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A MULTIDIMENSIONAL CLASSIFICATION FOR THE INFORMATION TECHNOLOGY MARKET

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A MULTIDIMENSIONAL CLASSIFICATION FOR THE INFORMATION TECHNOLOGY MARKET ³

This paper expands the existing informational and analytical opportunities of application of the results of business tendency surveys which solve the problem of the loss of valuable statistical information in its traditional aggregation into simple and composite indicators. Based on methods of multidimensional classification, an algorithm of statistical analysis significantly raises the analytical opportunities for the more wide measurement of trajectories of development and short-term fluctuations of branch of the information technology (IT) is developed and discussed. This allows the construction of behavioral models of business tendency data which improve the understanding of the business cycle in more detail. Furthermore the empirical results confirm the possibility of receiving various information which increases the analytical potential of business tendency surveys.

Keywords: information and communication technology (ICT), information technology (IT), business climate, business tendency surveys, behavioral models, digitalization.

JEL: C1, C81, C38, C83, E32, E39, L26, L1, O10, O11, O19, M2

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Introduction

The diffusion of digital technology into social and economic systems defines the scientific and practical importance of research on the measurement of dynamics of the development of information technologies branch (IT). As the integral parameter for transformations in the economy and other spheres, IT is an important mechanism for successful innovation and for promoting information and communication technologies (ICT).

Global production of ICT goods and services makes up about 6.5% of the global gross domestic product (GDP), and about 100 million people are occupied in sector of ICT services (Information Economy Report 2017: Digitalization, Trade and Development, 2017). However in contrast to Russia, the ICT sector plays significantly more important role in the majority of the developed countries—its share in gross value added (GVA) of the business sector in OECD (Organisation for Economic Co-operation and Development) countries is 1,6 times higher (3,4% and 5,4%, respectively) (Abdrakhmanova et al., 2018). The absolute size of the IT market in Russia remains relatively small: the share of IT expenditure to GDP in Russia is only 1.1% while in developed countries it is 3–4% (Federal'naja sluzhba gosudarstvennoj statistiki, 2017).

The global economic crisis and the consequent fluctuations in business tendencies lowered ICT value added in general in most OECD countries and Russia while it increased in the IT segment, especially, in the software development branch. In 2017 the Russian ICT sector GVA gain (2.8% in real terms) was almost twice that of the GDP gain (1.6%). The main contribution to this was made by IT branch, which grew by 12% (Abdrakhmanova et al., 2018).

According to the OECD Digital Economy Outlook 2017, in 2015 investments in ICT in OECD countries were 11% of the total investments in fixed capital and 2.3% of the gross domestic product (GDP). Nearly 60% of investments were made in computer software and databases, which dominated the IT market trends including Russia. In particular, in 2016 Russian investments in ICT were 3.1% of GDP (Indikatory cifrovoj jekonomiki: 2018, 2018) and in 2015 they were 3.2% of investments in fixed capital (Indikatory cifrovoj jekonomiki: 2017, 2017).

At the same time, the IT sector has high export potential. So, in 2015 in the OECD the share of ICT in GDP was more than 5%. In some countries, this indicator was even higher: in South Korea it was more than 10%, in Japan and Sweden it was over 7% (OECD 2017a).

IT research is currently focused on quantitative and qualitative aggregated standards. The available analytical frameworks are mainly presented by various information resources which contain mainly cumulative estimates of the ICT sphere and cover IT sphere partially.

Ratings and indices are widespread sources of information but owing to the aggregated approach of their construction and visualization, they do not allow the measurement of short-

term fluctuations of the IT segment quickly (RAEX (Jekspert RA, 2018), “CNews Analytics” (CNews Analytics, 2018), “E-Government Development Survey” (E-Government Development Survey, 2018), ICT Development Index (IDI) (ICT Development Index 2017, 2018), “ICT Globalization Index”, “Networked Society City Index”, “The Web Index” (The Web Index, 2018), e-Friction Index (Boston Consulting Group + ICANN (Low J-R, 2015)) etc.). This is also true for analytical reports by various research organizations (IDC Russia/CIS, Gartner (Gartner, 2018), Ernst & Young (Ernst & Young, 2018), J`Son & Partners (J`Son & Partners, 2018), The Web Index, Web Index Report etc.).

With the use of the aggregated values, such data cannot be used in more detail to describe the development of ICT or to assess the achievement of the established purposes and tasks. For example, ICT Development Index (IDI) by the International Telecommunication Union (ITU) represents a unique control indicator of the development of ICT worldwide. This instrument tracks the so-called “digital inequality” between technologically advanced countries and other world. IDI includes 11 indicators for access to, use of and skills in ICT. Key aspects of ICT are covered by a single measure that allows comparisons between the countries and over time. IDI-2017 covers 176 countries and, in comparison to IDI-2016, shows that in almost all countries there has been progress in access to and use of ICT. The comparison also shows that in the difference in ICT development between more and less developed countries remain considerable. This need to be eliminated so all societies can contribution to sustainable development and other international level.

The leading region in development of ICT is Europe, demonstrated by the IDI value which is higher than the world average (7.50). This reflects the high level of economic development of the region, the existence of the competitive markets and high levels of skills in ICT. According to ITU data, the ICT development index 2017, the first five countries are Iceland (8.98), South Korea (8.85), Switzerland (8.74), Denmark (8.71), and Great Britain (8.65). Russia is 45th having lost two positions since 2016, although Russia’s ICT development index grew from 6.91 to 7.07 (ICT Development Index 2017, 2018).

