of scientific sources, we identified five main groups of factors that stimulate the search for a partner in innovation: cost, property, information and communication, quality, and market.

Cost factors are formed by the costs of implementing the stages of the innovation process, and their indicator is measured in cost units. The cost factors include the amount of costs for completing the stages of the innovation process; the cost of attracting credit resources (borrowed funds); the cost of attracted resources; the ability to mobilize resources; the lack of funding from sources outside the enterprise.

The costs of innovation processes are associated with research and design work; with the production of a prototype; laboratory and market testing of innovative products; technological preparation for the production of innovative products and with the promotion of products to the market and further distribution.

Financial resources in the form of borrowed or borrowed funds, funds received for non-returnable use, funds received for the implementation of a specific order, as well as in the form of the enterprise's own resources can be used for innovation activities. Due to the high risk of innovation processes, the cost of financing them is high.

Thakur-Wernz, P., Bruyaka, O., & Contractor, F. (2020) investigate the costs of research and development activities, and claim that cost motives will be less salient in technology sourcing as they are in sourcing for NPD [26].

Cost factors need to include both the internal factors (the peculiarities of innovative activities in the enterprise, innovative enterprise product system innovation management) and environmental factors (the rate of credit resources for financing, the level of profitability of the domestic market of bonds, stocks).

Cost factors are closely related to other factors and affect other groups of factors. The amount of innovation costs determines the level of quality factors, the level of security of the subject's property and the completeness of information support, and setting up communications with other market counterparties.

Property factors related to the volume and availability of property of the subject of innovation are also very important for the implementation of innovation processes. To property, we include funds and labour items, as well as intangible assets. The group of property factors includes: the availability of own fixed assets (working capital) for the introduction/production of innovative products, the availability of intangible assets(patent, copyright, design rights, production secrets (know-how), trademarks, service marks), the availability of basic and auxiliary research equipment. Information and communication factors are important for the development of innovative processes and the formation of interaction systems: the formation of a system of information exchange between the organization and the external environment, the introduction of modern information systems. Information and communication factors should form cooperation with the company's contractors, a circle of strategic consumers has been formed and distribution channels have been established, and so on.

Kijek, T., & Kijek, A. (2019) note in their research on dominant route by which information and communication technology contributes to innovation and hence to productivity as well as the quality of firms' human resources influences on success of innovation [14].

Information and communication factors include: volumes of information about technology; volumes of information about markets; unformed circle of strategic consumers; smoothness of distribution channels; parameters of the database about the market as a whole and individual buyers; the level of external and internal communication systems; the level of popularity in the market and among market participants (company reputation, customer base, customer commitment, order portfolio, franchise agreements, license agreements).

Quality factors are those conditions for the implementation of the innovation process that are ensured by compliance with the requirements of quality management. Quality factors are therefore determined not only by the quantitative composition of the staff, which is directly or indirectly related to the innovative activity of the enterprise, but also by its qualitative characteristics, i.e. the combination of creative abilities, problem-solving skills, leadership qualities, entrepreneurial and managerial skills of the staff. So, the quality factors in this study have many compatible features with the factors of formation of the intellectual capital of the subject of innovation.

Quality factors that form the need for interaction include: sufficiency of employees; production experience; insufficient (lack) of scientific and technical base; the level of efficiency of enterprise management; the level of efficiency of establishing a supply chain; the level of collective knowledge of employees of the enterprise, their creative abilities, problem-solving skills, leadership qualities, entrepreneurial and managerial skills; the level of cross-functional cooperation in R&d; experience in marketing innovations.

Market factors include environmental factors that provide the company with a stable competitive advantage. Partnerships with advertising agencies and other marketing intermediaries complement the company's resources with their skills and experience. In addition, the market factors should include the level of development of innovation infrastructure, indicators of demand for innovations (the size of demand, the dynamics of demand).

Therefore, market factors should take into account: the number of specialized intermediary agencies (venture companies, marketing and advertising agencies); the development of innovation infrastructure; the level of competition in the market; the demand for innovative products; the dynamics of demand for innovation.

If cost factors can be clearly attributed to objective factors of interaction, then quality, market and information and communication factors-to mixed (depending on the methods of evaluation) or subjective.

