Optimization of the System of Monitoring the Effectiveness of Venture Investments

Larysa Ivanchenkova, Inna Sysoieva, Julia Ratushna, Tetiana Kotenko, Nataliia Baistriuchenko, Yurii Melnyk

Abstract: ***The paper discusses real examples of venture capital firms that have reached a high level, as well as start-ups that have not yet managed to become mature companies. The paper presents statistical data on venture investments in the form of tables and graphs for clarity and simplification of the perception of numerical data. The process of evaluating venture capital enterprises is described, which allows you to decide to invest money in a project or abandon such a decision. In the course of the research, scientific, comprehensive literature, periodical informational publications, and Internet resources of various types were used: websites of venture funds, Internet blogs of famous business angels, research articles on venture investment. The choice of diverse literature made it possible to approach the questions of research critically, which helped to ensure an independent assessment. Besides, scientific calculations were used from related fields - marketing, economic psychology, management, which allowed us to consider the topic from different angles, illuminating the subject and object of research from new perspectives.***

The economic and mathematical model for assessing the impact of venture network actors on the commercialization of innovative products at the regional level consists of the following indicators: advanced manufacturing technologies used; volume of innovative goods, works, services; the number of personnel engaged in research and development; grant of patents; amount of investment; domestic current expenditure on research and development; share of investments in 1 private equity and venture capital fund; share of expenses of the first organization for research and development.

Keywords : Actors, Effectiveness, Monitoring, Venture Investments.

I. INTRODUCTION

In the age of high technology, it is impossible to imagine the development of technogenic thought without sound financial investments. In recent history, there are many examples of the development of entire scientific institutes and centres generated by the competent merger of great technical minds and effective management [1-5]. There are examples when small firms, as a result of a combination of investments and intellectual activity, turned into global companies. This means that venture capital investments do not go unnoticed, but rather, as a relatively new and fresh phenomenon, they make it possible to develop the ingenious idea into a large profitable corporation, like a small kernel into a sizeable fruitful tree. But for such a transformation, it is necessary to go through many important stages from the "sowing stage" to the maturity stage [6-8]. And only a few companies achieve it through several rounds of selection. Therefore, for the successful development of a young enterprise - start-up to a venture company and then to a successful company, you need to understand how to behave at each stage of such a difficult process to different business participants - investors and entrepreneurs. Venture capitalists, in turn, are essential to understand how much return they can expect from a particular venture company, taking into account unique internal and external factors. For this, you can use not only the financial assessment of the company but also its strengths and weaknesses, for example, using SWOT analysis [9-11].

Considering that the investor and the entrepreneur will act expediently with the stage at which the company is at a particular historical moment in the given conditions, revealing the necessary information, both will have greater efficiency and returns from such a process, development is more efficient, and material and moral results are better. Therefore, exploring the topic of financial investment efficiency for both parties, you can find specific solutions that make the search process by the investor and entrepreneur easier for each other. With a favourable outcome, the percentage of start-ups that have grown into successful firms may increase, which can bring a positive effect to the economies of countries, since innovative products tend to be in demand on their own and, together, move forward scientific and technological progress as a whole.

II. FEATURES OF VENTURE INVESTMENTS, RISKS AND OPPORTUNITIES

Currently, the constant development of technology provides the prerequisites for building a business in this niche. The key to success in such a business can be the symbiosis of good managers and high minds in the field of technology. However, the development of such a company faces some problems: high risks, the need for large-scale financing, lack of information.

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Nevertheless, these problems are solved, and such enterprises are successfully developing. Venture capital firms appear - investment companies that work with innovative enterprises and projects. The venture capital business is mainly carried out by small firms, organized, as a rule, in the high-tech fields of production, scientific research, and developers of new technologies. Despite the high risks, venture investment is one of the most effective methods of financing young innovative enterprises. The fact that the companies were created recently do not have much experience in the market makes it challenging to raise capital for the development and marketing of innovative products. Such enterprises experience difficulty in paying interest on debt obligations, as they incur significant losses in the initial stages of development. There is a gap between the demand and supply of financial resources for innovation, overcoming which, you can create a venture company. Thus, venture investment allows you to accumulate capital on the necessary scale and optimize the risk protection system. This is a process of investing capital of an investor in exchange for a share in a start-up company (investments in fast-growing and often high-tech companies) with a focus on the further growth of capitalization of the financed company in the future and making a significant profit when this share is sold after a certain period of time. The venture is a high-risk enterprise using high technology and R&D that have not been previously used. The risk is that investment income is not guaranteed.

