

PAPER • OPEN ACCESS

Tools for digitalization of economic processes for supporting management decision-making in the region

To cite this article: O Skotarenko *et al* 2019 *IOP Conf. Ser.: Earth Environ. Sci.* **302** 012147

View the [article online](#) for updates and enhancements.



IOP | ebooks™

Bringing you innovative digital publishing with leading voices to create your essential collection of books in STEM research.

Start exploring the collection - download the first chapter of every title for free.

Tools for digitalization of economic processes for supporting management decision-making in the region

O Skotarenko¹, A Babkin², L Senetskaya¹, S Bespalova¹

¹Murmansk Arctic State University, Murmansk, Russia

²Peter the Great Saint-Petersburg Polytechnic University, Saint-Petersburg, Russia

kсен12@mail.ru, babkin@spbstu.ru, senetskaya@mgtu.ru, bespalova@mgtu.ru

Abstract. The article proposes a solution to one of the key problems – the use of information technology in the management of territorial processes based on the development of tools for digitalization of economic processes on the basis of the software product to identify the structural elements of the economic potential of the regions of Russia, including the features of such regions as the Arctic. As a tool for the implementation of this approach, the VBA programming language built into the Excel spreadsheet is used, which allows flexible use of a standard software product for solving problems at the macroeconomic level. The aim of the study is to develop tools for digitalization of economic processes on the basis of a computer program to determine the extreme structural elements of the growth of the economic potential of the regions to support management decision-making. The systematic approach, methods of statistical and economic analysis, including horizontal and vertical analysis, allowed the authors to assess the dynamics of extreme values of the level of development of economic sectors in the regions of Russia and to develop recommendations for the development of the Federal districts and regions. The directions of further researches consist in application of multidimensional modeling of data for collecting and automatic processing of statistical information on a condition of subjects of the Arctic region.

1. Introduction

The accelerated development of scientific and technological progress, and, above all, information and computer technologies on the scale of not only one particular country, but the entire population of developed countries in the stage of post-industrial service state, the creation of intercountry communications, is of great importance for the digitalization of economic processes in the regions.

Among domestic authors, who consider the problems of digitalization of the economy in Russia, such researchers as Belous A. P. [3], Bodrunov S. D.[4] Plotnikov, V. A. [5], Vertakova [6], Garnaev A. Y. [7], Glukhov V. V. [8], Albright, K. I. [9], Popova E. M. [10], Seneca L. B. [11] should be noted. The problems of digitalization of the economy were reflected in the works of foreign authors D. Barlow [12], H. Seo [13], Y. Lee [14], N. Chesbrough [15].

The impact of digitalization on the economy of Sweden, Japan, and the G7 countries was considered in the works of H. Edquist [16], H. Gruber [17], D. Jorgenson [18], Motohashi K [19], Vu K [20], M. Kooshki [21].

The experience of digitalization of economic processes at the level of the economic entity is reflected in the writings of K. Katba [22] M. O'Mahony [23], H. Pasandideh [24], P. Vasanthi, S. Chahana [25].



The issues of application of various information technologies are studied by foreign researchers such as D. Dedrick, V. Gurbaxani, K. Kramer [26] K. Chaffin, S., Lalmohamed, A. Chakor [27].

The strategic direction of development of the Russian socio-economic processes, which is declared by the Government and the President of the Russian Federation as a priority, is the transition to the digital economy or digitalization of life activity [1,2]. Therefore, the use of information technologies to solve various economic problems and their application in the management of regional economic processes is an urgent task, the solution of which allows improving the quality of management decision-making in the regions of Russia, including the Arctic zone, which confirms the relevance of this study.

The research method is presented in the form of a sequence of stages [28,29]:

at the first stage, a sample of statistical data of the annual State statistical reporting for the last 7 years was made;

the second stage involves the formation of an array of maximum and minimum values of the level of economic sectors development in the regions of Russia, including the Arctic zone;

at the third stage, an array with the maximum and minimum growth rates of the level of economic sectors development in the regions of Russia is formed;

the final fourth stage involves the formation of an array of Russian regions in accordance with the points of economic growth.

2. Results

In modern conditions, the use of modern means of information technologies, including spreadsheets, to solve problems in the field of economics and management is quite relevant. The developers have added a built-in programming language Visual Basic for Application (VBA) in Excel 5, which allows for greater use of the program. With VBA complex scientific management models are made available to ordinary users. VBA enables the user to efficiently use modeling in spreadsheet applications to solve current problems.