There are some advantages in identifying worldwide tendencies using these sources, since, for example, ratings show the conditions for transforming branches, reveal barriers and define priorities for state policy. They set the thinking for how to separate sectors, in particular of the Russian economy, so they are not left out of “digital revolution”, and to create an ecosystem of strong players who can provide ideas and strategies for big data.

There are frequent changes in the calculation for assessing ICT sectors which often involve change caused by stereotypes, the geopolitical situation and the dynamics of key national macroeconomic trends. Thus, along with their advantages, some problems of the most

widespread information content are the variety and instability of methodological approaches, the representativeness of samples, the instability of the distribution of published information, the narrow range of composite indicators for business climate estimated on the basis of business tendency surveys. It is difficult, therefore, to distil and detail the development of IT segment at various stages of the business cycle. The increasing scale and the considerable uncertainty related to ICT require more information, direct dialogue with participants, and actions from all the parties. In the OECD, questions about the measurement of these services in the system of National accounts (SNA) and the sufficiency of the statistical framework both for large-scale research of branch processes and for receiving of the detailed estimates are more and more relevant (OECD 2017a).

It is possible to collect more, and more reliable, information using the analysis of the development of the IT segment at the company level when carrying out business tendency surveys. For modeling the business climate, timely expanded estimates through the use of periodical monitoring (not only from decision-making bodies, but also from economic agents) can accelerate the acceptance of strategic corrective actions (especially in post-recessionary or stagnant phases of the business cycle).

Long-term international and Russian research demonstrates that statistical time series and business-climate indicators (BCI) calculated on their basis, are necessary for complex, and local monitoring of branch tendencies in various sectors of economy (EC, 2017, OECD, 2003). However, in practice in many countries there are no the published aggregated indicators for the measurement of the IT segment.

In Russia for the analysis of the IT segment a system of nonparametric indicators and the composite indicator of business activity calculated on their basis, the index of enterprise confidence (IEC), is used. IEC is the average of the estimates (as percentage changes in demand for services during the current quarter in comparison with the previous quarter, and also the expected change of demand for services in the following quarter). This indicator has wide circulation in business tendency surveys in the European Community and the Eurozone (The Joint Harmonised EU Programme of Business and Consumer Surveys, 2014).

The rapid development of services related to IT needs expansion and a more detailed specification of the currently limited information. The more the ICT sphere grows, the more insistent is the need for methodologically developed tools and the subsequent economic analysis, to react quickly and comprehensively to the current and future tendencies of the IT segment as key conductor of development of technologies. The increasing scale and the considerable uncertainty connected related with digital shift demand the increasing volume of the facts, dialogue directly with participants of technological process and actions of all interested parties.

In this regard it is expedient to involve and expand researches as which basis are the harmonized, methodologically developed statistical tools allowing to measure key tendencies of development of IT segment, proceeding from enterprise estimates in the mode of almost real time.

This paper offers a technique to carry out a detailed structuring of the opinions of heads of IT companies on past, present and future tendencies, on the basis of business tendency surveys of the Russian IT segment.

In particular, an algorithm for the statistical analysis of business tendency surveys based on a multidimensional classification to build and analyze behavioral models at the level of concrete objects of observation. The problem of the cumulative behavior of market participants at various phases of the business cycle, when aggregated industry analysis using only simple and composite indicators is insufficient and can lead to loss of valuable information, is solved.

The behavioral models used data from 2010–17, as important evolutionary period of the development of the Russian IT segment from the point of view of the transformations, flexibility, and opportunities of the organizations to various shocks. In particular, the method details the reaction of behavioral models during the period of post-crisis restoration after the economic crisis of 2008 and the subsequent short stage of dynamic development and until the stagnation in 2015. The method also shows two subsequent phases of a business cycle until 2017. The results of the technique show the structuring of opinions of heads of IT organizations of planned development in 2018.

In general, the main objectives show that the development of IT organizations is well traced using business tendency surveys. A detailed identification of groups allows a careful situational analysis of the IT segment, which:

- a) expands the analytical interpretation of business tendencies of the organizations determined by branch indicators;
- b) confirms the reliability of short-term forecasts from business tendency surveys;
- c) shows an objective reaction to the arising business tendency shocks in various phases of the business cycle;
- d) promotes a more exact measurement of the adaptation potential in the IT segment to business shocks at various phases of a business cycle.

Date and Methodology

1. Empirical base of research

The empirical basis of this research are the results of business tendency surveys of the organizations rendering information — technological services carried out during 2010 — 2017.

According to OKVED2 in Russia to such organizations are carried the economic agents who are carrying out the following kinds of activity: development of the computer software, activity advisory and works in the field of computer technologies, activities for management of the computer equipment, activities for data processing, rendering of services for placement of information and the activity related with it (Indikatory cifrovoj jekonomiki: 2018, 2018). Results of this activity can be realized, both on internal, and in foreign markets.

In particular, within the realization of formation and development of statistical surveys of ICT sphere, since 2010 by the request of Institute for Statistical Studies and Economics of Knowledge NRU HSE, selective specialized business tendency monitoring of business activity of the organizations rendering the service IT are carried out by Autonomous Non-Commercial Organization "Statistics of Russia".

