The Impact of Supply Chain Dynamic Evaluation of Economic Stability of Enterprises of Radio-electronic Complex in Russia

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***Abstract*- This research aims to assess the impact of supply chain capacity on competitiveness and business efficiency of enterprises of radio-electronic complex in Russia. The aim of the scientific article is to approve the results of quantitative measuring of an economic stability of enterprises of radio-electronic cluster in Russia that let diagnose problems of their development. The methodological basis of the research is a general and statistical method of dynamic standard, index and coefficient analysis, method of paired comparisons, methods of evaluation a financial stability of enterprises. The results of the research: factors, economic profile and normative and evaluative model of economic stability of enterprises are offered. The practical significance of the received results of the research is in the possibility of using the authoring for monitoring the economic stability of enterprises of defense industry complex of Russia for basing strategic and management decisions.**

Keywords- *economic stability of enterprise, Supply chain dynamic, integral and statistic indicator, monitoring.*

1. Introduction

Supply chain capacity is the construction of a closed loop for supply chain strategy and a source of competitive advantage for firm success. The plans of development the government corporation "Rostekh" provide the increase of effectiveness of economic and management activity of enterprises of defense industry complex of Russia (DIC) by digitalization and diversification of their activity. The planned results are defined by the President of the Russian Federation V. Putin. The total volume of realization of civilian items at the DIC enterprises should exceed 20 billion rubles in the nearest 12 years. The share of proceeds from production of civilian items should be 50 per cent by 2030. Such indices will be achieved by the aggressive export policy and conversion. Such a strategy made a good showing in China where munitions factories led the share of civilian items to 60-90 per cent during 20 years. "Rostekh" aims to reach the planned indicators 5 years earlier by 2025. It is set in its renewed strategy that provides the union of holdings in branch clusters. It was realized in 2015. The radio-electronic cluster (REC) is the most successful according to planned and actual results. Its new strategy provides annual growth rates of proceeds – 22.4 per cent and the share of civilian items should be no less than 60 per cent by 2025. "The cluster led out a large number of civilian items for sale, power engineering, housing and utilities services, medicine, education, telecommunications and other branches in 2018. The clusters' enterprises managed to provide the growth of proceeds on 18 per cent. At the same time the proceeds from realization of civilian items were more than 55 per cent. The share of proceeds from realization of civilian items grew from 16 per cent in 2017 to 23.2 per cent in 2018" [1].

However, if we evaluate the results of activity of individual clusters' enterprises we will see that key indices and their dynamics do not look so encouraging. There is an issue of poor financial stability that will be aggravated because of reducing the volume of state defence order to 30 per cent according to experts. At that as Secretary of the Security Council of Russia N. Patrushev said: "It is necessary to save this potential of the DIC in the conditions of coming reduce of the state defence order and enterprises of the DIC themselves look to the future with confidence, work without stoppage saving the financial stability and workers' association" [2]. The solution of set tasks depends on how competently a system of management of the financial and economic stability of enterprises of the defence industry complex and the DIC in total will work. In this connection the topical scientific task is to work out models of evaluation of the economic stability of the DIC enterprises. Dynamic economic and mathematical models of evaluation of the economic stability as the DIC in total and as the clusters and individual enterprises in particular will let solve problems of practical economy and management of the defence industry complex of Russia. The results of using the normative and evaluative models of the economic stability of enterprises on the example of individual enterprises of radio-electronic cluster are presented in this article. They made it possible to establish recommendations on making strategic and tactic management decisions that were directed to increase their economic stability.

2. Methodological basis and offered methodological developments

2.1 Scientific problem

The development of tools to evaluate the economic stability of the DIC enterprises that takes into account specificity of their activity and perspectives of development.

2.2 The level of study of the scientific problem and the offered structure of enterprises' economic stability.

The evaluative questions of enterprises' economic stability were being raised by many foreign and native authors for quite a long time. However, there is still no united definition of the concept "the economic stability of enterprises". Many authors do not separate the financial and economic stability of enterprises (Chuprov S.V., 2013 in the paper [3],[17], Kochetkov S.A., Tikhomirov S.V., 2013 in the paper [4, 59]. Among the foreign authors who made a contribution to the development of the methodology of evaluation the financial stability of enterprises should be mentioned Robert Foulk (Empirical Pragmatists School), James Bliss, Arthur H. Winacor (Multivariate Modelers School), Edward Altman, William H. Beaver (Distress Predictors School) [5],[6]. Thus the mentioned approach is a characteristic for western scientists and experts. It is connected with peculiarities of keeping the accounting report and international standards [7],[8]. Nowadays, Russian companies cannot turn to the system of International Financial Reporting Standards (IFRS) because it is necessary to present accounting on Russian standards and according to tax and other normative requirements [9, 360]. When evaluating the economic stability the use of this approach is not actual for the DIC enterprises in Russia. This conclusion is proved by results of the research that are in the paper [10].

Analyzing scientific works of Russian authors we have made a conclusion that it is necessary to emphasize two scientific approaches: **statical approach** when the economic stability of enterprises is a possibility of enterprises to save characteristics permanent (Bakanev I.L, 2016 in paper [11, 455 p.]), (Konyashova A.V., Merzlikina G.S., 2012 in paper [12, 138 p.]) in a long-term outlook and **dynamic approach** when the economic stability of enterprises is an adaptability of enterprises to changes of external environment which is connected with possibilities of enterprises' development, presence potentials of steady development and their effective use for neutralization of external influences and factors of destabilization [13].

In this connection authors offer a structure of a research object which is presented on the picture 1.