VI. DATA ANALYSIS AND INTERPRETATION

To conduct the research, a questionnaire was formed with questions about the importance of the selected factors for establishing interaction in innovative processes for businesspeople. Selected group of factors proposed to rate on a 10-point scale, where 0 is no weight, 1 is the lowest importance for respondents, 10 is the greatest weight factor for interaction.

We used a set of application programs "Statistica (version 10)" to process the data received from the questionnaires.

The results of the evaluation are shown in Fig.2 and Fig.3. and in table 1. For Fig.2. the rounded data of estimates are presented, and in table.1. accurate estimates that should be used to generate research results.

Table I - Summary of the survey results on the importance of interaction factors (compiled based on surveys of authors)

Variable	Descriptive Statistics (Spreadsheet1.sta)					
	Valid N	Mean	Median	Mode	Frequency of Mode	Minimum
Information and communication	25	4,680000	5,000000	Multiple	5	1,000000
Market	25	7,040000	7,000000	7,000000	11	5,000000
Quality	25	6,760000	7,000000	7,000000	9	3,000000
Cost	25	8,600000	9,000000	9,000000	8	7,000000
Property	25	8,160000	8,000000	Multiple	7	6,000000

Variable	Descriptive Statistics (Spreadsheet1.sta)				
	Maximum	Lower Quartile	Upper Quartile	Variance	Std.Dev.
Information and communication	7,00000	3,000000	6,000000	2,976667	1,725302
Market	10,00000	6,000000	7,000000	2,456667	1,567376
Quality	9,00000	6,000000	8,000000	2,773333	1,665333
Cost	10,00000	8,000000	9,000000	1,166667	1,080123
Property	10,00000	7,000000	9,000000	1,223333	1,106044

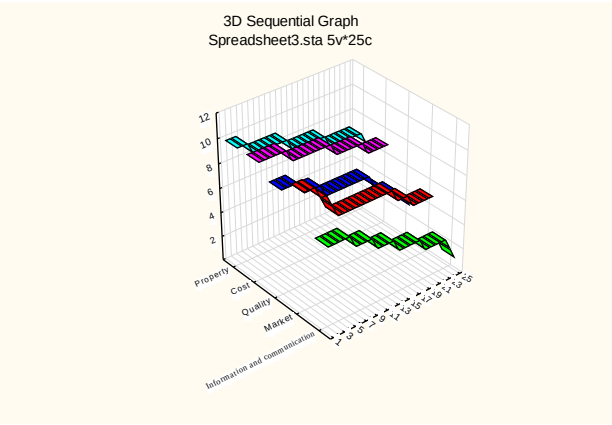

Fig.1. Graphical representation of the assessment of the weight of factors that determine the need to find a partner in innovation (compiled based on surveys of authors)

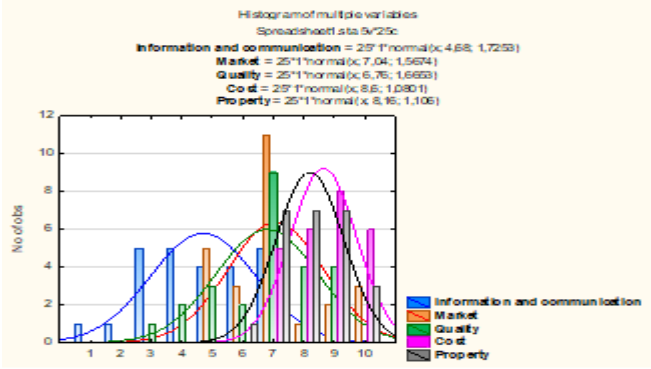

Fig.2. Graphical representation of the assessment of the weight of factors that determine the need to find a partner in innovation (compiled based on surveys of authors)

In general, the importance of factors is represented as an average in the Mean column, and the average value gives a generalized estimate.

H1a: Cost factors are most likely to cause the need for interaction

To prove this hypothesis, let us look at the respondents' estimates. The respondents rated the most important 8.6 cost factors, in particular, the high cost of innovation and the high cost of attracting credit resources in the financial resources market. In second place – property factors (8.16 points). The group of property factors, which are rated as the second most important factors, includes the lack of own resources for innovation, and the lack of qualified employees. Market criteria that encourage attracting partners include a high level of competition in the market and low demand for innovative products. Market factors rank third in importance for the surveyed businesspersons at 7.04 points, and quality factors are rated at 6.76 points. Moreover, accordingly, information and communication factors take the fifth place with 4.68 points. Such assessment results are quite consistent with the data of statistical observations in Ukraine and the experience of innovative cooperation of the surveyed businesspersons.