At the beginning of the development of the company, it is not easy to attract investment. This stage is called the "valley of death" (Fig. 1). It is characterized by too high risks, a long time before the project reaches profitability (2-3 years), lack of collateral, since one of the main property values of such an enterprise is intangible intellectual property.

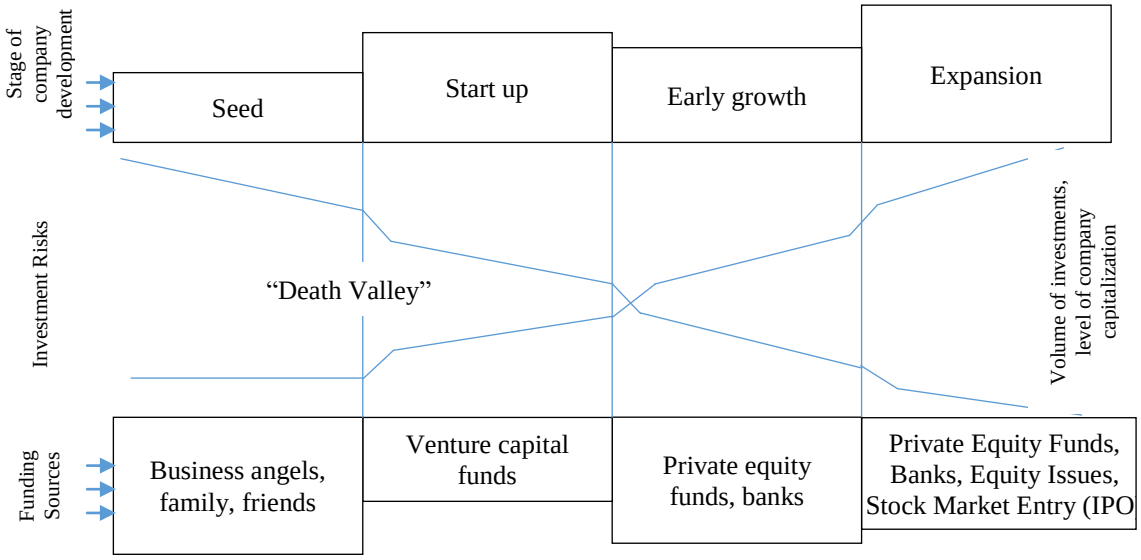

Fig. 1. Volumes and sources of venture capital investments at different stages of a company's development, associated with varying degrees of investment risk

Further main stages of development of a young high-tech company can be reflected in the form of a table (see Table 1).

Table- I: Stages of venture development

Title	Description
Seed "Sowing Stage"	At the initial stage, the formation of the company takes place, projects or business ideas are proposed and considered, a management team is created, R&D works are carried out, prototypes are created, the central business concept of the organization is developed.
Start-up	The company is formed. Availability of prototypes. Mass production is being organized. Products are on the market. Initial marketing research.
Early-stage	The production and commercialization of finished products is carried out. This stage is characterized by a lack of sustainable profit. The company goes to the "breakeven point". The volume of required working capital is growing.
Expansion	The company occupies certain market positions, receives steady profits from the core business, expands production and sales, conducts market research, increases fixed assets and working capital. At this stage, significant investments are needed in further development.
Later stage ("Mezzanine")	The company is gaining a strong position in the target markets, receiving a stable profit. It can issue shares (circulation on the stock exchange) by paying dividends on them. The annual growth rate of the company is low.

III. OPTIMIZATION OF THE SYSTEM OF MONITORING THE EFFECTIVENESS OF

VENTURE INVESTMENTS

Venture network formation in innovation clusters contributes to GDP growth through two mechanisms - it increases economies of scale through outsourcing and stimulates technological progress through technology diffusion among manufacturing sectors. To successfully evaluate the process of venture financing of network innovation, the authors propose using a venture clustering index based on statistics that determine four economic indicators, such as the amount of venture investments in a particular industry in a particular region, the total amount of venture investments in a specific industry, the amount of venture investments in all industries in a particular region, the total amount of venture capital investments in all regions.