Visual Basic for Applications is an object-oriented programming language that allows managing MS Office applications, in which it is embedded. For Excel it is the management of workbooks, worksheets, cell ranges, and other application objects. VBA allows combining the components of several applications into a single integrated hardware and software complex, which makes it possible to solve management problems of varying complexity. This tool uses the technology of visual programming, in other words, the construction of the application directly on the screen, and also includes a macro recorder to record parts of the program, which ensures the formation of a code based on the execution of actions familiar to the user in the application, even without knowledge of the language. Undoubtedly, this feature allows including in the development team those who are experts in the subject area and are usually professional users without knowledge of the basics of programming and program development.

The ActiveX technology used by VBA allows embedding objects of other applications into the developed applications, as well as managing external Windows applications. Client-server applications, multidimensional data analysis can be implemented using this tool. Thus, the well-known Excel table is convenient for solving a wide range of tasks from the preparation of a simple financial report to the creation of scenarios for complex economic projects, choosing the optimal solution from possible alternatives, which largely determines the success in modern management.

For example, authorities at various levels can widely use VBA in Excel to form strategies for the development of regions and municipalities.

As an example, consider the computer program “Definition of extreme structural elements of growth of economic potential of regions” [30].

This program is designed to identify the extreme values of the points of economic growth in each Federal district – the region of the Russian Federation and solves the following problems:

- selects the maximum and minimum values for each factor indicator in all regions for the reporting year;

- represents the maximum and minimum factor indicators in the form of a cross-table for the study period (Print Screen of tables 1-2);

- forms indicators from the cross-table that are identified as the point of economic growth of the Russian region (Print Screen of table 3).

The program to identify the maximum growth rate of industries allowed identifying in each region in the 1st year those industries that do not need additional investment and fully cover their financing needs, and can also serve as sources of funding for strategic programs, maintaining the stability of other industries in the maturity stage, and industries in the growth phase, i.e. to establish priority within regional financial ties.

Table 1. Fragment of the array showing maximum growth rate of economic sectors development in Russian regions^a

Per capita value	2010	2011	2012	2013	2014	2015	2016
1) Goods shipped in minerals production, RUB	59.85	71.51	73.97	84.37	78.95	90.00	112.15
.....
25) Amount of innovative goods and services, RUB	3.78	5.37	6.40	6.81	5.71	7.88	19.84

^aThe table is formed by the authorial computer program "Definition of extreme structural elements of growth of economic potential of regions"

Table 2. Fragment of the array showing minimum growth rate of economic sectors development in Russian regions^a

Per capita value	2010	2011	2012	2013	2014	2015	2016
1) Goods shipped in minerals production, RUB	0.98	1.42	2.70	2.92	1.12	1.25	1.28
.....
25) Amount of innovative goods and services, RUB	0.33	0.46	0.359	0.97	0.82	1.17	2.18

^aThe table is formed by the author's computer program "Definition of extreme structural elements of growth of economic potential of regions»

Table 3. Array showing Russian regions by economic growth areas^a

Per capita value	2010	2011	2012	2013	2014	2015	2016
1) Goods shipped in minerals production, RUB	УФ0	УФ0	УФ0	УФ0	УФ0	УФ0	УФ0
2) Goods shipped in processing industries, RUB	УФ0	УФ0	УФ0	УФ0	СЗФ0	УФ0	УФ0
3) Goods shipped in production and distribution of electricity, gas and water, RUB	УФ0	УФ0	УФ0	УФ0	УФ0	УФ0	УФ0
4) Coal production, kg	СФ0	СФ0	СФ0	СФ0	СФ0	СФ0	СФ0
5) Oil production, kg	УФ0	УФ0	УФ0	УФ0	УФ0	УФ0	УФ0
6) Natural gas production, cubic m	УФ0	УФ0	УФ0	УФ0	УФ0	УФ0	УФ0
7) Meat production, kg	УФ0	ЦФ0	ЦФ0	ЦФ0	ЮФ0	ЦФ0	ЦФ0
8) Dairy products, kg	ЦФ0	ЦФ0	ЦФ0	ЦФ0	ЦФ0	СЗФ0	СЗФ0
9) Textile production, sq. m	ЦФ0	ЦФ0	ЦФ0	ЦФ0	ЦФ0	ЦФ0	ЦФ0
10) Production of knitted goods, pcs	ДВФ0	ПФ0	ПФ0	ПФ0	ПФ0	ЮФ0	ЦФ0
11) Footwear production, pairs	ЮФ0	ЮФ0	ЮФ0	ЦФ0	ЦФ0	ЦФ0	ЦФ0