The technique of creation of behavioral models offered in research is based on the sample of the qualitative data obtained during annual polls of heads of more than 600 organizations which are carrying out service IT in 30 regions of the Russian Federation.

The longitudinal nature of the ongoing surveys in the branch of information technologies is caused by comparability of results of surveys. The sample of respondents during each poll is panel in relation to the similar ongoing surveys in the previous periods. All units of pilot business tendency survey keep continuity when forming the sample, providing its multidimensional, stratified nature, and also representativeness on the key economic parameters of thirty regions of Russia.

According to structure of a sample, the distribution of the reporting economic agents demonstrates the prevailing share of small IT organizations with a private property (more than 70%).

The methodology of the ongoing surveys, which is based on the international practice of researches of business climate taking into account the specifics of functioning of the Russian economy, is developed and updated with use of scientific and practical capacity of the international organizations and institutes (The Joint Harmonized EU Programme of Business and Consumer Surveys, 2014). In particular, the methodology of the ongoing studies relates to the some international business tendency surveys (Germany, IFO institute, Munich; France, INSEE – National institute of statistics and economic researches; Switzerland, KOF ETH – the Swiss institute of economy; OECD, Paris, France; and also some other organizations – members of the CIRET – Centre for International Research on Economic Tendency Surveys).

The business tendency surveys characterizing the conditions of business climate of the Russian IT of branch are directed on expeditious receiving from businessmen in addition to official statistical quantitative data of short-term quality standards. The system of nonparametric

indicators which is developed and annually updated for these surveys allows to carry out the analysis of the cross interrelations characterizing scales and short-term changes in a modern phase of economic development of IT branch. The received information represents the main tendencies and dynamics of a situation with the orders for IT services of the organizations, development of labor market, the main activities, competitive advantages, investment activity, pricing, the factors limiting their activity, and also other parameters of business activity in this sphere.

Polls of heads of the organizations rendering information and computer services are carried out under specially developed questionnaires "Surveys of business activity of the organizations rendering information and computer services"; which are annually updated according to specifics of the present business tendency conditions. Monitoring is carried out by the method of self-filling of questionnaires by the directors or managers of the organizations possessing the necessary level of competence of the relation of the questions asked in the questionnaire. Selection of the organizations for carrying out polls about business tendencies are carried out by statistical territorial authorities of the state independently.

The system of indicators and the structure of appropriate questions in the programs of surveys of business climate is based on the following methodological principles:

- questions belong to characteristics of activity of directly surveyed IT organization;
- questions reflect the dynamics of indicators in a year;
- three-category graduation is used on all questions concerning estimates of dynamics of indicators: growth (+), no change (=), decline (-);
- all information received during business tendency surveys has a qualitative nature.

The group of the variables included in the technique of creation of behavioral models contains in the section of questionnaires — "Indicators of activity of the organization" and characterize the flowing and expected demand changes; investment activity; competitiveness; economic situation.

2. The creation of the behavioral models

It should be noted that the offered technique based on methods of multidimensional classification allows to analyze various processes of the deep branch changes which arose owing to influence on the organizations of various on scale business tendency factors (Ajvazjan et al., 1974), (Aleskerov et al., 2013), (Arhipova et al., 2010). For the first time in Russian statistical practice, being based on the information base of qualitative type containing estimates of financial and economic activity of the heads of organizations rendering it is informational and

technological services, without using the habitual aggregated estimates, changes of behavioral reactions to business shocks are revealed and analyzed. Using the models, the transformation of entrepreneurial mindsets during the business cycle over the last ten years that allowed to raise considerably the existing analytical opportunities of measurement of business activity and an assessment of a cumulative condition of business climate of IT segment in general is thoroughly investigated.

At the same time, in this research, it is proved that the cyclical analysis, which, based on calculations of balances of estimates of respondents and composite indicators of business climate is not the only measure of information potential of business survey tendencies promoting careful analytical study of branch tendencies. A similar point of view is found in research studying the practical application and distribution of business polls (Mitchell et al., 2002), (Crosilla et al., 2010). In particular, after the analysis, which is carried out, by Carlson and Parkin in many works, the criticism of use only of a balance method of quantification of a final data of surveys was traced. It is necessary to understand the identification of the balance value as the difference of shares of the respondents who noted an increase or decrease of value in any indicator in comparison with the previous period (as a percentage).

Among the foreign researches studying problems of quantification of information, it is possible to note the work of the Italian researchers of ISAE "New proposals for the quantification of qualitative survey data" (Proietti et al, 2007) based on the spectral analysis of the business climate tendency. The methods of quantification of surveys, in particular the method of scaling of qualitative signs and their quantification are also discussed in one of the researches of ISAE specialists (Crosilla et al, 2009) and in the paper of their German colleagues from the ifo institute - CESifo Group Munich (Pesaran et al, 2005).