The index helps illustrate venture capital concentration in specific industries over the study period, and also reflects the venture capital policy of the regions. It is expected that a high degree of attention can be observed in densely populated areas. Thus, deviations from the average distribution of venture investments in all regions are analyzed. By analogy, the Gini coefficient [12] indicates a difference or inequality compared to the average. Still, it is difficult for them to measure the deviation from the average distribution of venture capital investments throughout the country's venture capital space. To analyze spatial venture capitalization and / or investment flows, it is necessary to take into account the geographical distribution in detail. It is proposed to use the following method to estimate the difference in these distributions. If each parameter, such as the sum of venture investments, reflects the same distribution by region, then we can find an equal dispersion of investments. In addition, one can observe venture capital concentration as a relatively high percentage of specific industries in some regions, combined with a low rate of the same industries in other areas.

The Network Venture Clustering Index (IVC) for industry r will be as follows:

$$IVC = \frac{1}{2}\sum\left|\left(\frac{V_{ri}}{V_r}\right) - \left(\frac{V_{ni}}{V_n}\right)\right| \quad (1)$$

where the summation is over all regions i.

Vri is the sum of direct and venture investments in industry r of region i;

Vr is the total amount of direct and venture investments in the industry r;

Vni is the total amount of direct and venture investments of all industries of region i;

Vn is the total amount of direct and venture investments in all areas.

The value ranges from zero to one. A value of 0.0 in IVC means equal dispersion, and a value of 1.0 indicates full venture concentration. As a rule, an increase in the IVC value indicates the process of localization of venture investment by industry to spatial frequency, and a decrease, on the other hand, shows an outflow of investment.

The main findings from IVC analysis will be as follows. Sectors have their spatial mobility of venture capital investments, reflecting the processes of concentration or dispersion. Venture capital investments by industry are concentrated not only during their growth but also during a decline. Spatial mobility of venture capital investments is quantified by IVC. Sectors that show a rise or fall in venture capital inflows as part of venture capital concentration (IVC value tends to 1.0) can be described as industries whose key technologies depend on explicit or implicit knowledge, such as know-how. Industries with a scattering nature of investment (IVC tends to 0.0) are less dependent on the exchange of tacit knowledge.

Table 2 presents the data adopted for calculating the IVC indicator.

Table- II: Volume of direct and venture investments for 2017-2018, mln. dollars by industry and regions

Branch	R1		R2		R3		R4		R5		R6		R7		Total	
	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
Transport	113,00	3.0	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	113,00	3.00
Biotechnology	0,00	20,27	0,00	0,31	1,91	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	1,91	20,58
Construction	30,60	47,6	0,00	0,00	0,14	0,04	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	30,74	47,64
Chemical materials	4,67	2,2	0,00	0,49	0,50	1,01	4,20	0,00	0,00	2,42	0,46	0,00	0,00	0,33	9,83	6,45
Agriculture	13,00	0,0	20,00	0,00	0,00	0,00	3,33	60	0,00	0,00	0,00	0,00	200,00	110	236,33	170
Industrial equipment	224,33	23,41	0,00	0,00	2,55	1,11	0,00	30	0,00	6,63	0,00	0,39	0,00	0,03	226,88	61,57
Electronics	10,10	10,64	6,00	1.00	0,00	0,00	0,00	0,00	0,00	0,00	0,30	0,00	0,00	0,00	16,40	11,64
Energetics	645,33	31,6	5,53	0,00	0,78	0,28	0,00	0,00	0,00	2,7	10,30	0,00	3,50	48	665,44	82,58
Healthcare	262,29	78,21	5,06	0,00	1,00	0,00	0,00	0,00	0,00	0,00	0,58	0,00	0,00	0,00	268,93	78,21
Computers	62,40	62,84	0,00	0,83	0,00	0,00	7,67	0,00	0,00	1,6	0,00	0,00	0,00	0,00	70,07	65,27
Telecommunications	1 027,60	1008,88	18,02	706,15	1,60	4,55	0,00	0,03	0,66	0,09	0,00	8,53	0,00	0,00	1 047,88	1728,23
Financial services	779,00	461,2	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	92,50	0,00	871,50	461,2
Consumer market	260,00	43,6	0,00	0,00	35,00	0,00	4,50	0,00	0,00	0,00	0,00	0,15	0,00	0,00	299,50	43,75
Other	264,17	21,06	0,00	1,4	1,50	41,35	6,00	116,44	0,00	2,33	0,30	0,00	0,00	1,03	271,97	183,61
Total	3 696,49	1814,51	54,61	710,18	44,98	48,34	25,70	206,47	0,66	15,77	11,94	9,07	296,00	159,39	4 130,38	2963,73

Venture investments in 2017 amounted to 9.59% and 8.94% in 2018, respectively, of the total number of direct and venture investments, but it is proposed to use the entire amount for calculating IVC.

