

Digital Simulation of Economic Processes

Tatiana A. Subbotina ¹*[ORCID 0000-0003-3479-9722]

¹ Yaroslav-the-Wise Novgorod State University, Veliky Novgorod, Russia
tatyana.subbotina@novsu.ru

ABSTRACT

This article is devoted to the study of digital simulation as a method of strategic management of economic processes. Digital transformation has affected all spheres of development, especially the economy and its sectors. However, digital simulation of economic processes is still not considered a priority for the development of the digital economy, despite its innovative importance. This study aims to determine the effectiveness of the transition from traditional business models to strategic management using digital twins. At the same time, the author refers to early academic papers on the study of digital twins and their role in the economic process. Based on statistical data, the current innovative state of entrepreneurship is presented. In addition, conclusions were drawn regarding digitalization of economic entities. The practical application of digital simulations in economic activity, types of digital simulations, their advantages and disadvantages are discussed in detail in the study. Relevant conclusions are drawn on the basis of the analysis. The results of the study show the importance of digital simulations not only for enterprises, but also for the country. The prospects for the development of digital simulation in Russia under the relevant conditions are described. All other things being equal, the development of digital simulation of economic processes may remain at the initial stage. However, the advantages of this method over traditional modeling methods are ponderable, but this method requires not only the development of the digital economy, but also the development of IT-technologies and specialists in the relevant fields of programming and economics.

Keywords: digitalization, simulation, business planning

1. INTRODUCTION

Back in the XX century, the increasing complexity of management decision-making led to the introduction of mathematical simulation (modeling). The economy does not stand still, and today this method is becoming obsolete. Models based on probability theory are gaining popularity at this time. Some of the best-known works include D.S. Scharfstein's model of investment decision making and Th. Schelling's model of segregation. But any human-accepted probability is subject to cognitive bias. The list of such biases includes a huge number of distortions, but in this case, we can single out the "Observer-expectancy Effect", the "Overconfidence Effect", the "Focusing Effect", etc. Thus, models of economic processes become relative rather than justified. The state programs on digital technology implementation will continue to be implemented, as digital development is crucial for the country at the moment [1].

Since all elements of the economy are subject to digital transformation, simulation of economic processes should also be digital. This format of model building eliminates the subjective component, which significantly increases the efficiency of economic processes management.

This study addresses the effectiveness of digital simulations and their advantages over traditional ways of modeling of economic processes. At the same time, examples of the use of digital simulations and their impact on the development of economic structures are given.

2. MATERIALS AND METHODS

The purpose of the study is to identify the level of effectiveness of digital simulations at this stage of digital transformation of the economy.

To achieve the goal, we must perform several tasks:

- analyze the current development of digital simulation of economic processes;
- compare innovative models with traditional modelling methods;
- predict, on the basis of the data obtained, the economic result from the use of digital simulations;
- identify the advantages and disadvantages of digital simulations.

The methods used in the work were: empirical data collection; generation of models, theories and hypotheses; analysis and synthesis.

The results of this study are subject to substantive and qualitative limitations due to the unevenness of digital development and digital literacy.

3. RESULTS

Economic processes characterize the system of economic relations at macro- and microlevels [2].

In order to manage economic processes effectively, it is necessary to use modern methods of economic activity analysis, in particular, the digital simulation method.

Already today, digital simulation has practical applications in areas such as:

- 1) design of production processes;
- 2) strategic management of the organization;
- 3) forecasting of prices on stock exchanges.

The last decade has seen a noticeable simplification of the production process through the extensive use of production process simulation. Just one software product includes a single package with extensive functionality:

- 1) assignment of an assembly or part creation sequence;
- 2) simulation of the production optimization process;
- 3) establishing the optimum time per part;
- 4) verification of the efficiency of the production process;
- 5) cost and cost of production analysis;
- 6) production program planning;

- 7) obtaining information about deviations in real time.

Simulation of the production process is the formation of so-called “lean production” based on objective data, devoid of relative conclusions.

Strategic management of the organization is the basis of the efficiency of economic activity. These days, innovative tools are available not only to large holding companies, but also to small businesses. Nowadays, there is a wide range of applications for business process simulation. Such tools include Bizagi Suite. This program helps to create not only models of economic processes, but also executable applications based on them. ELMA BPM allows you to integrate the model with the 1C platform. In addition to data synchronization, the tool provides real-time execution and tracking of economic processes. Visual Paradigm is the most user-friendly modeling tool. The greatest advantage of this application is the possibility to obtain models in the form of program code. In addition, the program allows you to link models to add your own elements to them.