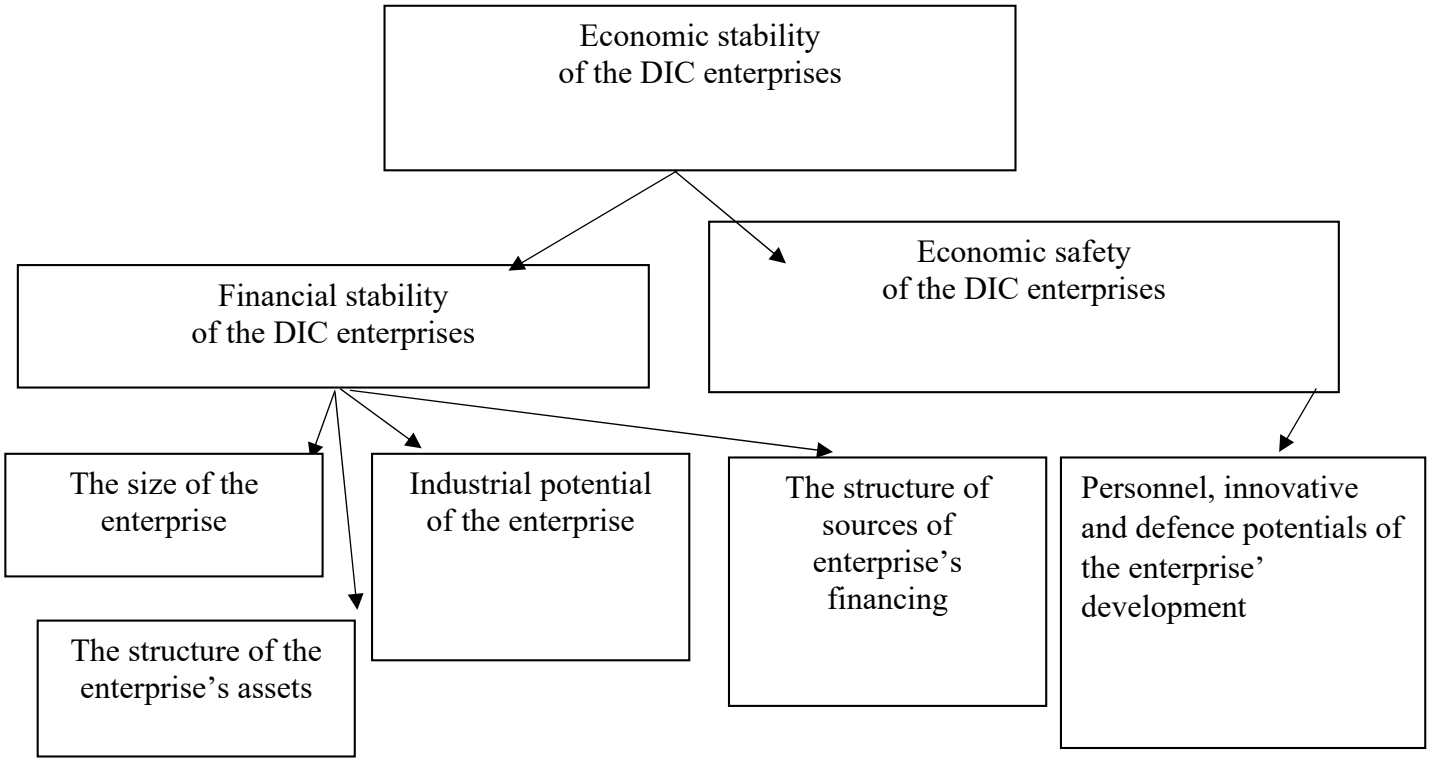

Figure 1. The structure of the economic stability of the DIC enterprises as an object of measuring and evaluation

The author program of a concept "the economic stability of the DIC enterprise" is based on the offered hypothesis and it lies in that the economic stability of the DIC enterprise is a balanced state of economic resources that provide steady conditions for steady economic growth in a long-term outlook taking into account important external and internal factors. "The economic safety" is the external factor of the economic stability in the framework of the offered scientific hypothesis. "The financial stability of the enterprise" is

the internal factor. The offered structure allows to take into account a specificity of the DIC enterprise and to analyze factors as a tactical level of management and as a strategical level of management. Due to this the received results of evaluation of the economic stability of the DIC enterprises can be used for their choice when distributing the state defence order (the SDO) in the framework of realization the federal targeted programs.

2.3 The algorithm of building the normative and evaluative model of the economic stability of the DIC enterprises

The algorithm of building the normative and evaluative model was offered to realize the dynamic evaluation of the economic stability of the DIC enterprises:

1) to offer and prove the profile of the economic stability of the DIC enterprises on the basis of which a normative and evaluative model will be build;

2) to give economic interpretation of correlation the rates of indices' growth in the profile of the economic stability of the DIC enterprises;

3) to build a normative and evaluative model which could take into account both direct and mediate connections of profile's indices in dynamics.

A profile of the economic stability of the DIC enterprises is offered to solve problems of research taking into consideration its scientific hypothesis. The profile is represented in the table 1. The specificity of the activity of the DIC enterprises is presented in the economic profile. It is in the following:

1. A great part of the DIC enterprises is a state defence order;

2. The main source of financing of the DIC enterprises is bankroll in the form of target financing, contracts advance payment and budget means;

3. The main factor that is peculiar to the DIC field is research and developments (R&D), the results of it are reflected in using own used technologies.

Table 1. The profile of the economic stability of the DIC enterprises

No	The name of indices	Factors of the economic stability	
		Financial stability	Economic safety
1	Average staffing level, S	+	
2	Staffing level till 35 years old, Sm		+
3	Volume of production, Q	+	
4	Volume of the SDO, Qg		+
5	Main funds on full initial cost, F	+	
6	Main funds on residual value, F'	+	
7	General utilization of capacity, U	+	
8	Utilization of capacity for realization of the SDO, Ug		+
9	Duration of production cycle, D	+	
10	Volume of material stock, Qms	+	
11	Volume of realized production, Qrp	+	
12	Volume of financing, Qf	+	
13	Volume of targeted financing, Qtf		+
14	Volume of innovative production, Qinov		+
15	Value of non-material assets, Vna		+
16	Value of assets, Va	+	
17	Number of used modern technologies, N		+
18	Number of own used technologies, No		+

This profile is worked out starting from an author's interpretation of the economic stability of the DIC enterprises. The factors of the financial stability of enterprises and economic safety of enterprises are taken into account in it. The first factor is understood by us as "such a state of its financial resources, their distribution and use that provides development of enterprises on the basis of growth and capital by saving paying capacity in the conditions of allowed risk". In this case we share the point of view of Fedotova M.A. and Rodionova V.M. [14]. This point of view implies that key features when determining the financial stability are paying capacity, financial independence, availability of internal funds and minimal level of risk. Thus, the financial stability is a complex concept and as a result it is prone to the influence of many factors. The most important factors are taken into consideration by us in the profile of the economic stability. They reflect the specificity of the DIC enterprise, to be more exact, a size of the DIC enterprise, volume of realization, structure of assets, sources of financing, level of utilization of capacity, level of depreciation of fixed assets, age structure of staff resources and duration of production cycle. The second factor "the economic safety of the DIC enterprises" is understood by us as a complex of the following factors:

1. Economic independence which means the necessity of an enterprise to go at the level of effective and qualitative

production creating competitiveness with other DIC enterprises.

2. Secondly, a stability of an enterprise's economy which means an ability of an enterprise to save and reestablish its economic position and to move to a new more favorable position after a number of factors that have made it go out from this state.

3. Thirdly, an ability of economic system be self-development and progressive in the conditions of economic safety, its ability to form favorable conditions for investments and innovations, modernization of production, increase of labour productivity, etc.