12) Timber production, cubic m	СЗФО	СЗФО	СЗФО	СЗФО	СЗФО	СЗФО	СЗФО
13) Production of mineral and chemical fertilisers, kg	ПФО	ПФО	ПФО	ПФО	СЗФО	ПФО	ПФО
14) Production of reinforced concrete structures, cubic m	УФО	УФО	УФО	УФО	ЦФО	ЦФО	УФО
15) Steel production, kg	УФО	УФО	УФО	УФО	УФО	УФО	УФО
16) Ferrous metals production, kg	УФО	УФО	УФО	УФО	УФО	УФО	УФО
17) Light vehicle production per 1,000 people, pcs	ПФО	ПФО	ПФО	ПФО	ПФО	СЗФО	СЗФО
18) Electricity production, kW hours	УФО	УФО	УФО	УФО	УФО	УФО	УФО
19) Total agricultural production, RUB	ЮФО	ЮФО	ЮФО	ЮФО	ПФО	СФО	ПФО
20) Cultivated area for all crops, ha	СФО	ПФО	СФО	ПФО	ПФО	ПФО	СФО
21) Fisheries catch (production) per capita, kg	ДВФО	ДВФО	ДВФО	ДВФО	ДВФО	ДВФО	ДВФО
22) Total new residential buildings, sq. m	ПФО	ПФО	ПФО	ПФО	ПФО	ПФО	ПФО
23) Retail turnover, RUB	ЦФО	ЮФО	ЮФО	ЮФО	ЮФО	ЮФО	ЮФО
24) Innovative technologies in use	ПФО	ПФО	ПФО	ПФО	ПФО	УФО	УФО
25) Amount of innovative goods and services, RUB	ПФО	ПФО	ПФО	ПФО	ПФО	ПФО	ДВФО

«The table is formed by the author's computer program "Definition of extreme structural elements of growth of economic potential of regions»

The results form an array of regions of the Russian Federation, including the subjects of the Arctic region, in accordance with the points of economic growth indicate that the leading region is the Ural Federal district, in which it is advisable to develop such structural elements of economic growth potential as mining, manufacturing, production and distribution of electricity, oil and natural gas, manufacture of reinforced concrete structures, steel production, ferrous metal production, power generation, advanced technologies used, bringing the greatest increase throughout the analyzed period. In the Central Federal district, the maximum positive growth is provided by the light industry – the production of meat, fabrics, shoes and knitwear. According to the results obtained in the North-Western district the production of dairy products, timber and cars should be developed; for the Volga district the production of mineral and chemical fertilizers and agriculture is significant. Siberia can be strategically focused on the development of coal mining and the maintenance of areas of all crops. The Southern Federal district (including the North Caucasus) is characterized by the development of retail trade.

The logic of this reasoning is based on the fact that the quality of any socio-economic process in the region is a dynamic category, so it should be analyzed in time with respect to the stage of the life cycle of economic growth points, which were considered using a matrix based on two indicators – the relative market share and the growth rate of economic growth points, characterizing the strategic positions of the Federal districts. Individual fragments of the results are shown in table 4.

Table 4. Fragment of economic growth areas distribution in Russian regions by quadrants of the matrix of strategic positions

Регион	Life cycle stages of economic growth areas	Addi-	Res-	Quality
--------	--	-------	------	---------

	Development (Quadrant III)		Growth (Quadrant II)		Maturity (Quadrant I)		Decline (Quadrant IV)		tive rating	ul- ting rat- ing	group
	number / share of building blocks	rating	number / share of building blocks	rating	number / share of building blocks	rating	number / share of building blocks	rating			
Central	4/16	1	0/0	3	7/28	2	14/56	2	8	2	2-й
Northwestern	1/4	4	2/8	1	2/8	5	20/80	4	14	4	1-й
Southern (incl. North Caucasian)	1/4	4	0/0	3	3/12	4	21/84	5	16	5	2-й
Volga	4/16	1	1/4	2	6/24	3	14/56	2	8	2	1-й
Ural	2/8	3	2/8	1	9/36	1	12/48	1	6	1	1-й
Siberian	4/16	1	0/0	3	6/24	3	15/60	3	10	3	2-й
Far Eastern	3/12	2	2/8	1	0/0	6	20/80	4	13	4	3-й

Depending on the distributed positions of their points of economic growth in the regions of the Russian Federation in the quadrants of the BCG matrix in three qualitaxons – quality class on the basis of “a number of phases of the life cycle”: 1st – full cycle of functioning; 2nd – incomplete – no phase of growth; 3rd – incomplete – no phase of maturity. These results will make it possible to develop priority strategies for the development of economic growth points for each region, taking into account the regional potential and the real state of the regional socio-economic system.