Computer modeling of financial markets is a program that implements an abstract stock system. With the help of this model, investors get an opportunity to get an approximate estimate of securities market behavior and, as a result, to get higher profits (income). This model is widely used to find undervalued options. A special program analyzes all option transactions for internal consistency of the model. Then the potential income is calculated for multiple combinations of put and call options. Based on the combination results, the trading robot opens the session. When the set parameters are reached, the robot sends the data to close the trade and fix the profit.

The findings indicate that digital simulation is a full-fledged strategic management tool. So why is it rational to prefer innovative ways of managing economic processes nowadays? The answer to this question reveals the essence of digital simulation. The essence of digital simulation is that on the basis of an economic and mathematical model, a digital model is built in a specialized application, such as MS Excel. The use of these models significantly reduces time costs and eliminates calculation errors.

Digitalization has become an integral part of business operations. One only has to look at the percentage of enterprises that use digital technology in business planning (*Figure 1*).

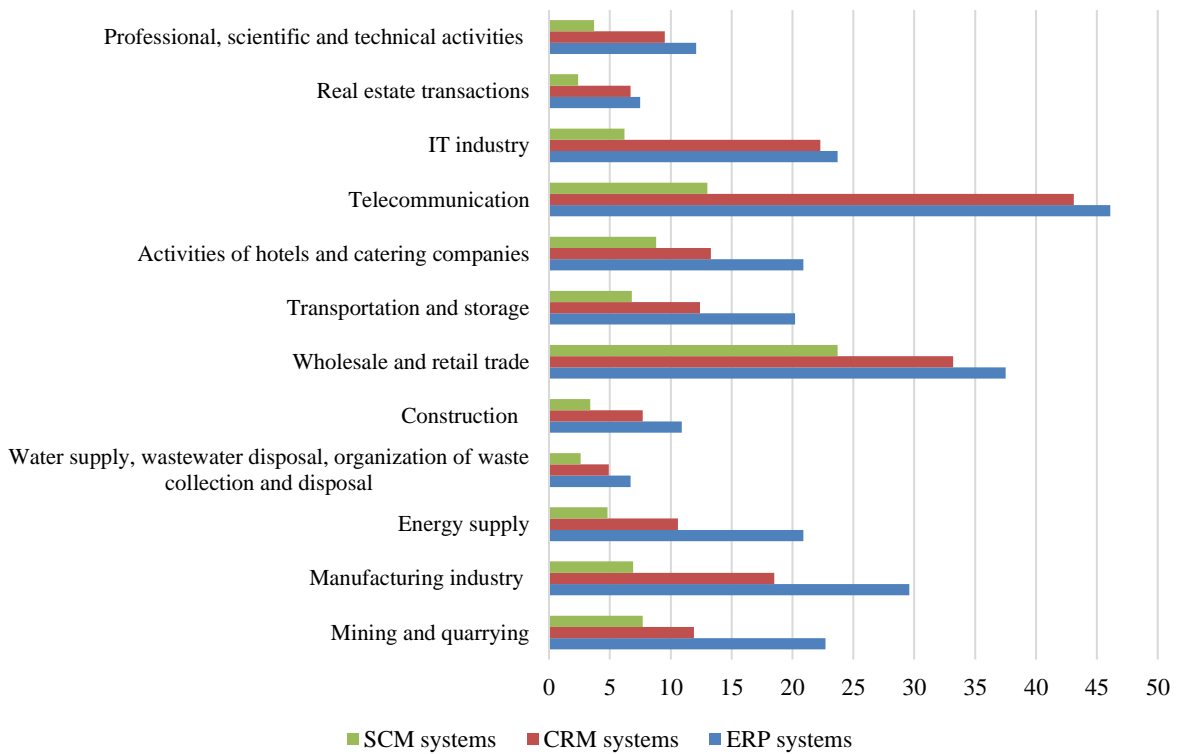


Figure 1. Share of enterprises using digital business process technologies (SCM-, CRM-, ERP-systems) in Russia, %

Source: [3]

SCM system stands for “supply chain management system”. This application software is designed to automate the procurement and turnover process in an enterprise. The use of this system in management helps to greatly simplify the planning process of production processes.