For realization of the second stage of the algorithm of building the normative and evaluative model of the economic stability of the DIC enterprise let us assign normative correlations of the indices' growth in the profile of the economic stability of the DIC enterprise based on the economic and statistical coefficients that characterize its factors. It will allow to work out a matrix of preferences (MP) of the normative model. For better understanding we will indicate coefficients as Cij where i is a number of the MP's line and j is a number of the MP's column (i and j are numbers of indices composing the emphasized coefficient). The developed matrix of preferences of the normative and evaluative model of the economic stability of the DIC enterprise is introduced in table 2. The accepted in table 2 sings of profile's indices of the economic stability of the DIC enterprise are used in the further issued coefficients. From the structure of the MP it follows that Cij = Cji.

Table 2. The matrix of preferences for measuring the economic stability of the DIC enterprise

No	The name of the index	le ve l	ol d	uc tio n	S D O	l co st	va lu e	pa cit y	S D O	cy cl e	st oc k	uc tio n	an ci ng	an ci ng	uc tio n	as set s	as set s	lo gi es	lo gi es
1	Average staffing level, S		(1)	(2)	(3)	(4)	(5)					(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
2	Staffing level till 35 years old, Sm	(1)																	
3	Volume of production, Q	(2)			(14)	(15)						(16)			(17)		(18)		
4	Volume of the SDO, Qg	(3)		(14)															
5	Main funds on full initial cost, F	(4)		(15)			(19)					(20)					(21)		
6	Main funds on residual value, F'	(5)				(19)													
7	General utilization of capacity, U								(22)										
8	Utilization of capacity for realization of the SDO, Ug							(22)											
9	Duration of production cycle, D										(23)								
10	Volume of material stock, Qms									(23)							(24)		
11	Volume of realized production, Qrp	(6)		(16)		(20)													
12	Volume of financing, Qf	(7)												(25)					
13	Volume of targeted financing, Qtf	(8)											(25)						
14	Volume of innovative production, Qinov	(9)		(17)												(26)	(27)	(28)	(29)
15	Value of non-material assets, Vna	(10)													(26)		(30)		
16	Value of assets, Va	(11)		(18)		(21)					(24)				(27)	(30)			
17	Number of used modern technologies, N	(12)													(28)				(31)
18	Number of own used technologies, No	(13)													(29)			(31)	

Note: in the matrix of preferences of a correlation between indices are given based on the numbers of coefficients figured in the formulae 1-31.

$$C_{1,2} = Sm/S \quad (1)$$

$C_{1,2}$ indicates the staffing level of the DIC enterprise under 35 years old. The correlation of growth rate of corresponding indices of the GR(S)<GR(Sm) is set based on the normative and evaluative model (NM). The GR is the growth rate of index given in brackets. In that way *the size growth of young personnel of the DIC enterprise as the rise of level of its economic safety* which is the aim is set in the NM.

$$C_{1,3} = Q/S \quad (2)$$

$C_{1,3}$ indicates the volume of production of the DIC enterprise per one worker. It characterizes the productivity of the labour of the DIC enterprise. According to the NM: the GR(Q)>GR(S), *the*

productivity of the labour at the DIC enterprise should increase in order the financial stability can grow.

$$C_{1,4} = Qg/S \quad (3)$$

$C_{1,4}$ indicates the specific volume of the SDO of the DIC enterprise. It characterizes the labour productivity in connection with the main activity of the enterprise. According to the NM: the GR(Qg)>GR(S), *the specific volume of the SDO should increase in order the level of economic safety of the DIC enterprise can grow.*

$$C_{1,5} = F/S \quad (4)$$

$C_{1,5}$ is capital-labour ratio of the DIC enterprise. According to the NM: the GR(F)>GR(S) is *a growth of the capital-labour ratio as a characteristic of the production potential of the DIC enterprise and the increasing level of its financial stability.*

$$C_{1,6} = F'/S \quad (5)$$

$C_{1,6}$ is capital-labour ratio of the DIC enterprise at the depreciable cost. According to the NM: the GR(F')>GR(S) is *a growth of the capital-labour ratio as a characteristic of the production potential of the DIC enterprise and the increasing level of its financial stability.*

$$C_{1,11} = Qrp/S \quad (6)$$

$C_{1,11}$ is the specific volume of realized production of the DIC enterprise. According to the NM: the GR(S)<GR(Qrp) is the growth of the specific volume of realized production of the DIC enterprise as a characteristic of the increase of its financial stability.

$$C_{1,12} = Qf/S \quad (7)$$

$C_{1,12}$ is the specific volume of financing the DIC enterprise. According to the NM: the GR(Qf)>GR(S) is *the growth of the specific volume of financing the DIC enterprise as a parameter of improvement its financing stability.*

$$C_{1,13} = Qtf/S \quad (8)$$

$C_{1,13}$ is the specific volume of financing the SDO of the DIC enterprise. According to the NM: the GR(Qtf)>GR(S) is *the growth of the specific volume of financing the SDO of the DIC enterprise as an indicator of the increase of its economic safety.*

$$C_{1,14} = Qinov/S \quad (9)$$

$C_{1,14}$ is the specific volume of innovative production of the DIC enterprise. According to the NM: the GR(S)<GR(Qinov) is *the growth of the specific volume of innovative production as a characteristic of improvement the economic safety of the DIC enterprise.*

$$C_{1,15} = Vna/S \quad (10)$$

$C_{1,15}$ is a unit value of non-material assets of the DIC enterprise. According to the NM: the GR(Vna)>GR(S), *the unit value of the DIC enterprise should increase having the reference level of the economic stability because of the growth of the economic safety of the enterprise.*

$$C_{1,16} = Va/S \quad (11)$$

$C_{1,16}$ is a unit value of assets of the DIC enterprise. According to the NM: the GR(Va)>GR(S), the increasing unit value of assets of the DIC enterprise characterizes the development of its economic potential and the growth of the financial stability.

$$C_{1,17} = N/S \quad (12)$$

$C_{1,17}$ is the specific number of used modern technologies of the DIC enterprise. According to the NM: the GR(N)>GR(S), *the increasing of the specific number of used modern technologies at the DIC enterprise shows the development of innovative potential of the enterprise and the growth of its economic safety.*

$$C_{1,18} = No/S \quad (13)$$

$C_{1,18}$ is the specific number of own used technologies of the DIC enterprise. According to the NM: the GR(No)>GR(S), *the increasing of the specific number of own used technologies at the DIC enterprise shows the development of innovative potential of the enterprise and the growth of its economic safety*.