The logic of the processing and interpretation of results of surveys is that the initial data appear in the form of distributions of opinions who specified one of answers "increase", "no change", "decrease" or if the indicator is, "above normal level", "at normal level", "below normal level". In the classical theory of measurements, the scale is identified as unambiguous display of empirical system on the relations in numerical system with the corresponding relations. Within such questions between the surveyed objects the sequence relations are established, and the corresponding qualitative signs are measured by a serial scale. Thus at each point of such a scale a certain number demonstrating the relative intensity of a qualitative sign is identified (Suppes et al., 1962), (Pfanzagl, 1976), (Kitrar et al., 2018).

International and Russian experience of representation of results of business tendency surveys on large and small businesses shows that the information weight of each separately taken position forming balance of an indicator represents very important information. A more careful

study of such information can represent useful data of various operational indicators of activity of IT organizations. This aspect is especially important when studying the cumulative behavior of businesses during specific phases of the business cycle and when it is necessary to detail the reactions of businesses to real or expected economic events.

As information sources for studying behavioral models, there are primary results (answers in questionnaires) of annual business tendency surveys of the organizations rendering the service IT which are carried out by Rosstat to the period from 2010 to 2017 (8 surveys) acted. The sample for each surveyed period varied in the range of 650 sampling units.

As variables, four indicators of business activity were chosen from a form of statistical monitoring as an expert way. The executive (the head of IT organization), comparing a situation in firm on each indicator during this period in comparison with previous and the subsequent in comparison with the current year, noted that situation improved, remained the same or worsened. From this, it follows that each firm was characterized by 8 variables, from which 4 are actual and 4 are expected. These include actual and expected: demand for services (x1; x2); investment (x3; x4); company's competitiveness (x5; x6); assessment of overall economic situation (x7; x8).

The basis for a choice of such indicators were the following reasons:

- the part of the indicators from the given set characterizing the actual and expected estimates of respondents are a part of the composite indicator of business climate – an index of enterprise confidence;
- throughout the entire period of carrying out business tendency surveys of IT segment expected short-term expectations of these variables are characterized by the best reference points of enterprise moods, and also further prospects of branch development;
- empirical experience of results of business tendency surveys shows that the flowing and expected (forecasted) estimates of respondents on each of the chosen indicators give complementary information on position of the organization, give the accurate and coordinated auxiliary characteristic to branch processes.

When carrying out classification the method of k-averages is applied. The formalized description of algorithm is given below.

S – is a set of clusters, $S = \{S_1, \dots, S_K\}$, where K is the number of clusters. μ_i – is a centroid of cluster S_i , $\mu_i \in \mathbb{R}^N$. There are M objects of clustering, which are IT organizations in this research. ($M = 600$):

$$X = \{x_1, \dots, x_m\}, \text{ where } \forall j = \overline{1..M}: x_j \in R^N \quad (1)$$

where $N = 8 * 1 = 8$ (annual data for 2010-2017).

As a proximity measure in this algorithm the Euclidean metrics was used:

$$\rho(a, b) = \|a - b\| = \sqrt{\sum_{p=1}^N (a_p - b_p)^2}, \text{ where } a, b \in \mathbb{R}^N. \quad (2)$$

The classification problem is in the minimization of the total square deviation of objects x_i from the centroid of clusters μ_i and is as follows:

$$\sum_{i=1}^K \sum_{x_j \in S_i} \rho(x_j, \mu_i)^2 = \sum_{i=1}^K \sum_{x_j \in S_i} \|x_j - \mu_i\|^2 \rightarrow \min. \quad (3)$$

Functionality of quality – the minimization of a total square deviation of objects of x_i from the centers μ_i of clusters of S_i where $i=1,2\dots9$. Originally, as the center of clusters its ideal representatives to which each studied object (organization) is compared acted.

As a result of the preliminary analysis 9 clusters, at the heart of which three typological groups of companies were allocated: high (type A); average (type B) and low potential of business activity (type C).

The group of type "A" is presented by the organizations in which for the considered year positive estimates of these indicators were noted (i. e. businessmen in the questionnaire pointed to increase in demand, investments, competitiveness, etc.). The group of type "B" included the organizations with which during the studied period the dynamics of indicators remained without change of rather previous year. The group of type "C" is presented by the organizations at which decrease in economic activity in comparison with the previous monitoring period was observed.

As a result, 9 behavioral groups together with a task of an initial arrangement of centroid of a clustering are presented to (Table 1) ($\mu_1 \dots \mu_M$). Each object of a clustering of x_i is characterized by a set of indicators:
 $= (\text{sps_t_ft}, \text{inv_t_ft}, \text{kov_t_ft}, \text{eso_t_ft}, \text{sps_s_et}, \text{inv_s_et}, \text{kov_s_et}, \text{eso_s_et}) \quad (4)$

Tab. 1. Centroids of clustering

Source: composed by the authors

Questions and answers Designation			Behavioral groups								
			TYPE «A»			TYPE «B»			TYPE «C»		
			AA	AB	AC	BA	BB	BC	CA	CB	CC
The actual trend (ft)	Demand	sps_t_ft	1	1	1	2	2	2	3	3	3
	Investment	inv_t_ft	1	1	1	2	2	2	3	3	3
	Company's competitiveness	kov_t_ft	1	1	1	2	2	2	3	3	3
	Assessment of overall economic situation	eso_t_ft	1	1	1	2	2	2	3	3	3
Expected trend (et)	Demand	sps_s_et	1	2	3	1	2	3	1	2	3
	Investment	inv_s_et	1	2	3	1	2	3	1	2	3
	Company's competitiveness	kov_s_et	1	2	3	1	2	3	1	2	3
	Assessment of overall economic situation	eso_s_et	1	2	3	1	2	3	1	2	3

Results of the given technique will be involved in the analysis of a condition of business climate of IT segment for identification and a specification of behavior of businessmen in the period of the most evident cyclic episodes and business tendency calls during 2010-2017.