For industry processes at the “Development” stage it is advisable to use one of the two strategies in the future. The first is the strategy of increasing investment and expansion (if the industries have high potential), aimed at increasing the sales of goods of the fast-growing industry in other regions, which will ensure the transition to the “Growth” stage. The second one is the strategy of termination and redistribution of financial resources in more promising areas or sectors of the regional economic complex.

Regions that have taken a leading position in a fast-growing market in the “Growth” stage usually require significant investment to expand production capacity and increase working capital, but they themselves generate significant inflows of funds as they have rich production experience, low costs and save on the scale of production. The first strategy is based on self-financing and self-investment of capacity building in the region, the second – on financial support from the Federal center or non-regional sources (investors), including private ones.

Two strategies are also proposed for the leading regions with points of economic growth in the “Maturity” phase. The first strategy is applied in the region if the strategic goal is to strengthen and protect the market positions of mature industries for a long period to solve the problem of investing in the sectors in the phases of “Development” and “Growth” and their transition to the leaders. The second strategy, when regional processes may become candidates for a gradual reduction in activity over a period and enter a phase of recession, if there is a fierce competition from other regions or an increased need for significant investment due to the need to introduce new technologies, will not be fully met.

For such regions, where the points of economic growth are in the stage of “Recession”, two strategies are appropriate. The first strategy is to reduce or eliminate industries – points of economic growth depending on which of the two options can bring the greatest economic benefits. The second strategy is that stronger points of economic growth may exist as long as the profits provided by the industry remain at an acceptable level.

The assignment of districts regions to a particular qualitaxon allows us to develop priority strategies for the development of points of economic growth for each region, taking into account its socio-economic development.

Socio-economic development depends on the rational construction of the system of management of this development. Priority in the management of the region at the present stage are those tasks that are aimed at creating conditions for the concentration of available resources in the selected strategic directions, in the “points of growth”, enabling one region to maintain a leading position, and the other – to create conditions for economic growth. The solution of such problems is possible only if there is a scientifically based management system that allows analyzing and identifying the main directions of its improvement, which will contribute to the development of the regions.

To solve these problems, it is necessary to improve the socio-economic policy both at the Federal and regional levels, as well as to develop new concepts, methods and scientific and methodological tools to justify the strategies and programs of socio-economic development of the regions of the Russian Federation, reflecting and taking into account the various features of such regions as the Arctic zone.

3. Conclusions

In the context of this study, using a program written in the programming language VBA, a sample of the maximum growth rate of industries – points of economic growth in the regions of the Russian Federation are made and the industry leaders or “locomotives” are identified.

The developed program for identifying the maximum growth rate of the industries allowed determining those industries in each region that do not require additional investment and fully cover their financing needs and can also serve as sources of financing for the strategic programme, maintaining the stability of other branches that are in the “Maturity” stage, and industries in a phase of “Growth” that will contribute to establishing priority of intra-regional financial linkages.

It is obvious that the identified structural elements of economic growth will allow developing different scenarios of the strategy of socio-economic development of the regions in the medium and long term prospects in order to improve the quality of life of the population, while reflecting the characteristics of such regions as the Arctic.

Thus, the introduction of electronic methods into the practice of management will ensure the transparency of the activities of power structures and promote the involvement of the public in the process of making important decisions.

4. Directions for further research

In the future, this study can be expanded on the basis of digitalization using multidimensional data modeling and communication technologies for the collection and automatic processing of statistical information on the state of subjects and Federal districts of the Russian Federation and special regions, such as the Arctic.

References

- [1] Putin at the Congress of Rectors set a task for the new government: Putin's report at the plenary session of the XIth Congress of the Russian Union of Rectors 26.04.2018 in St. Petersburg Available at: <https://svpressa.ru/society/news/198977> [Accessed 2th May 2019]
- [2] Digital economy of the Russian Federation: Order of the Government of the Russian Federation of July 28, 2017 № 1632-R Collection of legislation of the Russian Federation 07.08.2017 № 32 article 5138.
- [3] Belous A P and Lalkov S 2017 Yu Vector of business development in the flow of the digital revolution *Banking* **10** p 16-19
- [4] Bodrunov S D 2017 The Coming. New industrial society: reset: monograph St. Petersburg. INIR named after S. Yu. Witte p 170
- [5] Bodrunov S D *et al* Reindustrialization and formation of the “digital economy”: harmonization of trends through the process of innovative development 2018 *Management* **2** pp 43-54
- [6] Bodrunov S *et al* 2017 Technological Development as a Factor of Ensuring the National Security /, V. Plotnikov, Y. Vertakova *Proceedings of the 30th International Business*