$$C_{3,4} = Qg/Q \quad (14)$$

$C_{3,4}$ is a part of the SDO in the volume of production of the DIC enterprise. According to the NM: the GR(Qg)>GR(Q) is *the growth of the volume of the SDO of the DIC enterprise as a parameter of improvement of its economic stability and economic safety.*

$$C_{3,5} = Q/F \quad (15)$$

$C_{3,5}$ is an output per unit of capital funds at the DIC enterprise. According to the NM: the GR(Q)>GR(F) is *the growth of output per unit of capital funds as an evidence of improvement of the using production potential of the DIC enterprise and increasing its financial stability.*

$$C_{11,3} = Qrp/Q \quad (16)$$

$C_{11,3}$ is a part of realized production of the DIC enterprise in the total volume of production. According to the NM: the GR(Qrp)>GR(Q) is *the growth of realization coefficient as a characteristic of*

improvement the financial stability of the DIC enterprise.

$$C_{14,3} = Qinov/Q \quad (17)$$

$C_{14,3}$ is a part of innovative production in the total volume of the production of the DIC enterprise. According to the NM: the GR(Qinov)>GR(Q) is *the growth of the part of innovative production as a characteristic of improvement of economic safety of the DIC enterprise.*

$$C_{15,3} = Q/Va \quad (18)$$

$C_{15,3}$ is an effectiveness of the using the assets (turnover). According to the NM: the GR(Q)>GR(Va) is *the growth of turnover of assets of the DIC enterprise as a growth characteristic of its financial stability.*

$$C_{5,6} = F'/F \quad (19)$$

$C_{5,6}$ is a coefficient of suitability of main funds of the DIC enterprise. According to the NM: the GR(F')>GR(F) is *the growth of suitability of production potential of the DIC enterprise as a growth characteristic of its economic stability.*

$$C_{5,11} = Qrp/F \quad (20)$$

$C_{5,11}$ is a coefficient of output per a unit of capital funds on realized production. According to the NM: the GR(Qrp)>GR(F) is *the growth of output per unit of capital funds of the DIC enterprise as an improvement of its financial stability.*

$$C_{5,16} = F/Va \quad (21)$$

$C_{5,16}$ is a part of main funds in the assets of the DIC enterprise. According to the NM: the GR(F)>GR(Va), *the growth of main funds indicates the growth of financial stability and investment activity of the DIC enterprise.*

$$C_{7,8} = Ug/U \quad (22)$$

$C_{7,8}$ is a coefficient of correlation of utilization of capacity for realization of the SDO and general utilization of capacity of the enterprise. According to the NM: the GR(Ug)>GR(U), *the growth of the SDO in the production of the DIC enterprise indicates the demand of its production and the growth of the economic safety.*

$$C_{9,10} = Qms/D \quad (23)$$

$C_{9,10}$ is a specific volume of material stock. According to the NM: the GR(Qms)<GR(D) is *the reduce of specific volume of material stock as a characteristic of the level increase of the financial stability.*

$$C_{10,16} = Qms/Va \quad (24)$$

$C_{10,16}$ is a part of material stock in the assets of the DIC enterprise. According to the NM: the GR(Va)>GR(Qms), *the reduce of a part of material stock in the assets of the DIC enterprise provides the growth of its financial stability.*

$$C_{12,13} = Qtf/Qf \quad (25)$$

$C_{12,13}$ is a part of targeted financing in its total volume at the DIC enterprise. According to the NM: the GR(Qtf)>GR(Qf), *the growth of a part of the targeted financing in its total volume of financing indicates the increase of the SDO and the growth of economic safety of the DIC enterprise.*

$$C_{14,15} = Qinov/Vna \quad (26)$$

$C_{14,15}$ is a specific volume of innovative production per a unit of non-material assets of the DIC enterprise. According to the NM: the GR(Qinov)>GR(Vna) is *the growth of the specific volume as a characteristic of improvement of the using non-material assets of the DIC enterprise, the growth of its economic safety.*

$$C_{14,16} = Qinov/Va \quad (27)$$

$C_{14,15}$ is a specific volume of innovative production per a unit of assets of the DIC enterprise. According to the NM: the GR(Qinov)>GR(Va) is *the growth of the specific volume as a characteristic of improvement of the using assets of the DIC enterprise, the growth of its economic safety.*

$$C_{14,17} = Qinov/N \quad (28)$$

$C_{14,17}$ is a specific volume per a unit of used modern technologies of the DIC enterprise. According to the NM: the GR(Qinov)>GR(N) is *the growth of the specific volume as a characteristic of improvement of the using modern technologies of the DIC enterprise, the growth of its economic safety.*

$$C_{14,18} = Qinov/No \quad (29)$$

$C_{14,18}$ is a specific volume of innovative production per a unit of used modern technologies of the DIC enterprise. According to the NM: the GR(Qinov)>GR(No) is *the growth of the specific volume as a characteristic of improvement of the using own technologies of the DIC enterprise, the growth of its economic safety.*

$$C_{15,16} = Vna/Va \quad (30)$$

$C_{15,16}$ is a part of non-material assets in its total value of the DIC enterprise. According to the NM: the GR(Vna)>GR(Va), *the growth of this coefficient indicates the growth of effectiveness of the using the*

non-material assets, improvement of their structure and the growth of the economic safety for the DIC enterprise.

$$C_{17,18} = No/N \quad (31)$$

$C_{17,18}$ is a number of own used technologies by the DIC enterprise in a number of used technologies. According to the NM: the GR(No)>GR(N). *The growth of a coefficient indicates the improvement of the economic safety of the DIC enterprise.*

In that way we have explained the economic sense of pairwise coefficients that have direct correlations in a matrix of preferences. The formalization of this matrix is based on the method of dynamic standard. It allows to take into account mediate connections of chosen indices in the profile of the economic stability, to get integral evaluation and to analyze its growth on factors that have been offered by us to study the economic stability of the DIC enterprises.

Formally, the matrix of preferences is set by the matrix of reference correlations ($E=\{e_{ij}\}_{nxn}$). Each element of it shows a normative correlation between indices (faster/slower) of lines and columns of the matrix of preferences. The matrix E is described in the following way:

$$e_{ij} = \begin{cases} 1, if\ GR(P_i) > GR(P_j); \\ -1, ifGR(P_i) < GR(P_j); \\ 0, ifreferencecorrelationbetween \\ GR(P_i)andGR(P_j)isnotrevealed \end{cases}, (32)$$

where i, j are numbers in the profile of the economic stability, Pi, Pj are indices that have i and j numbers in the profile of the economic stability correspondingly. The GR(Pi)>GR(Pj) and the GR(Pi)<GR(Pj) are reference correlations between the growth rate of indices.

Thus, formed in such a way *the matrix E is a normative model (the NM) of the system on studied characteristic* after revealing the additional correlation[1]. The matrix E for normative and evaluative model of the economic stability of the DIC enterprise is presented in table 3.