Findings

According to the presented technique, for formation of a detailed picture of evolutionary development of IT segment, we will consider the obtained behavioral models reflecting reaction of respondents—participants of poll on the developing business tendencies during 2010 — 2017. Along with quantitative indices, the results of the development of the Russian IT segment for the specified period were traditionally represented by the aggregated indicators of business activity that limits possibilities of carrying out expanded analytical interpretation of branch changes, the decision to detail reaction of respondents and to present 8 behavioral models containing results of each business survey to the comparative analysis was made.

In particular, such timeline and its subsequent analysis covering retrospective results since 2010 in our opinion is an important and necessary condition in achievement of one of important research problems which is in identification of adaptation potential of IT segment by

the totals of 2017 that is possible only when comparing of the happened changes in entrepreneurial mindsets seven years later. Earlier periods in this case are basic, allowing to compare models of behavioral groups of different years and by that to expand an analytical assessment of a condition of IT segment in general.

Besides, such extensive time coverage is actual from the point of view of the opening possibility of carrying out the careful comparative analysis between each model reflecting changes in entrepreneurial mindsets on the changing environment or the arising shocks. It should be noted that development of the IT companies in the studied time interval happened within enough difficult micro- and macroeconomic transformations. First of all, it is about the period of the general unstable business climate in Russia created as a result of financial and economic crisis of the end 2008 - the beginning of 2009 which consequences continued to have negative impact on their positions at advance of development on the market of the corresponding services within the next several years.

During the period there was also important transformations owing to reforms of IT which was followed by an intensification of the informatization and digitalization of the Russian economy. The estimates contain the major business tendencies which can be useful for the complex coordination of measures defining the foresight of IT.

Thus, will consider the behavioral models reflecting changes in IT organizations in groups according to reaction of entrepreneurs to the post-crisis business tendencies which developed during the base period (2010–2011).

At estimation of the received behavioral models specifically we will track distribution of the organizations not only possessing high and low potential (type "A" and "C", respectively), but also the surveys making throughout the entire period the most stable group "B".

Fig. 1 visualizes the behavioral models reflecting groups of the organizations according to their reaction to economic changes in 2010 and 2011.

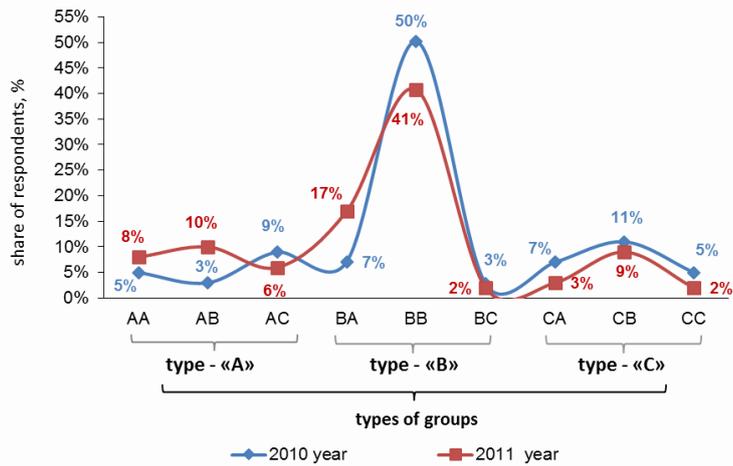


Fig 1. The changes in behavioral models of IT organizations (2010-2011)

Source: composed by the authors

Proceeding from the received groups it is possible to draw a conclusion that in 2010 and 2011 the majority of firms (60% on selection) belonged to type "B" and were concentrated round a neutral position on the relation as to the current estimates, and short-term expectations. However, in 2011 in group with neutral answers there was an expansion of the BA group reflecting a growth in neutral/positive mood of respondents.

The signals of improvement of a situation in a segment were given also by changes in groups "A" and "C". So, if in 2010 the general share of the organizations in group "C" which heads gave mainly negative estimates to the developed tendencies and expectations, made 23%, in 2011 their share decreased to 14%. At the same time, the general share of the successful organizations increased from 17 to 26%. In addition, in all groups the tendency of growth of positive estimates concerning prospects of development of the companies in 2012 was noted. Thus, proceeding from Fig. 1 it is possible to draw a conclusion that the branch of information and technological services in 2011 followed in a waterway of the stabilization post-crisis measures which caused functioning of business in more favorable market conditions.

Nevertheless, despite 2011 sated with post-crisis compensation activity, it would seem put all prerequisites for further formation of IT sector for future periods, in 2012 the economic situation began to become aggravated. Dynamics of development of the companies was slowed down, and the come period was rather conservative.

The happening changes in 2012 and 2013 rather brightly reveal in behavioral models that reflect changes relatively 2011.