CRM-system stands for “customer relationship management system”. Such a system implies special software, but in small companies it can store only e-mail, phone numbers and addresses of clients. Therefore, the creation of complex models in this case is not required. At the same time, mailing companies need an out-of-the-box API integration where basic customer interaction functions are automated and can be parsed.

ERP-system is a set of modules (applications) that cover the entire process of economic activity. In doing so, each module is responsible for a specific process. Such a system consists of three levels: database; modules, graphical interface. It is worth noting that the improved version of 1C: ERP-Enterprise Management 2 is just such a system. An ERP system is a unified database, the essence of which is accurate and prompt control.

Returning to the topic of the study, the systems described are developed software based on digital business models.

Figure 1 shows that enterprises prefer to use ERP systems that can easily include other systems. At the same time, the greatest demand for this software is observed in the field of telecommunications and trade. The transition to new business systems is the hardest for businesses involved in real estate and utilities operations. Companies will have to regularly update their development strategy using digital tools [4].

Russia has not long embarked on the path of digitalization, but the introduction of innovation in production is accelerating. Sales digitization is necessary in this day and age because it improves the customer experience and promotes sales growth. Digital technology has become an integral part of business processes [5].

Already today, most of the businesses' activities have been digitized (Figure 2).

According to the Government of the Russian Federation, the highest rates of digital technology

use are in telecommunications, higher than in IT sector.

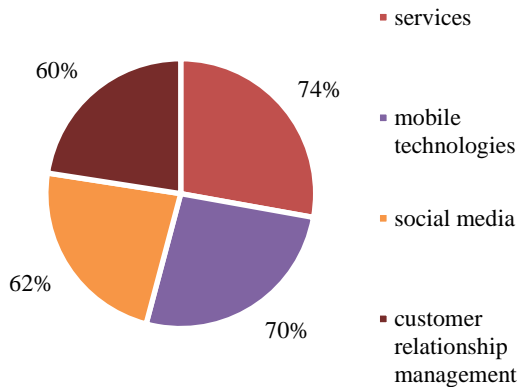


Figure 2. Digital technologies used by innovative enterprises, %

Source: [3]

However, enterprise spending on digital development and research accounts for about 5% of all digital spending. This indicates an unpreparedness on the part of economic entities to innovative development. Instead of developing their own business models, businesses use off-the-shelf software. Still, according to IT-analysts, small and medium-sized enterprises will soon start switching over to service business models [6].

Also, we should not forget about Solow's Paradox. Adjustment delays, measurement problems, inflated expectations of entrepreneurs, and mismanagement cause IT investments to fail [7].

Let us focus on some more ways of digital modeling. It is worth noting that unlike traditional models, digital models provide the ability to simulate economic processes. The BPMN standard is used to model business processes using diagrams. This way of presenting information helps to simplify the data, while the standard has a strict set of concepts designed to create visual models, which allows creating software on a special BPMS platform.

Application of holography in all spheres of human life becomes topical. Holographic models offer a number of advantages over traditional models: accelerated data exchange; mobility of production; raw material savings. Holograms are relatively common in the economic sphere: holographic models are used to determine the authenticity of goods, banknotes and documents [8].

Digital simulation is a complex process that not only economists have to work on, but also IT specialists. It is this fact that complicates the process

of implementation of digital simulation and creation of a new information product on its basis. Businesses prefer to buy a ready-made business solution instead of investing in a new project. But in order to reach a new level of development, Russian companies should pay attention to agile management, which implies flexible adaptation to constantly changing conditions [9].

It is worth noting that the presentation of graphs and charts using holograms in the prospective future can become an integral part of business planning.

4. DISCUSSION

The author of the paper proposes several ways in which digital models can be used in economic processes. However, it is worth paying attention to the principles of forming a digital ecosystem based on business models proposed by A.S. Koretsky. The example of calculating the reliability of equipment in use shows the implementation of the IT ecosystem, in which the calculation of the required amount of resources is carried out by means of a digital twin. Thus, the result of the study boils down to the fact that the creation of business models is advisable to carry out along with simulation experiments with digital twins [10].

Digital twins have been a part of our lives for quite some time, but almost no one associates them with economic processes. But after all, digital twins have the advantage of “predictive powers” that are so necessary in entrepreneurship. However, in the classification of digital twins, there is already the concept of “digital process twin”, which allows the development of the most efficient way of production [11].