Consider the calculated values \of the IVC indicator and its components for 2017-2018 in Table 3. Table 3 presents the data adopted for calculating the IVC indicator.

Table- III: Network venture clustering index by industry for 2017-2018

Branch	R1		R2		R3		R4		R5		R6		R7		Σ	
	$\frac{1}{2}\|(V_{ri}/V_r) - (V_{ni}/V_n)\|$															
	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	**2017**	**2018**
Transport	0,053	0,194	0,007	0,120	0,005	0,008	0,003	0,035	0,000	0,003	0,001	0,002	0,036	0,027	**0,105**	**0,388**
Biotechnology	0,447	0,186	0,007	0,112	0,495	0,008	0,003	0,035	0,000	0,003	0,001	0,002	0,036	0,027	**0,989**	**0,373**
Construction	0,050	0,193	0,007	0,120	0,003	0,008	0,003	0,035	0,000	0,003	0,001	0,002	0,036	0,027	**0,100**	**0,387**
Chemical materials	0,210	0,136	0,007	0,082	0,020	0,070	0,211	0,035	0,000	0,185	0,022	0,002	0,036	0,001	**0,505**	**0,510**
Agriculture	0,420	0,306	0,036	0,120	0,005	0,008	0,004	0,142	0,000	0,003	0,001	0,002	0,387	0,297	**0,854**	**0,877**
Industrial equipment	0,047	0,116	0,007	0,120	0,000	0,001	0,003	0,209	0,000	0,051	0,001	0,002	0,036	0,027	**0,094**	**0,525**
Electronics	0,140	0,151	0,176	0,077	0,005	0,008	0,003	0,035	0,000	0,003	0,008	0,002	0,036	0,027	**0,368**	**0,302**
Energetics	0,037	0,115	0,002	0,120	0,005	0,006	0,003	0,035	0,000	0,014	0,006	0,002	0,033	0,264	**0,087**	**0,555**
Healthcare	0,040	0,194	0,003	0,120	0,004	0,008	0,003	0,035	0,000	0,003	0,000	0,002	0,036	0,027	**0,086**	**0,388**
Computers	0,002	0,175	0,007	0,113	0,005	0,008	0,052	0,035	0,000	0,010	0,001	0,002	0,036	0,027	**0,103**	**0,370**
Telecommunications	0,043	0,014	0,002	0,084	0,005	0,007	0,003	0,035	0,000	0,003	0,001	0,001	0,036	0,027	**0,090**	**0,171**
Financial services	0,001	0,194	0,007	0,120	0,005	0,008	0,003	0,035	0,000	0,003	0,001	0,002	0,017	0,027	**0,034**	**0,388**
Consumer market	0,013	0,192	0,007	0,120	0,053	0,008	0,004	0,035	0,000	0,003	0,001	0,000	0,036	0,027	**0,115**	**0,384**
Other	0,038	0,249	0,007	0,116	0,003	0,104	0,008	0,282	0,000	0,004	0,001	0,002	0,036	0,024	**0,092**	**0,781**

In 2018, the level of direct and venture investments decreased by 28%. Still, the data obtained as a result of the study suggest that investments began to strive for venture concentration, which in turn territorially contributes to the development of cooperative ties between innovation participants.

According to the IVC indices, a small increase in the concentration of venture capital investments was noted in almost all sectors, in some even despite a drop in the total volume of investments (Fig. 2).