The results' reflection of accepted and realized decisions acts a factual matrix of preferences. The closer the factual indices' regulating to the normative established order are, the more normative correlations fixed in the NM are fulfilled and the higher the level of studied property of a system is. The matrix of factual correlations of the indices' growth ($F=\{f_{ij}\}_{nxn}$) is described in the following way:

$$f_{ij} = \begin{cases} 1, if\ GR(P_i) > GR(P_j); \\ -1, if\ GR(P_i) < GR(P_j); \\ 0, if\ GR(P_i) = GR(P_j), \end{cases} \quad (33)$$

where i, j are numbers of indices in the profile of the economic stability of the DIC enterprise; Pi, Pj are indices that have i and j numbers in the profile of the economic stability of the DIC enterprise, correspondingly; the GR(Pi), the GR(Pj) are factual growth rate of i and j indices correspondingly.

The evaluation of closeness of factual and normatively established regulating of the indices' growth in the NM is the integral evaluation of the economic stability of the DIC enterprise (S).

$$S \quad Y = \frac{\sum_{i=1}^{n}\sum_{j=1}^{n} b_{ij}}{\sum_{i=1}^{n}\sum_{j=1}^{n}\left|e_{ij}\right|} (34), \text{ where}$$

$$b_{ij} = \begin{cases} 1, if\ e_{ij} = 1\ atthesametimewith\ f_{ij} \geq 0; or \\ if\ e_{ij} = -1\ atthesametimewithf_{ij} \leq 0; \\ 0, inothercases \end{cases} \quad (35)$$

n is number of indices in the profile of the economic stability of the DIC enterprise; i, j are numbers of indices in the profile of the economic stability of the DIC enterprise; b_{ij} is an element of matrix coincidences of factual and reference correlations of the growth rate ($B = \{b_{ij}\}_{nxn}$); e_{ij} is an element of the NM matrix, f_{ij} is an element of matrix $F=\{f_{ij}\}_{nxn}$.

The evaluation S changes in the range from 0 to 1. S is equal to 1 if all normatively established correlations of the indices' growth are actually fulfilled. The coincidence of factual and established order of indices in the NM indicates the highest level of realization of the studied property of the system. S is equal to 0 if the factual order of indices is completely opposite to the normative order of indices in the NM. The closer S to 1 is, the larger part of normative correlations between indices is realized in reality.

S is *a generalized estimate of economic stability of the DIC enterprise* as it characterizes the degree of approaching the standard at this moment. S can increase or decrease from period to period. At the same time its growth does not mean that only positive changes have occurred which have led to the fulfillment of those reference correlations that have not been carried out before. The growth of S can be accompanied by new disarrangements of the correlations set in the NM. In other words, the fulfillment of the reference correlation between pair of indices in a period does not guarantee an invariable fulfillment of this correlation in future.

In this connection together with evaluation of stability the estimate of changeability (C) is calculated. It characterizes the change of the structure of the

[1] Additional correlations are revealed based on the transitivity principle

fulfilled and unfulfilled reference correlations from the point of view of changes' direction on realization of set aims in the NM. The calculation of the changeability' evaluation is fulfilled according to the formula:

$$C = \frac{\sum_{i=1}^{n}\sum_{j=1}^{n} d_{ij}}{\sum_{i=1}^{n}\sum_{j=1}^{n} |d_{ij}|} \quad (36), \text{ where}$$

$$d_{ij} = \begin{cases} 1, \text{если } b_{ij}^{0} > b_{ij}^{б} \\ -1, \text{если } b_{ij}^{0} < b_{ij}^{б} \\ 0, \text{в остальных случаях} \end{cases} \quad (37)$$

n is a number of indices in the profile of the economic stability of the DIC enterprise; i, j are numbers in the profile; d_{ij} is an element of the changeability' matrix ($D = \{d_{ij}\}_{nxn}$) of the indices' dynamics in the report and basic periods. The direction of changes of correlations' growth formed in the NM is reflected in D. If the factual correlation of indices growth in the basic period did not coincide with the reference order and the violation was corrected in the report period then the corresponding element D is equal to 1. If the coincidence of factual and reference correlations of indices according to the ratio of their growth took place in the basic period and the situation was changed in the report period then the corresponding element of the matrix of changeability is equal to -1. In case if correlation of the ratio growth was not changed in the report period in comparison with the basic period or the reference correlation between indices was not set in the NM then the corresponding element of the matrix D is equal to 0.

The evaluation of changeability characterizes the transfer from one level of realization of fixed aims in the NM to another. It expresses a connection between the evaluation's increase of changeability generated by changes in the structure of indices' movements and by the size of the structural changes. This evaluation changes from -1 till 1. C = 1 if all the fulfilled correlations in the previous period are kept in the given period too. C = -1 if all the changes in the structure of indices' movements have a negative character (reduce S). C = 0 if a number of indices' shifts that provides improvement coincides with a number of shifts that makes worse the level of studied property or in case of invariability of this level.

The evaluations of S and C are measuring instruments that are not dependent from each other. S characterizes the studied level in one period and C evaluates the structural changes when transferring from one level to another.

The integral evaluation that reflects combined influence of these processes is calculated according to the formula $C = Y^{\frac{2}{И-1}}$ (38). S is the integral evaluation of stability.

The formed NM can be observed as a factorial system. The influence of each factor on the growth of S which is an effective index is determined by the formula:

$$\text{if} \quad \text{if} \quad \text{in other cases} \quad \wedge S(P_i) = \frac{\sum_{j=1}^{n} b^{0}_{ij} - \sum_{j=1}^{n} b^{б}_{ij}}{\sum_{i=1}^{n}\sum_{j=1}^{n} |e_{ij}|} \quad (39), \text{ wh}$$

ere

$\Delta S(P_i)$ is a growth of the economic stability caused by the dynamics of correlation of the i index's rate growth with other indices; n is a number of indices in the profile of the economic stability; i, j are numbers of indices in the profile; b^{0}_{ij}, $b^{б}_{ij}$ are elements of matrix of coincidences of factual and reference correlations of the rate growth of indices in the report and basic periods correspondingly; e_{ij} is an element of a matrix of reference correlations between the growth rates of indices. The formed NM can be observed as a factorial system. The influence of each factor on the growth of S which is an effective index is determined by the formula:

$$\Delta Y(П_i) = \frac{S(P_i)_j - \sum_{j=1}^{n} b^{б}_{ij}}{\sum_{i=1}^{n}\sum_{j=1}^{n} |e_{ij}|} \quad (39), \text{ where}$$

$\Delta S(P_i)$ is a growth of the economic stability caused by the dynamics of correlation of the i index's rate growth with other indices; n is a number of indices in the profile of economic stability; i, j are numbers of indices in the profile; b0ij, bбij are elements of matrix of coincidences of factual and reference correlations of the rate growth of indices in the report and basic periods correspondingly; eij is an element of a matrix of reference correlations between the growth rates of indices. Such examples of building the normative and evaluative models and evaluation S and its increases are given in the works [15], [16]. It is necessary to realize the closing operation by multiplying table 3 eighteen times to get the normative and evaluative model of the economic stability of the DIC enterprises. The normative and evaluative model is in table 4.