The cost factors are both most valued, and most often, so think the respondents, the opinions of the respondents are most consistent regarding the high valuation. Therefore, the hypothesis is confirmed.

In terms of information and communication factors, respondents ' opinions differ greatly. The set of responses is not uniform, and the average value of 4.68 is not typical for this set.

The distributions of estimates in Fig. 3 for quality, cost and market factors, which are qualitatively homogeneous aggregates, are single-vertex.

Among the single-vertex, distributions are symmetrical and asymmetrical (bevelled), acute and flat-vertex.

Asymmetry occurs due to limited variation in one direction or under the dominance of the cause of development, which leads to a shift in the centre of distribution.

Calculate the asymmetry coefficient (according to Pearson) [30] for these factors.

$A_{squality} = \frac{6,76-7}{1,665} = -0,14$, hence, the asymmetry is left-handed.

$A_{sMarket} = \frac{7,04-7}{1,57} = 0,25$, hence, the asymmetry is right-handed.

$A_{scost} = \frac{8,6-9}{1,08} = -0,37$, hence, the asymmetry is left-handed.

The distributions for information and communication and property factors are threefold. This indicates the heterogeneity of the population, the combination of groups with different levels of activity.

To characterize the distribution of estimates for these groups of factors, we use the calculation of the asymmetry coefficient and the kurtosis coefficient (table II).

Table II - Calculation of the asymmetry coefficient and the excess coefficient (compiled based on surveys of authors)

Name of the indicator	Value of the indicator for property factors	Indicator value for information and communication technology factors
primary moment of the first order	3,16	-0,32
primary moment of the second order	17,48	47,92
primary moment of the third order	85,72	141,04
primary moment of the IV order	424,52	295,6
central moment of the first order	0	0
the central moment of the second order	1,1744	48,4576
central moment of the third order	0,072192	42,87206
the central moment of the IV order	2,892754	45,36486
asymmetry coefficient	0,053361	8,352319
coefficient of excess	-1,06674	2,123458

The coefficient of excess for information and communication factors confirms the acute-peak distribution (E_x>0), and for property factors - flat-peak distribution (E_x<0). The asymmetry coefficient for information and communication factors indicates right-sided high asymmetry, and for property factors - right-handed low asymmetry.

The obtained results of assessing the importance of the factors of interaction were supplemented by calculating the coefficient of variation by groups of factors and are presented in table 3.

Table III - Indicator of the coefficient of variation of estimates of the importance of interaction factors (compiled based on surveys of authors)

Groups of indicators	Average, points	Dispersion	Standard deviation	Coefficient of variation,%
inform-communic	4,680000	2,976667	1,725302	36,86543
market	7,040000	2,456667	1,567376	22,26386
quality	6,760000	2,773333	1,665333	24,6351
cost	8,600000	1,166667	1,080123	12,55957
resource	8,160000	1,223333	1,106044	13,55446

If the coefficient of variation, %, is less than 30 (33%), then the experts did not reach a common point of view and did not agree. The largest coefficient of variation is calculated for information and communication factors and market factors. However, the cost and property factors that have the lowest coefficient of variation. So, the most manageable factors that are easiest to influence are the group of factors information and communication and quality factors.

Since the most significant factors are considered cost factors and property factors, the density of the relationship between the estimates of these factors for the respondents was estimated.

H2b: Establishing interaction in innovation processes is caused by the lack of own resources to create new value.

To justify this hypothesis, we need to answer the question: do respondents who value factors highly tend to value resource factors as well?

The analysis of relationships between attribute attributes is carried out based on tables of mutual conjugacy formed as a result of combinational grouping by factor and effective features.

If the number of groups by factor (m_x) does not match the number of groups by result (m_y), it is recommended to use the coefficient of conjugation of Cramer [23]**:**

$$C = \sqrt{\frac{\chi^2}{n(m_{min}-1)}}, \quad (2)$$

where m_{min} – minimum number of groups by factor or performance criteria, χ^2 – Pearson's quadratic conjugation, n – volume of totality

Due to this heterogeneity, it is advisable to study the distribution of evaluation results according to Fig.3.