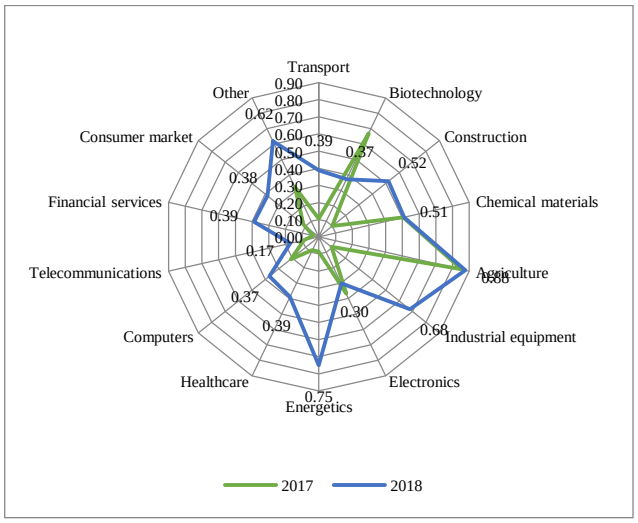

Fig. 2. Graphical interpretation of the IVC index

Using the data in Table 3, you can group the IVC index according to the following values (Table 4):

Table- IV: Characterization of the value of the IVC index

IVC Value	Characterization
0 – 0.1	Investments in industries are scattered, the participants of which are least inclined to standardize innovative activities, exchange implicit knowledge
0.1 – 0.3	The weak territorial concentration of investments
0.3 – 0.5	The moderate territorial concentration of investments distributed over all regions of the country and contributing to the coverage of the largest number of participants in the innovation
0.5 - 0.7	The noticeable territorial concentration of investments indicates the orientation of the industry towards functioning within a certain region, a decrease in activity in other sectors
0.7 - 1.0	The strong regional concentration of investments, contributing to the development of participants in the innovation process, effective transfer of knowledge within a particular region

Fig. 3 indicates the positive dynamics of the IVC index towards moderate values, which shows the stabilization of venture financing of innovation.

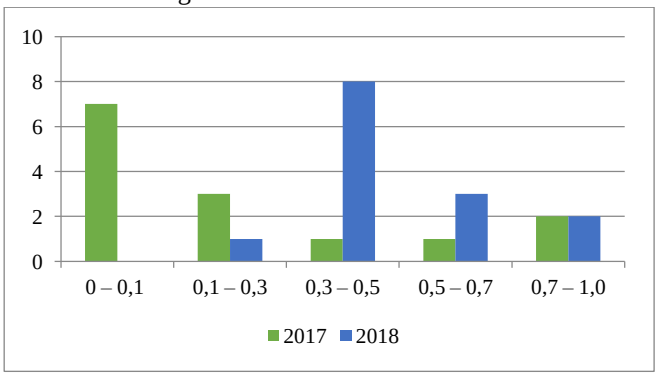

Fig. 3. The dynamics of the IVC index for 2017-2018

The IVC indicator shows that the fall in investment is offset by their territorial concentration, which in the form of a network of participants in innovative activities contributes to regional development.

In determining the impact of the activities of venture network actors on the indicator of commercialization of regional innovations, we propose to use the following econometric model.

Assign each type of venture network actor a list of indicators that affect the effectiveness of commercialization, and find their relationship.

For the resulting indicator (commercialization efficiency) we take the advanced manufacturing technologies used, which logically relate to the actor-recipient of innovation.

The innovation actor is proposed to include the volume of innovative goods, works, services, dollars; the number of personnel engaged in research and development, people; grant of patents.

It is proposed to include the number of direct and venture investment funds, units; the number of direct and venture investments at the regional level; the amount of direct and venture investments, rubles; share of investments per 1 fund, rubles

It is proposed to include the number of organizations performing research and development as an actor-supplier of a venture network; current domestic expenditure on research and development; share of costs of the first organization for research and development.

The economic and mathematical model for assessing the impact of venture network actors on the commercialization of innovative products at the regional level will be as follows:

$$Timp = -11332{,}45 + 0{,}04\,Q_g + 0{,}418\,Q_p + 3{,}742\,Q_s + 300{,}019\,Q_{inv} - 2{,}014\frac{S_{inv}}{Q_f} + +184{,}068\frac{C_i}{Q_{int}} - 0{,}727Ci$$

where *Timp* is the advanced manufacturing technology used;

Qg - the volume of innovative goods, works, services;

Qp - the number of personnel engaged in research and development;

Qs - grant of patents;

Qinv - amount of investment;

Ci - current domestic expenditure on research and development;

Sinv/Qf - share of investments in 1 private equity and venture capital fund;

Ci/Qint - the share of the costs of the 1st organization for research and development.