3. Results of the study

A high efficient SC would bring great benefits to an enterprise such as integrated resources, reduced logistics costs, improved logistics efficiency, and high quality of overall level of services. In contrast, an inefficient SC will bring additional transaction costs, information management costs, and resource waste, reduce the production capacity of all enterprises on the chain, and unsatisfactory customer relationships. So the evaluation of a SC is important for an enterprise to survive in a competitive market in a globalized

business environment. The dynamics of the economic stability of the DIC enterprise has been studied over short time periods of evaluation: 2015-2016 and 2016-2017. As a result the integral evaluations of the economic stability of enterprises of radio-electronic cluster have been received and their ratings have been build. The management solutions and actions to increase the economic stability have been also offered.

The calculation values of the economic stability were:

- for JSC "Kalugapribor" were: 2016 by 2015 of the evaluation of steadiness S=0,702703, 2017 by 2016 S=0,702703, the evaluation of changeability C=0,000000, the evaluation of stability = 0,493791.

- for JSC "Concern"Avtomatica" were: 206 by 2015 of the evaluation os steadiness S=0,702703, 2017 by 2016 S=0,621622, the evaluation of changeability C=-0,428571, the evaluation of stability = 0,189383.

- for JSC "PNIEI" were: 2016 by 2015 of S=0,702703, 2017 by 2016 S=0,567568, the evaluation of changeability C=-0,294118, the evaluation of stability = 0,200932.

- for JSC "BPO"Progress" were: 2016 by 2015 of S=0,756757, 2017 by 2016 S=0,486486, the evaluation of changeability C=-0,416667, the evaluation of stability = 0,084547.

- for JSC "NPO"Signal" were: 2016 by 2015 of S=0,810811, 2017 by 2016 S=0,621622, the evaluation of changeability C=-0,538462, the evaluation of stability = 0,127432.

- for JSC "PO"Electropribor" were: 2016 by 2015 of S=0,594595, 2017 by 2016 S=0,513514, the evaluation of changeability C=-0,230769, the evaluation of stability = 0,176781.

Table 3. The formalized matrix of preferences for measuring the economic stability of the DIC enterprise

No	The name of the index																		
1	Average staffing level, S	0	-1	-1	-1	-1	-1	0	0	0	0	-1	-1	-1	-1	-1	-1	-1	-1
2	Staffing level till 35 years old, Sm	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	Volume of production, Q	1	0	0	-1	1	0	0	0	0	0	-1	0	0	-1	0	-1	0	0
4	Volume of the SDO, Qg	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	Main funds on full initial cost, F	1	0	-1	0	0	-1	0	0	0	0	-1	0	0	-1	0	-1	0	0
6	Main funds on residual value, F'	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
7	General utilization of capacity, U	0	0	0	0	0	0	0	-1	0	0	0	0	0	0	0	0	0	0
8	Utilization of capacity for realization of the SDO, Ug	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
9	Duration of production cycle, D	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
10	Volume of material stock, Qms	0	0	0	0	0	0	0	0	-1	0	0	0	0	0	0	-1	0	0
11	Volume of realized production, Qrp	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
12	Volume of financing, Qf	1	0	0	0	0	0	0	0	0	0	0	0	-1	0	0	0	0	0
13	Volume of targeted financing, Qtf	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
14	Volume of innovative production, Qinov	1	0	1	0	1	0	0	0	0	0	0	0	0	0	1	1	1	1
15	Value of non-material assets, Vna	1	0	0	0	0	0	0	0	0	0	0	0	0	-1	0	1	0	0
16	Value of assets, Va	1	0	1	0	1	0	0	0	0	1	0	0	0	-1	-1	0	0	0
17	Number of used modern technologies, N	1	0	0	0	0	0	0	0	0	0	0	0	0	-1	0	0	0	-1
18	Number of own used technologies, No	1	0	0	0	0	0	0	0	0	0	0	0	0	-1	0	0	1	0

Table 4. The normative and evaluative model of economic stability of the DIC enterprise

No	The name of the index																		
1	Average staffing level, S	0	-1	-1	-1	-1	-1	0	0	0	0	-1	-1	-1	-1	-1	-1	-1	-1
2	Staffing level till 35 years old, Sm	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	Volume of production, Q	1	0	0	-1	1	0	0	0	0	0	-1	0	0	-1	-1	-1	0	0
4	Volume of the SDO, Qg	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
5	Main funds on full initial cost, F	1	0	-1	-1	0	-1	0	0	0	0	-1	0	0	-1	-1	-1	0	0
6	Main funds on residual value, F'	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
7	General utilization of capacity, U	0	0	0	0	0	0	0	-1	0	0	0	0	0	0	0	0	0	0
8	Utilization of capacity	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0

	for realization of the SDO, Ug																		
9	Duration of production cycle, D	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
10	Volume of material stock, Qms	0	0	0	0	0	0	0	0	-1	0	0	0	0	-1	-1	-1	0	0
11	Volume of realized production, Qrp	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
12	Volume of financing, Qf	1	0	0	0	0	0	0	0	0	0	0	0	-1	0	0	0	0	0
13	Volume of targeted financing, Qtf	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
14	Volume of innovative production, Qinov	1	0	1	0	1	0	0	0	0	1	0	0	0	0	1	1	1	1
15	Value of non-material assets, Vna	1	0	1	0	1	0	0	0	0	1	0	0	0	-1	0	1	0	0
16	Value of assets, Va	1	0	1	0	1	0	0	0	0	1	0	0	0	-1	-1	0	0	0
17	Number of used modern technologies, N	1	0	0	0	0	0	0	0	0	0	0	0	0	-1	0	0	0	-1
18	Number of own used technologies, No	1	0	0	0	0	0	0	0	0	0	0	0	0	-1	0	0	1	0

The results of factorial analysis of the dynamics of the economic stability of the REC enterprise are on the pictures 2-7.