In the Middle East, for example, a digital twin system has unified all ADNOC facilities into one control room with unified management. Then we can conclude that it is indeed realistic to integrate all economic processes within an enterprise by means of digital twins. And if you look at it even more broadly, you can integrate economic processes within a region or a country. And, of course, digital interconnection at the international level is possible. All this will become available if we move to a new level of digital development – computer simulation of economic processes.

5. CONCLUSION

The objectives of this study were accomplished. Analysis of digital development in the country

showed that digital simulation is in its infancy, and few are using new methods of strategic management. Unlike traditional methods, digital simulation does not require large amounts of raw materials and can provide information quickly. The main advantage of such a model is the possibility to combine all objects into a single system with the help of digital twins. Digital simulation is already in use, and new digital products are being created based on it. However, the level of digital literacy in the country remains at a relatively low level, which prevents the entrepreneurial sector from reaching a new innovative level of development. The shortage of IT specialists has been highlighted as a major drawback of digital modeling. But thanks to the digitalization process, the demand for IT jobs has increased considerably, which means that digital simulation is also about to change.

This research bears practical relevance for the digital economy of the future. Further research on digital simulation will contribute to the strategy of management decision-making.

REFERENCES

- [1] D.E. Bloom, M. Kuhn, K. Prettnner, “Modern Infectious Diseases: Macroeconomic Impacts and Policy Responses”, *Journal of economic Literature* (Forthcoming), National Bureau of Economic Research, 2020, working paper 27757. DOI: 10.3386/w27757
- [2] N.C. Mrochkovsky, Y.V. Lyandau, I.S. Pushkin, M.A. Fedosimova, “Digital transformation of Business Models”, *Innovation and Investments*, 2019, vol. 5, pp. 69-72. (In Russ.).
- [3] “Digital Economy: 2021: Brief Statistical Digest” in Ed. by L.M. Gokhberg, E.Yu. Kislyakov, Ya.I. Kuz'minov, M.V. Parshin, I.N. Shapoval, Moscow: National Research University Higher School of Economics, 2021, 124 p. (In Russ.).
- [4] D. Chaffey, P.R. Smith, “Digital Marketing Excellence: Planning, Optimizing and Integrating Online Marketing”, London, 2017, 690 p. DOI: 10.4324/9781315640341
- [5] A. Priyono, A. Moin, V. Nur, A.O. Putri, “Identifying Digital Transformation Paths in the Business Model of SMEs during the COVID-19 Pandemic”, *Journal of Open Innovation: Technology, Market, and Complexity*, 2020, vol. 6(4), p. 104. DOI: 10.3390/joitmc6040104
- [6] E.S. Sokolova, “Peculiarities of the Marketing of IT-Companies”, *BENEFICIUM*, 2019, vol. 2(31), pp. 47-56. (In Russ.). DOI: 10.34680/BENEFICIUM.2019.2(31).47-56
- [7] S. Schweickl, R. Obermaier, “Lessons from three decades of IT productivity research: towards a better understanding of IT-induced productivity effects”, *Management Review Quarterly*, 2020, vol. 70, pp. 461-507. DOI: 10.1007/s11301-019-00173-6
- [8] E.S. Porubleva, G.A. Gareeva, D.R. Grigoreva, “Effective using of holographic and pseudoholographic in the context of the development of information technologies” [Effektivnoye ispol'zovaniye tekhnologiy golografii i psevdogolografii v usloviyakh razvitiya informatsionnykh tekhnologiy], *Innovation Science*, 2018, vol. 5(1), pp. 65-68. (In Russ.).
- [9] E. Murray, “Epidemiology's Time of Need: COVID-19 Calls for Epidemic-Related Economics”, *Journal of Economic Perspectives*, 2020, vol. 34(4), pp. 105-120. DOI: 10.1257/jep.34.4.105
- [10] A.S. Koretsky, “Principles of forming digital ecosystem of process management based on business model”, *E-Journal Public Administration*, 2021, vol. 84, pp. 221-240. (In Russ.). DOI: 10.24412/2070-1381-2021-84-221-240
- [11] D.S. Kokorev, A.A. Yurin, “Digital twins: concept, types and benefits for business”, *Colloquium-Journal*, 2019, vol. 10-2(34), pp. 101-104. (In Russ.).