Table 5 describes the significance of the model and its components.

Table- V: Qualitative characteristics of the economic-mathematical monitoring model for assessing the activities of venture network actors

DEPENDENT VARIABLE: TIMP		
METHOD: LEAST SQUARES		
SAMPLE: 1 32		
INCLUDED OBSERVATIONS: 32		
VARIABLE	Coefficient	Prob.
C	-11332.45	0.0002
QG	0.039935	0.0000
QP	0.418212	0.0001
QS	3.742122	0.0125
QINV	300.0193	0.0005
CI	-0.726886	0.0000
SINV/QF	-2.014500	0.1063
CI/QINT	184.0684	0.0000
R-SQUARED	0.973014	
F-STATISTIC	123.6213	

The value of the determination coefficient $R2 = 0.97$ indicates a high explanatory power of the model, the linear relationship in the model is significant, as evidenced by the high F-statistic, equal to 123.6213. The probability values of the p-level coefficients do not exceed $\alpha = 0.1$, and therefore the model can be considered adequate.

We are testing this model based on the Forecast of the Socio-Economic Development of the Russian Federation for 2015 and for the planning period of 2016 and 2017 to obtain author's forecast data on the indicator of advanced production technologies used.

According to table 3.7, we take the number of organizations performing research and development in 2013 as a constant and find data for 2013-2017, using the indicator of the proportion of organizations engaged in technological innovation. The number of patents granted in 2018 will also be taken as a constant for calculating the forecast.

The results of the study are shown in Fig. 4.

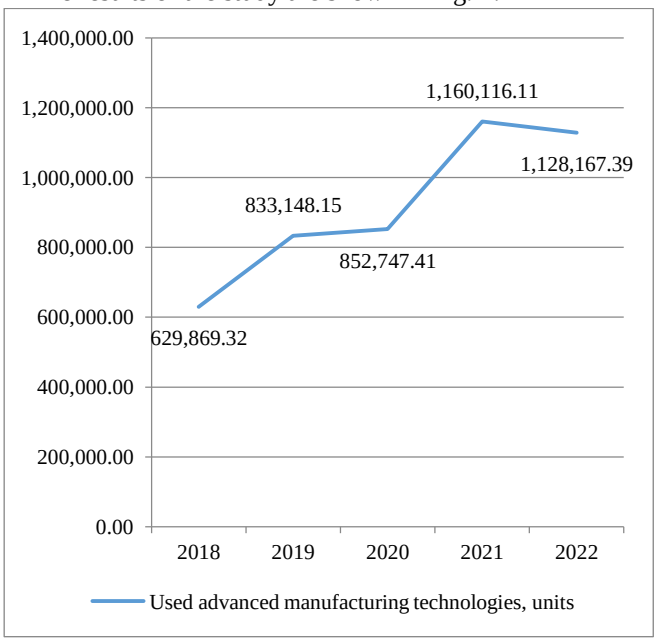

Fig. 4. Forecast of the indicator used advanced production technologies for the period 2014-2017

IV. RESULT AND DISCUSSION

A high concentration of investments (IVC tends to 1) indicates the development of innovation in a particular region, but not in the whole country as a whole, in connection with which we suggest accepting a moderate level of 0.3 - 0.5.

These forecast results reflect a significant increase in the performance indicator for the actor-recipient of venture network innovations.

This model can be used to predict the results of commercialization at the regional level, as well as when developing a program for integrating a venture network into innovative clusters.

V. CONCLUSION

The conceptual model of venture network competitiveness indicators is based on an analysis of the degree of its

innovativeness, moderating variables - entrepreneurial orientation, structural holes, relational relationships and venture complexity - network structure, strategy, competency.

The network venture concentration index reflects the territorial concentration of investments, the qualitative characteristics of the industry for the exchange of knowledge.

The economic and mathematical model for assessing the impact of venture network actors on the commercialization of innovative products at the regional level consists of the following indicators: advanced manufacturing technologies used; volume of innovative goods, works, services; the number of personnel engaged in research and development; grant of patents; amount of investment; domestic current expenditure on research and development; share of investments in 1 private equity and venture capital fund; share of costs of the first organization for research and development.

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