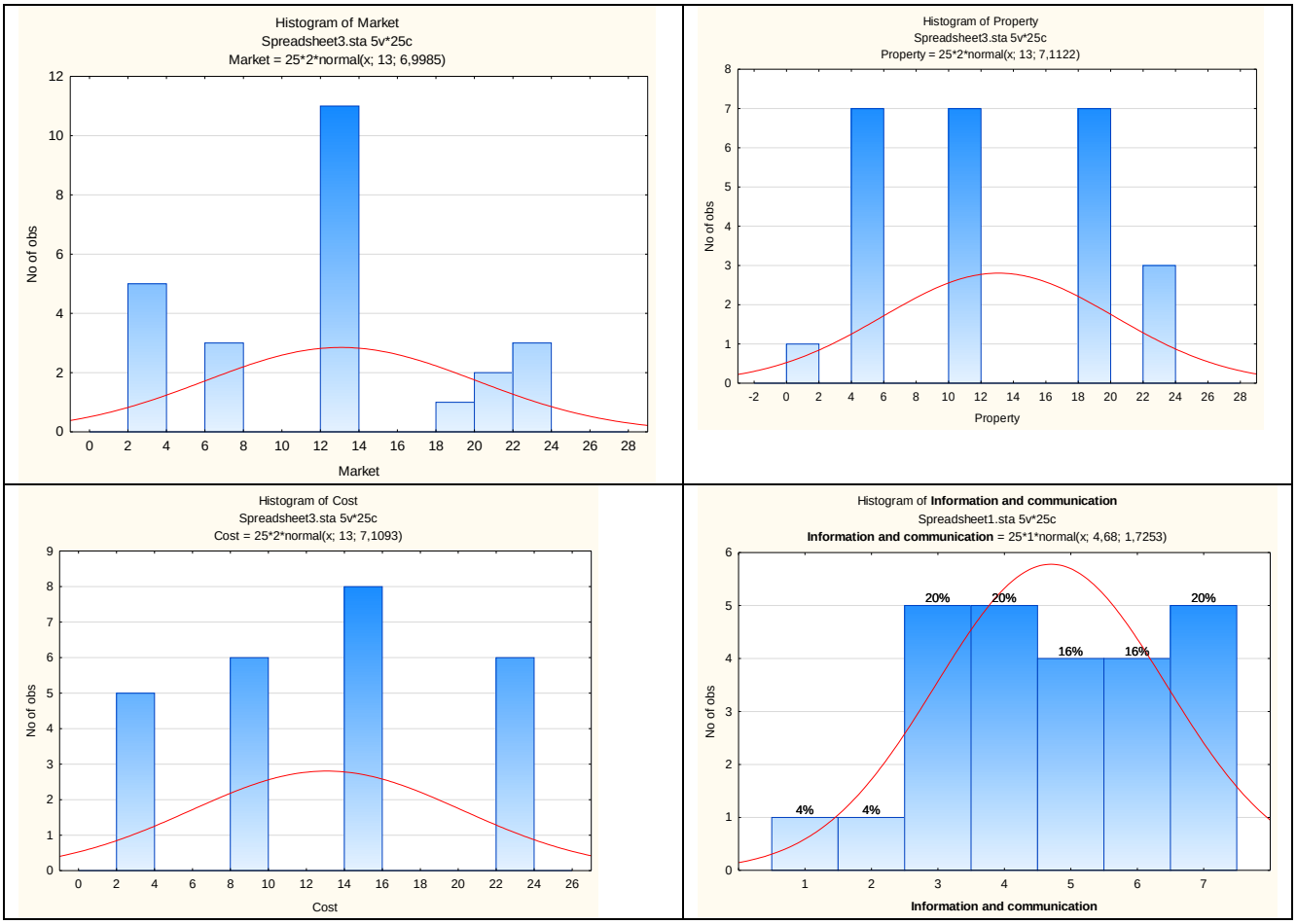

Fig.3 Histograms of the distribution of estimates of factors that determine the need to find a partner in innovation (compiled based on surveys of authors)

If the coefficient of variation, %, is less than 30 (33%), then the experts did not reach a common point of view and did not agree. The largest coefficient of variation is calculated for information and communication factors and market factors. However, the cost and property factors that have the lowest coefficient of variation. So, the most manageable factors that are easiest to influence are the group of factors information and communication and quality factors.