- Information Management Association Conference — Vision 2020: Sustainable Economic development, Innovation Management, and Global Growth* Madrid pp 2666-74.
- [7] Garnaev A Yu 2014 Using MS Excel and VBA in Economics and Finance St.Petersburg p 336
- [8] Glukhov V and Balashova E 2012 Economics and management in Infocommunications St. Petersburg p. 271
- [9] Albright K Modeling 2010 (economic) using Microsoft Office Excel and VBA: development of decision support systems Moscow p. 372
- [10] Popova E M and Bandurko S A 2017 Analysis of financial risks in crypto-economics under the information impact *Proceedings of St. Petersburg State University of Economics* **6**(108) p 36-40
- [11] Senetskaya L B 2007 Analysis of the behavior of microeconomic systems using methods of nonlinear dynamics. Materials of the international scientific and practical conference “Economics, organization and management of enterprise p 124-129
- [12] Barlow J 2005 Excel Models for Business and Operations Management John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester, West Sussex PO19 8SQ England pp 244–258
- [13] Seo H, Lee Y 2006 Contribution of information and communication technology to total factor productivity and externalities effects *Information Technology for Development* **12**(2) pp 159–173
- [14] Lee S, Gholami R, Tong T 7 October 2005 Time series analysis in the assessment of ICT impact at the aggregate level—Lessons and implications for the new economy *Information and Management* **42** pp 1009–22
- [15] Chesbrough N 2006 Open Innovation: The New Imperative for Creating and Profiting from Technology Harvard Business Press pp 126
- [16] Edquist H 2005 The Swedish ICT miracle—Myth or reality? *Information Economics and Policy* **17**(3) pp 275–301
- [17] Gruber H, Koutroumpis P 22–23 2010 Mobile telecommunications and the impact on economic development Paper presented at the 52nd Economic Policy Panel Meeting, Einaudi Institute for Economics and Finance October Rome Italy pp 232-235
- [18] Jorgenson D 2003 Information technology and the G7 economies *World Economics* **4**(4) pp 139–169
- [19] Jorgenson D and Motohashi K 2005 Information technology and the Japanese economy *Journal of the Japanese and International Economies* **19**(4) pp 460–481
- [20] Jorgenson D, Vu K 2007 Information technology and the world growth resurgence *German Economic Review* **8**(2) pp 125–145
- [21] Kooshki M and Ismail R 2011 The Impact of Information and Communication Technology Investment Externalities on Economic Growth in Newly Industrialized Countries *In Proceedings of the 2nd International Conference on Business and Economic Research* pp 1282–92
- [22] Kotb K *et al* 2011 Statistical quality control for constrained multi-item inventory lot-size model with increasing varying holding cost via geometric programming *Journal of the Japanese and International Economies* **2**(4) pp 409–414
- [23] O'Mahony M and Vecchi M 2005 Quantifying the Impact of ICT Capital on Output Growth: A Heterogeneous Dynamic Panel Approach *Economica* **72**(288) pp 615–633
- [24] Pasandideh H *et al* 2013 Two metaheuristics to solve a multi-item multiperiod inventory control problem under storage constraint and discounts *Economica* Springer London
- [25] Vasanthi P and Seshaiyah C V 2013 Multi item inventory model with shortages under limited storage space and set up cost constraints via Karush Kuhn Tucker conditions approach *Appl. Math. Sci* **5** pp 110-113.
- [26] Dedrick J *et al* 2003 Information technology and economic performance: A critical review of the empirical evidence *ACM Computing Surveys* **35**(1) pp 1–28

- [27] Hafshejani K *et al* 2012 Using genetic algorithm approach to solve a multi-product EPQ model with defective items, rework, and constrained space *Journal of Industrial Engineering International* **r 1** pp 1–8
- [28] Skotarenko O and Babkina L N 2013 Points of economic growth in the regions. *Microeconomics*. Moscow **4** pp 88-93
- [29] Skotarenko O V 2013 Algorithm of formation of investment strategies of points of economic growth in the regions of the Russian Federation. *Microeconomics Moscow* **5** pp 88-97
- [30] Skotarenko O V 23.07.2008 г. Calculation of coefficient of sensitivity of the enterprise under the factors of environment. Certificate on state registration of the computer program No 2008613491 Federal service for intellectual property, patents and trademarks