According to the groups defined by the methodology described above, we will consider Fig. 2. In all groups, increase of pessimism in answers respondents is distinctly traced and

growth of groups with negative estimates is recorded. Therefore, relatively 2011 the AC group in 2012 increased from 6 to 10%; "BC" – from 2 to 10%; "CC" - from 2 to 9%. However, in general, the group "A" decreased slightly: from 26 to 23%. Growth of a share of the companies of type "C" made from 14 to 18%.

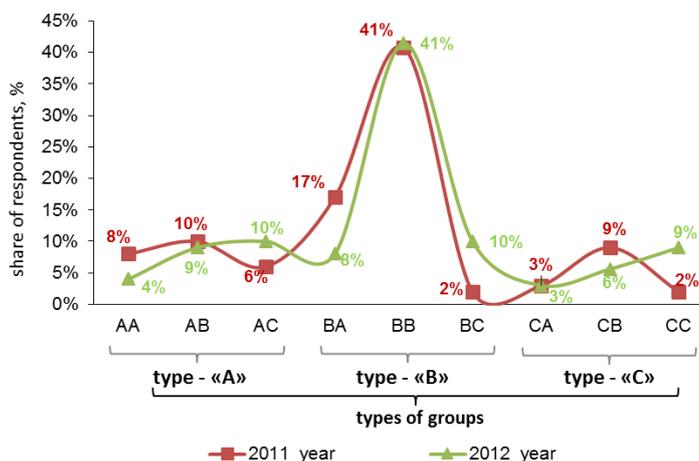


Fig 2. The changes in behavioral models of IT organizations (2011-2012)

Source: composed by the authors

Stagnation, which swept the enterprises of real sector of economy as main customers of services during 2013 and 2014, actually caused the subsequent rigid correction and compression of the market of information and technological services. Thus, if the last periods can be characterized as "resuscitation and recovery", 2014 became critical for a segment.

Similar changes showed also behavioral groups (Fig 3.). First, noticeable narrowing of number of the successful organizations attracts attention (type "A"). If by results of restoration of 2010-2012 their share represented essential part of selection, varying in the range of 23-26%, in 2013 in comparison with 2012 it decreased to 18%. At the same time, there also rose the scale of group "C" in which concentration of IT organizations with a low business potential considerably increased. During 2014, the share of those increased from 18 to 25%, having blocked result of 2010.

At the same time, more careful analysis of enterprise intra group estimates shows to accurately designated underestimated moods of respondents in each type of the organizations concerning short-term prospects of development of business. On all intra-branch groups in 2014 the underestimated moods of rather branch rates of development in 2015 were noted. On each cluster accumulating estimates of the expected changes for the next year (AC, BC, CC), traced signals of approach of a new phase of economic reduction. Especially this tendency was shown in group "C". Validly, according to further chronology of development of a segment, 2014 will become the last moderately positive period for IT market.

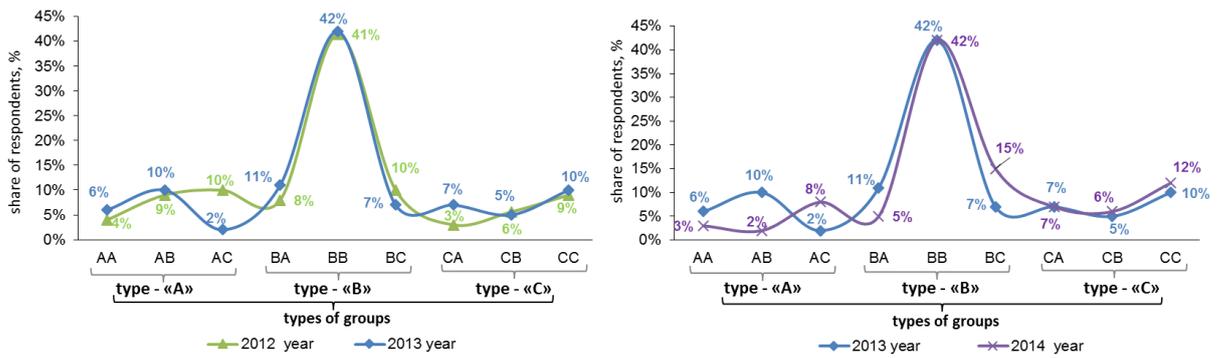


Fig 3. The changes in behavioral models of IT organizations (2012-2014)

Source: composed by the authors

Thus, the visualization of behavioral groups emphasizes that reaction of businessmen in 2014 appeared rather sensitive measurement not only for occurring, but also for future branch changes. Against sharp deterioration of a condition of business climate there was a regrouping of forces among IT organizations and the corresponding change in behavioral models (Fig. 4).

Concerning clusters "B" and "C" the group "A" which collected IT organizations, which also following the results of 2014 had the high potential of development considerably, loses. The share of such organizations in 2015 for all sample decreased to unprecedentedly low 9%, having established the second anti-record (even in 2010 the minimum value made 17%).

At the same time the happening changes in behavioral models reflecting significant increase in comparison with 2014 in a share of the organizations, which got to a cluster "C", to 36% are presented.

Against two presented groups a certain optimism causes a condition of the group "B" which included IT organizations, which heads remained insensitive to current changes and are rather positive to the expected changes in business tendencies. Though this fact is a little leveled by decrease in BB group from 42 to 30%, in general in group "B" the maximum majority of the companies (54%) continued to concentrate being characterized by primary resistance to an external environment.