Since the most significant factors are considered cost factors and property factors, the density of the relationship between the estimates of these factors for the respondents was estimated.

Pearson's quadratic conjugation characterizes the degree of similarity of the distributions of factor and result traits [3].

Table IV - Combined distribution of respondents ' responses regarding the importance of a group of resource factors and a group of cost factors, % (compiled based on surveys of authors)

Points	Number of responses, units.					Together
	Resource 6 points	Resource 7 points	Resource 8 points	Resource 9 points	Resource 10 points	
Cost 7 points	1	4				5
Cost 8 points		3	3			6
Cost 9 points			4	4		8
Cost 10 points				3	3	6
Together	1	7	7	7	3	25

Its calculation is based on the deviations of the frequencies of conditional and unconditional distributions. The value of the conjugation coefficient varies from 0 to 1 and characterizes the bond density. If there is no connection, then $\chi^2 = 0$, and accordingly C=0.

$$\chi^2 = 25\times\left[\frac{1^2}{5x1}+\frac{4^2}{7+5}+\frac{3^2}{7+6}+\frac{3^2}{7+6}+\frac{4^2}{7+8}+\frac{4^2}{7+8}+\frac{3^2}{7+6}+\frac{3^2}{3+6}-1\right]=5{,}43$$

Since $\chi^2 > 0$, you can make a preliminary conclusion about the presence of a relationship between the studied features.

$m_x=4$; $m_y=5$, 4 – min number of groups

$$C=\sqrt{\frac{5{,}43}{25(4-1)}}=0{,}269.$$

Checking the significance of the relationship between attribute attributes is reduced to comparing the actual value χ^2 with its critical (table) value:

$$\chi^2_{1-\alpha}(k) \quad (3), \qquad x^2_{1-\alpha}(k) \quad (4)$$

where α is the level of significance, k is the number of degrees of freedom.

The number of degrees of freedom is calculated using the formula:

$$k=(m_x-1)(m_y-1), \quad (5)$$

If the actual value χ^2 б is greater than the critical value $\chi^2_{1-\alpha}(k)$, then the hypothesis about the random nature of the relationship is rejected, that is, the relationship between the features for a given probability 1-α is recognized as significant.

$$k = (4-1)(5-1) = 12 \qquad \chi^2_{0,95}(12)= 5,23.$$

So, the second hypothesis is confirmed.

VII. CONCLUSION

Modern conditions for accelerating innovation processes and growing consumer demands complicate the processes of their independent implementation by individual entities.

Successful are those participants who enter into the joint implementation of the stages of the innovation process.

The study identified five groups of factors that motivate interaction: quality factors, market, information and communication, value and property. Factors of cooperation were evaluated in order to be important in forming a management decision for businessmen.

The most important were the factors of value and property, which are evaluated by the highest number of points and with the lowest coefficient of variation. The evaluation results were investigated using the indicators of distribution, the coefficient of asymmetry and the coefficient of excess, the coefficient of variation.

The relationship between value factors and property factors was also assessed and confirmed by calculating the Cramer conjugation coefficient.

The following studies need to determine the strength of interest of different participants in the implementation of certain factors of interaction. Assessment of factors should be the basis for the formation of a mechanism of interaction in innovation processes at different levels of government and the development of innovative strategies for the development of individual territories or innovation environment.

LIMITATIONS

The study was carried out taking into account the following list of restrictions:

The study was carried out within the framework of Ukraine, so to generalize its conclusions, it is advisable to expand it to the borders of Eastern Europe and justify the criteria for establishing innovative cooperation for their comparative analysis;

The conducted research is based on a survey of only representatives of one group of stakeholders, namely businessmen who have experience in innovative partnerships. To increase the reliability of the survey, you need to interview more representatives of such groups as scientists, government representatives, and public organizations.

It should also be noted that the power of influence and interest in providing these factors will differ for different types of activities. Interaction factors in it product development systems have a different content than in construction.