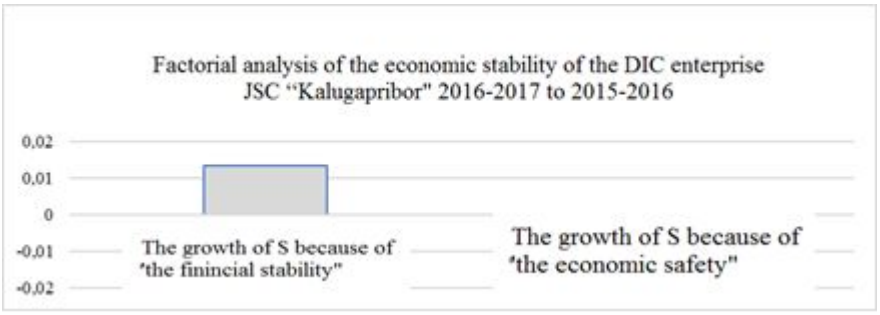

Figure 2. Factorial analysis of the dynamics of the economic stability of the JSC "Kalugapribor"

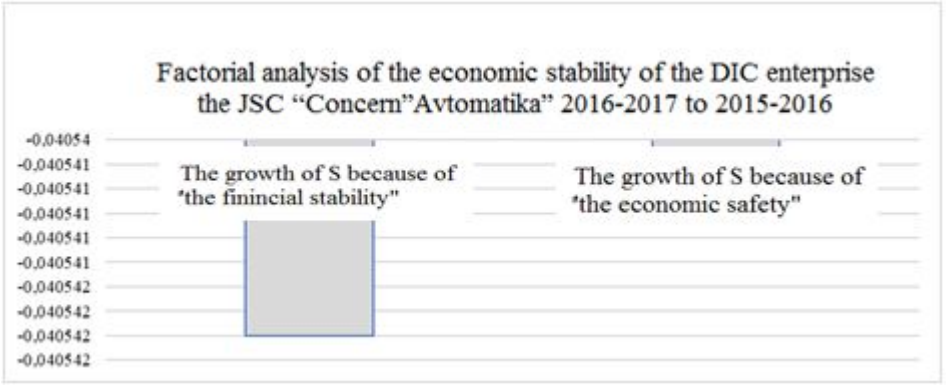

Figure 3. Factorial analysis of the dynamics of the economic stability of the JSC "Concern"Avtomatika"

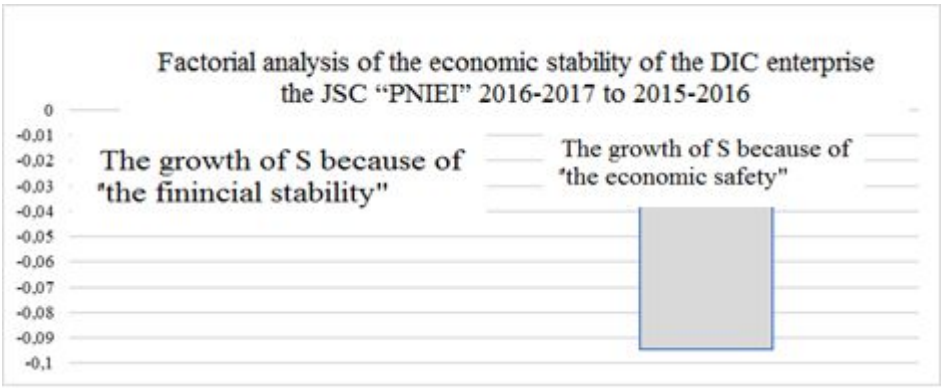

Figure 4. Factorial analysis of the dynamics of the economic stability of the JSC "PNIEI"

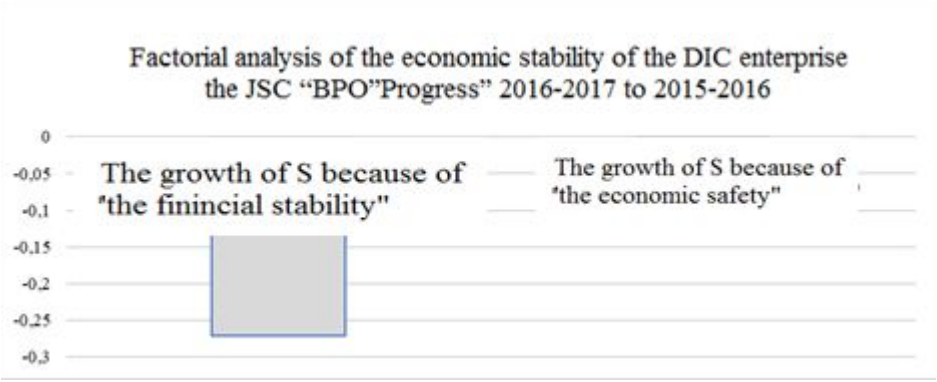

Figure 5. Factorial analysis of the dynamics of the economic stability of the JSC "BPO"Progress"

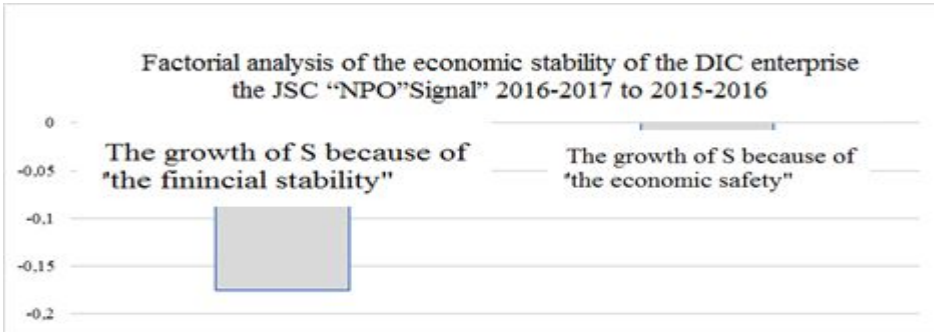

Figure 6. Factorial analysis of the dynamics of the economic stability of the JSC "NPO"Signal"

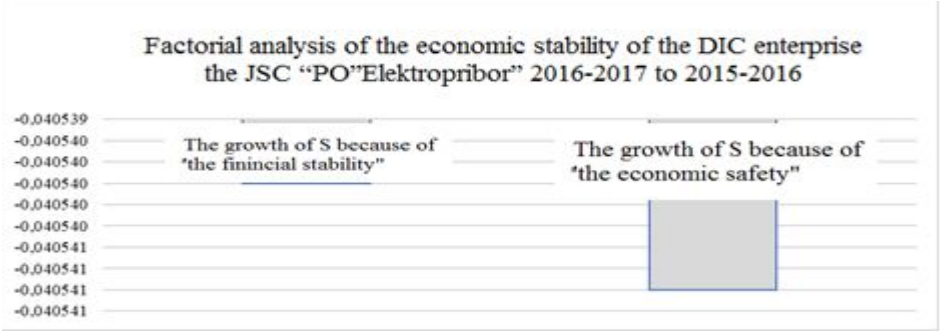

Figure 7. Factorial analysis of the dynamics of the economic stability of the JSC "PO" Elektropribor"

Based on the received evaluations of the economic stability for two periods of the analysis the ratings of the DIC enterprises are offered (table 5).