Nevertheless, specification of each group allows noting that in 2016 there will be favorable correcting changes. First of all, it is reflected by such groups as — "CC", the share of the companies in which in 2015 decreased to 6 against 12% and "CA" — growth to 18 against 7% in 2014, and also "AC" — decrease from 8 to 3%, respectively.

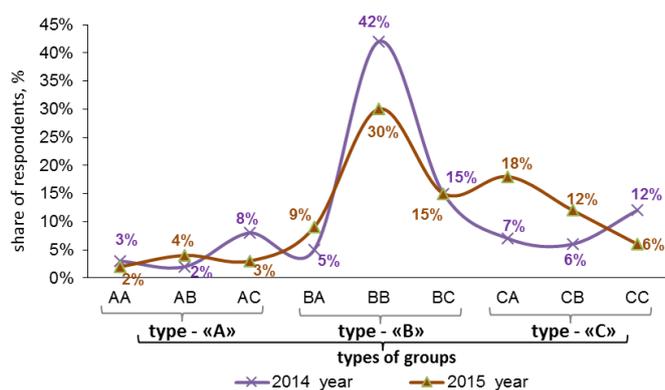


Fig 4. The changes in behavioral models of IT organizations (2014-2015)

Source: composed by the authors

In addition, it is valid, against 2015, obviously crisis for IT integrators of services, in 2016 rather noticeable compensation processes that was expressed in a change of negative dynamics of the indicators characterizing a state business climate are revealed. Positive changes are distinctly visualized in comparison of behavioral models 2015 and 2016 (Fig 5.).

The analysis of each group reflects positive tendencies not only the current, but also future development of a segment. Therefore, for example, during 2016 the group of companies possessing high business potential – from 9 to 16% almost increased twice. The accent in its change is the share of AC group on which it is possible to draw a conclusion on reduction of negative expectations for 2016.

Significant positive changes of rather previous period are traced also in group "C", where the share of the companies with adverse business climate decreased from 36 to 17%. Moreover, in this group the number of respondents ("CC"), who estimate development prospects negatively, decreased.

Similar tendencies are also created in group "B" in which the growth of BA and BB groups is swept up and on their background leveling of "BC" showing easing of neutral / negative estimates. Thus, the adverse business atmosphere, characteristic for last year in the IT sphere, considerably improved, and depressive estimates of heads in 2016 were replaced with more optimistic. Tactical realities, acting as a platform for a creative, continued to increase resistance to stress and adaptability of the IT organizations.

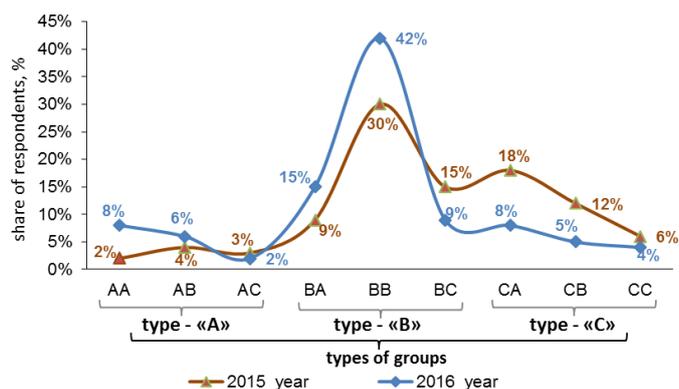


Fig 5. The changes in behavioral models of IT organizations (2015-2016)

Source: composed by the authors

According to the survey conducted in 2017, this segment for the first time since 2014 returned to positive growth rates having shown positive development tendencies. The depressive estimates of respondents created in last surveys considerably were leveled that promoted noticeable updating of the flowing and expected trends.

Changes in the behavioral models of 2015 and 2017 illustrate a rise in IT and a leveling off of negative tendencies. In each group (Fig 6.) the positive regrouping of IT organizations is expressed in the doubling, relative to 2015, in the proportion of successful companies from 9 to 18%, and in the noticeable narrowing of group "C" with 36 to 8% is accented. It should be noted that the reached values on selection are the best according to the nature of the happening processes since 2010.

The behavior of the type B companies representing group "B" which increased from 54 to 74%, emphasizes their adaptation opportunities to the fast economic restoration and their subsequent growth also attracts attention. This fact shows that as of the end of 2017, despite internal restructuring and continuous optimizing reorganization of administrative schemes in practically all branches of the economy, the integrators of the Russian IT market for services show high rates of development.

Considering the changes in the types of respondents reflecting expectations, it is expected that in 2018 IT will continue to increase growth rates.

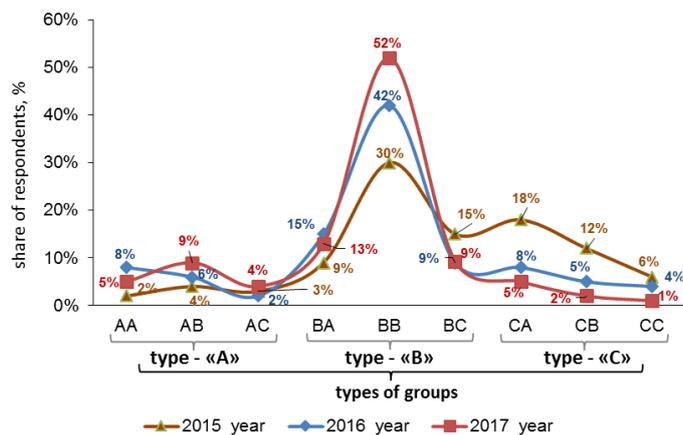


Fig.6. The changes in behavioral models of IT organizations (2015-2016)

Source: composed by the authors

Proceeding from the specifics of the results, it is possible to conclude that the observation over a share of “neutral” answers of respondents (group “B”), which, as a rule, prevails over the remained – “reduction” – “increase”; (the share of those during 2010-2017 fluctuated from 60% to 75%) is not less important.