The above list of limitations obliges us to emphasize the impossibility of fully transferring conclusions to the development of a universal and unified approach to the formation of a mechanism for establishing interaction. However, a classification of factors has been developed and the possibility of using them to build a matrix of managerial decision-making can be used as the basis for creating a model of innovation cooperation.

REFERENCES

1. Abbas, A., Avdic, A., Xiaobao, P., Hasan, M. M., & Ming, W. (2019). University-government collaboration for the generation and commercialization of new knowledge for use in industry. Journal of Innovation & Knowledge, 4(1), 23-31.
2. Anzola-Román, P., Bayona-Sáez, C., & García-Marco, T. (2019). Profiting from collaborative innovation practices: Identifying organizational success factors along the process. Journal of Management & Organization, 25(2), 239-262.
3. Belousov, B., & Peters, J. (2017). f-Divergence constrained policy improvement. arXiv preprint arXiv:1801.00056.
4. Belderbos, R., Gilsing, V., Lokshin, B., Carree, M., & Sastre, J. F. (2018). The antecedents of new R&D collaborations with different partner types: On the dynamics of past R&D collaboration and innovative performance. Long Range Planning, 51(2), 285-302.
5. Bigliardi, B., Colacino, P., & Dormio, A. I. (2011).Innovative characteristics of small and medium enterprises. Journal of Technology Management & Innovation, 6(2): 83-93.
6. Du Preez, N. D., & Louw, L. (2008, July). A framework for managing the innovation process. In PICMET'08-2008 Portland International Conference on Management of Engineering & Technology (pp. 546-558). IEEE.
7. Dziallas, M., & Blind, K. (2019). Innovation indicators throughout the innovation process: An extensive literature analysis. Technovation, 80, 3-29.
8. Fernández-Esquinas, M., Pinto, H., Yruela, M. P., & Pereira, T. S. (2016). Tracing the flows of knowledge transfer: Latent dimensions and determinants of university–industry interactions in peripheral innovation systems. Technological Forecasting and Social Change, 113, 266-279.
9. Fingar, P (2012) The Innovation Process (Adapted from the book, Business Innovation in the Cloud: Executing on Innovation with Cloud Computing).// https://www.bptrends.com/publicationfiles/06-05-2012-COL-EXT%20COMPETITION--Innovation%20Process-Fingar-Final.pdf
10. Franco, M., & Esteves, L. (2018). Inter-clustering as a network of knowledge and learning: Multiple case studies. Journal of Innovation & Knowledge.
11. Highlights from OECD Innovation Indicators 2019 URL:https://www.oecd.org/sti/inno/innovation-indicators-2019-highlights.pdf
12. Hosseini, Sabiolla, Kees, Alexandra, Manderscheid, Jonas, Roglinger, Maximilian, & Rosemann, Michael (2017) What does it take to implement open innovation? Towards an integrated capability framework. Business Process Management Journal, 23(1), pp. 87-107.
13. Karyy, O.I., Podvalna, H.V. Relationship marketing of automobile transportation companies: The need of establishing mutual understanding with a client // Actual problems of economics. 2016. # 10(184). Pp.149-158
14. Kijek, T., & Kijek, A. (2019). Is innovation the key to solving the productivity paradox?. Journal of Innovation & Knowledge, 4(4), 219-225.
15. Lacom, P., Bazzaro, F., & Sagot, J. C. (2017). Proposal of a Modelling of the Innovation Process in an International Manufacturing Company. Journal of technology management & innovation, 12(2), 26-33.
16. Leydesdorff, L., & Ivanova, I. (2016). "Open innovation" and "triple helix" models of innovation: can synergy in innovation systems be measured?. Journal of Open Innovation: Technology, Market, and Complexity, 2(1), 1-12.
17. Mansoori, Y., Karlsson, T., & Lundqvist, M. (2019). The influence of the lean startup methodology on entrepreneur-coach relationships in the context of a startup accelerator. Technovation, 84, 37-47.