Table 5. The ratings of the DIC enterprises included in the REC.

The name of the enterprise	The rating for the basic period	The rating for the report period
JSC "Kalugapribor"	0,702703 – 3 place	0,702703 – 1 place
JSC "Concern"Avtomatika"	0,702703 – 3 place	0,621622 – 2 place
JSC "PNIEI"	0,702703 – 3 place	0,567568 – 3 place
JSC "BPO"Progress"	0,756757 – 2 place	0,486486 – 5 place
JSC "NPO"Signal"	0,810811 – 1 place	0,621622 – 2 place
JSC "PO"Elektropribor"	0,594595 – 4 place	0,513514 – 4 place

Based on the results of the study introduced in table 5 we made a conclusion that all studied enterprises had worsened their position. The evaluations of the economic steadiness decreased in the report period in comparison with the basic one. As we see the JSC "Kalugapribor" took the leading position. It happened because of the positive influence of the factor "the financial stability". The results of the study have shown that four REC enterprises have financial difficulties and they are on the verge of bankruptcy. The following enterprises have the largest amount of bankruptcy's features: the JSC "BPO" Progress" (the 1st place), the JSC "Concern" Avtomatika" (the 2nd place) and the JSC "PNIEI" (the 3rd place).

To increase the economic stability of the enterprises of the radio-electronic cluster we offer:

- the JSC "Kalugapribor" should review the innovative strategy and increase the number of own used technologies. It will allow to increase the volume of the SDO and production and to increase the utilization of capacity.

- the JSC "Concern" Avtomatika" and the JSC "PNIEI" should pay attention to the capacity of the workforce and property potential. They should carry out financial recovery activities that will allow to review innovative strategy in future and to increase the volume growth of innovative products.

- the JSC "BPO" Progress" should pay attention to the capacity of the workforce and to carry out financial recovery activities.

- the JSC "NPO" Signal" and the JSC "PO" Elektropribor" should carry out financial recovery activities and work out a new strategy of development.

4. Conclusion

From the research results show that supply chain capacity increases the business efficiency of enterprises. It can be seen that enterprise standardization of supply chain processes and the removal of unnecessary processes will save time and costs. The main scientific issue is the evaluation of the dynamics of the economic stability of the DIC enterprises in modern conditions. Its solution will allow to solve the problem of choice of the management decisions for their modernization. A standard approach to evaluate the dynamics of the economic stability is not applied to the enterprises oriented on fulfillment of the SDO and on science-oriented enterprises as the specific of their activity is not taken into account. It is also necessary to use a large number of indices in small time periods. To solve this science task the interpretation of the economic stability of the enterprise is given, the profile of economic stability of the DIC enterprise is offered, pairwise coefficients are set and their economic sense is given, the normative and evaluative model with great informative capacity is worked out and approved.

These scientific results let see the monitoring of the dynamics of the economic stability of enterprises of radio-electronic cluster of the DIC and give the management solutions and offer activities to increase the economic stability.

The produced results allow to confirm that the given methodological developments can be used for a large spectrum of tasks connected with monitoring of strategies of enterprises' development and other objects of strategic planning. This method does not require serious mathematical tools but it is necessary to use automatized working for calculation values while increasing the used indices. That is why the authors use the own computer program. They realized the development of the normative models to get the integral quantitative evaluations of the investments attraction of the region [15].

References

[1] The official web-site of the state corporation Rostekh URL: https://rostec.ru (accessed 15.05.19).

[2] The official web-site of TASS URL:https://tass.ru/armiya-i-opk/6209308 (accessed 15.05.19).

[3] Chuprov S.V. "*The development of scientific opinions on stability of economic systems in the historical retrospective review*", Historical and economic researches. No. 1–2 (T. 14). 15–32 pp, 2013.

[4] Kochetkov S.A., Tikhomirov S.V. *"The financial stability as economic category and its role in economic mechanism of the enterprise"*, Modern high technologies. The regional supplement. The economic sciences, No. 2 (34). 57–65 pp, 2013.

[5] Altman E.I. "*Financial ratios, discriminant analysis and the prediction of corporate*

bankruptcy", Journal of finance, pp. 589−609, September 1968

[6] Biver W. "*Information content of annual earnings announcements*", Journal of accounting research, 1968.

[7] Debt ratios URL: http://afdanalyse.ru/publ/finansovyj_analiz/1/koehfficienty_obsluzhivanija_dolga/15-1-0-155#dscr (accessed: 15.05.19).

[8] IFRS, DipIFR URL: http://msfo-dipifr.ru/msfo-chto-eto-takoe/ (accessed: 15.05.19).

[9] Sakharov G.V., Burtseva T.A., Kushnir K.A. "*Perspectives and problems of introduction the international standards of financial accounting for Russian corporations*", Scientific works of free economic union, No. 5. 351-363 pp, 2016.

[10] Landsman, Wayne R. and Maydew, Edward L. and Thornock, Jacob "*The information content of annual earnings announcements and mandatory adoption of IFRS*", Journal of Accounting & Economics (JAE), Forthcoming. Available at SSRN: https://ssrn.com/abstract=1337567, April 14, 2011

[11] Bakanaev I.L., Tsokaeva L.A., Movtigova M.A. "*The economic stability of the enterprise activity",* A young scientist, No. 3. pp. 455–457, 2016.

[12] Konyashova A.V., Merzlikina G.S. "*The method of the degree evaluation of the economic stability of the enterprise development",* Business. Education. Law, No. 4 (21), pp. 174–179, 2012

[13] Aksenova O.V. "*The modern approaches to define the stability of the enterprise development: correlation of the growth and development"* Scientific herald of RANEPA (Economy), No. 1, pp. 21–26, 2015.

[14] Fedotova M.A., Rodionova V.M. *"The financial stability of an enterprise in the conditions of inflation"*. Moscow, Perspective Publ., 1995.

[15] Burtseva T.A. "*Indicative model of monitoring the investment's attraction of the region",* Questions of statistics, No. 6. 37-45 pp, 2009.

[16] Pogostinskaya N.N., Pogostinskii Yu.A., Vlasova M.S. "*Measuring the strategy for socio-economic development of the Russian Arctic zone",* Arctic: Ecology and Economy, No. 1 (33), pp. 21-33, 2019.