On the example of comparison of the changes happening to IT organizations within two cyclic episodes in 2011 and 2017 maintaining neutrality of developing business tendencies can be very useful as this group is the most representative. This is an important indicator of the general potential and degree of adaptability of businesses and allows the concretization of the potential level of IT companies in the current and retrospective phase of development.

In the context of the studied set, the behavior of the group with the prevailing share of the companies whose heads during the entire period of surveys were characterized by primary resistance to external business tendencies and was expressed by neutral opinions about the expected conditions for development. This demonstrates the exclusive mobility and quick adaptation of the Russian IT sector to the changing conditions in the post-crisis periods 2010 and 2011, and in 2017, after the recession of 2015.

However, it should be noted that despite expeditious restoration after crisis in 2010 and 2011 the share of IT companies which were concentrated on a neutral position on the current estimates and short-term expectations was much lower than in 2017. The expansion of group “B” which began in 2016 and continued in 2017, having made 74% against 60% in 2010 allows to note that now the enterprise potential and adaptability to macroeconomic fluctuations were considerably stronger (Fig. 7).

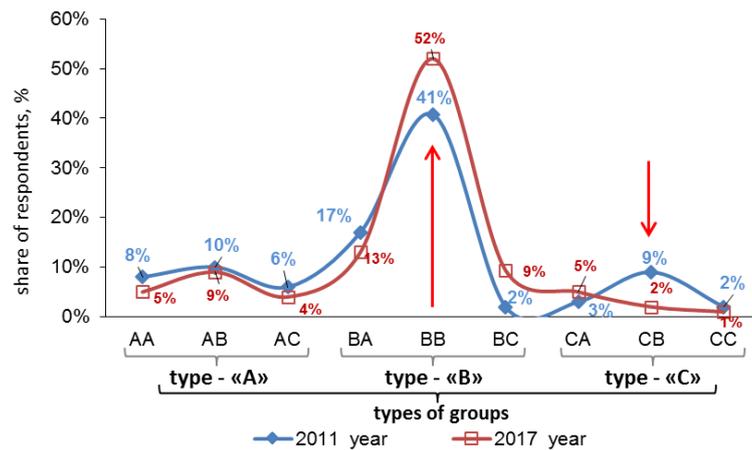


Fig.7. The changes in behavioral models of IT organizations (2010-2017)

Source: composed by the authors

The results confirm that the distribution of such answers could be sufficient during any period, but is most effective at a time of expansion, destabilization, and compensation restoration. When sharp transformations of enterprise estimates are possible, and aggregation can lead to a loss of valuable information at the firm level.

Conclusions

The escalation of social and economic transformations as a result of the many-sided and prompt development of the IT segment has caused the growing research interest in the flow and tendencies which reflect the activity of suppliers of IT services. The existing statistical methods of information accumulation and the tools for the analysis of the business climate are focused on the collection and representation of aggregated estimates. These focus research attention on the general trends, which limits and simplifies the possibilities of analytical study and the interpretation of results.

In this regard, one of our most important conclusions is that the Russian branch of IT, which is actively transforming, needs flexible and modern statistical tools capable of reflecting the responses of the economic community to many key questions related to the short-term features of IT organizations, which are often not reflected in official quantitative statistics and other sources of information.

The annual business tendency surveys which have been carried out in Russia since 2010 partly cope with this task, providing users of such information with the possibility of carrying out cyclic analysis of the business climate in the IT segment, and its further interpretation based on the opinions of entrepreneurs and the summary indicator—an index of enterprise confidence. However, this content does not reveal the detailed structure of enterprise responses obtained during business tendency monitoring, obscuring some important detailed information.

The method presented and tested is based on the technique of cluster analysis, allowing the building of behavioral models on the business tendency data and giving the opportunity to classify individual responses to various phases of the business cycle in detail. The empirical results of the application of this technique confirm the possibility of revealing information which increases the analytical potential of business tendency surveys. A detailed visualization of models revealed and concretized the behavior of all the designated groups of entrepreneurs during various periods of the business cyclic. In particular, a comparison of the models of enterprise groups in 2010 and 2017, allows us to conclude that in general, the Russian organizations rendering IT services considerably strengthened their economic potential and increased their adaptability to the arising shocks of recent years.

Considering the increasing significance of the IT segment for the Russian economy and the conditions of frequent destabilization of business confidence, the integration of this method into statistical practice is relevant for the development of additional operational anti-recessionary measures and the stabilization of political decisions. It also supports the intensification of economic growth. In this regard, the practicality of the results and the subsequent analysis lies in the use of this method as an instrument of modeling the IT segment's future profile, improving conditions for its accelerated transformation.

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