18. Martinez, J. M. G., de Castro-Pardo, M., Pérez-Rodríguez, F., & Martín, J. M. M. (2019). Innovation and multi-level knowledge transfer using a multi-criteria decision making method for the planning of protected areas. Journal of Innovation & Knowledge, 4(4), 256-261.
19. Miklovda, V. P., Latynin, K. I., Fialkovskyi, A. R. (2019). Faktory rozvytku rehionalnoi ekonomiky v konteksti systemnoi paradyhmy [Factors of regional economy development in the context of systemic paradigm] Bulletin of Lviv Polytechnic National University. Series: Problems of Economics and Management, 2019, Issue 4, C. 68–74. [in Ukrainian]. Retrieved from http://science.lpnu.ua/sites/default/files/journal-paper/2019/nov/19807/vse001-70-76.pdf
20. Öberg, C., & Alexander, A. T. (2019). The openness of open innovation in ecosystems–integrating innovation and management literature on knowledge linkages. Journal of Innovation & Knowledge, 4(4), 211-218.
21. Onufrey, K., & Bergek, A. (2020). Second wind for exploitation: Pursuing high degrees of product and process innovativeness in mature industries. Technovation, 89, 102068.
22. Philipson, S. (2020). Sources of innovation: Consequences for knowledge production and transfer. Journal of Innovation & Knowledge, 5(1), 50-58.
23. Ryzhov, S., Robich, M. P., Roberts, D. J., Favreau-Lessard, A. J., Peterson, S. M., Jachimowicz, E., ... & Sawyer, D. B. (2018). ErbB2 promotes endothelial phenotype of human left ventricular epicardial highly proliferative cells (eHiPC). Journal of molecular and cellular cardiology, 115, 39-50.
24. Romana Rauter, Dietfried Globocnik, Elke Perl-Vorbach, Rupert J. Baumgartner (2019) Open innovation and its effects on economic and sustainability innovation performance, Journal of Innovation & Knowledge, 4(4), 226-233.
25. Ryan, J. C., & Daly, T. M. (2019). Barriers to innovation and knowledge generation: The challenges of conducting business and social research in an emerging country context. Journal of Innovation & Knowledge, 4(1), 47-54.
26. Thakur-Wernz, P., Bruyaka, O., & Contractor, F. (2020). Antecedents and relative performance of sourcing choices for new product development projects. Technovation, 90, 102097.
27. The Global Competitiveness Report 2019. URL:https://www.globalinnovationindex.org/gii-2019-report
28. Török, Á., Tóth, J., & Balogh, J. M. (2019). Push or Pull? The nature of innovation process in the Hungarian food SMEs. Journal of Innovation & Knowledge, 4(4), 234-239.
29. Utterback, J. M., & Abernathy, W. J. (1975). A dynamic model of process and product innovation. 1975, 3(6), 639-656.
30. Wiedermann, W., & Hagmann, M. (2016). Asymmetric properties of the Pearson correlation coefficient: Correlation as the negative association between linear regression residuals. Communications in Statistics-Theory and Methods, 45(21), 6263-6283.

AUTHORS PROFILE

Lisovska Lidiya, Candidate of Sciences (Economics), Associate Professor, Associate Professor of the Department of Management of Organizations, Lviv Polytechnic National University. Author of more than 130 scientific and methodological works, including monographs, co-authored and published textbooks, published in Ukraine and in foreign editions. Research interests: innovation activity, quality management, competitiveness management, interaction in innovation processes.

Liutak Olena, Doctor of Economics, Professor, Professor, Department of International Economic Relations, Lutsk National Technical University. Research interests: global institutionalization of services, international tourism, regulation of the development of world markets for food and non-food products; innovation-investment potential, regional policy of cross-border cooperation, tourist-recreational potential of the cross-border region.

Terebukh Andrii, DSc in Economics, Professor, Head of Tourism Department, Lviv Polytechnic National University, Lviv, Ukraine. Author of more than 180 scientific works, including monographs, articles, textbooks, published in Ukraine and abroad. Research interests: Substantiation of economic decisions in the tourism industry on the basis of sustainable development, assessment of tourism potential.

Mrykhina Oleksandra, Doctor of Sciences (Economics), Associate Professor, Professor of the Department of Business Economics and Investments, Lviv Polytechnic National University. Author of more than 120 scientific and methodological works, including monographs, co-authored and published textbooks, published in Ukraine and in foreign editions. Research interests: investment and innovative activity of the enterprises, transfer of technologies, intellectual capital.