

Presentation of Digital Duplicates' Prototypes for Management Processes

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Abstract—Research on management modeling issues remains relevant for reasons such as: the need to provide information certainty in management decisions; visualization of management processes with the ability to compile and choose the best solutions; acceleration of the verification process of management algorithms. The issues of description, formalization, regulation of the simulated object deserve no less attention. The goal of the study is to develop the theoretical and practical aspects of management in the context of digital transformation. At the same time, the key tasks of the study are the following: identifying typical stages of the management algorithm; formalization and visualization of typical management processes through conditional algorithms; application and implementation of digitalization tools in the algorithmic management chains. The following methods of research are used: theoretical (analysis, modeling) and empirical (observation, assessment of information sources). The main scientific result of the study is prototypes of digital duplicates of standard management processes. The field of application is the management of business entities of various industry affiliation with the justification of information support for management decisions in the conditions of digitalization.

Keywords—new product offer, management algorithm, prototype of digital duplicate

I. INTRODUCTION

Economic entities are always in a high economic risk zone for the following reasons:

- multiplicity of factors affecting the external and internal environment of subjects making management decisions;
- the need to take into account huge amounts of dynamically changing information in the activities, and, consequently, in the management;
- significant dependence on the level of development of production and management technologies;
- a high level of social responsibility of economic entities due to the active involvement of the able-bodied population into social production, etc.

Of course, in this regard, it is important to ensure the safety of activities, reduce or even neutralize information uncertainty, which is a prerequisite for the occurrence of risks [1]. And, according to the author, such a tool as digital duplicates [2], which acts as a digital representation, a prototype of real processes, in this case, management processes, will help to cope with this task effectively.

The degree of development of process modeling and visualization to create digital prototypes can be assessed as low due to the fact that digitalization in general and the introduction of specific digital transformation tools, in particular, is an ultra-modern phenomenon.

In this regard, we can rely on researches that have a basic theoretical value for determining the methodological basis for the development of digital prototypes of management processes as a scientific prerequisites for the research area.

Assessment of information resources to build digital models of management activities based on researches of the scientific organization of management (Taylor, F. W., Church, A. G., Fayolle A., Emerson G., etc.). The formation of functional model of activity for the information security management process was researched by Mintzberg G., Zudin, L. N., Trusevich N. N., Frolov Y. V., etc. Simulation modeling, based on the principles of which digital duplicates are built, was developed in the works of Andersson M., Astrom K. J., Boudaud F, Ernst T., Jahnichen S., Jeandel A., Klose M. Mattsson S.E., and others.

Direct research of digital duplicates has been conducted mainly in the last 5-7 years (Grieves M., Reid J., Rhodes D., Parrott A., Warshaw L., etc.). However, it should be noted that these studies are conducted primarily in the plane of instrumental, technical, mathematical, software, and applied sections. Therefore, the digital transformation of the control system should be carried out only by the base developers for products, processes and systems that allow them to be adapted to the management processes.

However, constant, rather rapid, and often drastic changes in the modern economic, political, social, technical and technological spheres dictate the need for new research to

accumulate a significant array of empirical data that will allow a comprehensive assessment of the potential of digitalization for management [3].

II. HYPOTHESIS AND RESEARCH METHODS

In order to build digital duplicates of management activities, it is necessary to pre-formalize management that has clearly expressed creative characteristics. For this purpose, it is supposed to form a system of prototypes, which are a visual image (algorithm) of typical management processes with the assignment at each stage of the process of a particular digitalization tool (technology) - Big data, robotization, blockchain, the Internet of things, artificial intelligence (neural networks, machine learning), etc.

The main methods of research are modeling, observation, comparison.

III. RESEARCH RESULT

It is known that digital duplicate technology is a process of forming a virtual copy of products, systems or processes, preferably manufacturing ones.

However, this option is provided only if the parameters and elements of the simulated object are Descriptive, capable to be formalized, regulated, and therefore coded.

Concerning the goods and technological processes there are no serious restrictions in digitization and creation of digital duplicates. It is explained by that physical (material) products, systems and processes can be rather easily formalised, described, algorithmised and, finally, codified in the integrated model - the digital duplicate.

However, in this regard, there may be difficulties with virtual modeling of management processes. It is traditionally believed that managerial activity is not easily formalized due to its unpredictability and creative nature. But if we make a bold assumption that management activities and material production are not as polar as is commonly believed, then the problem of digitalization is at least partially leveled.

Taking into account, first of all, the factor approach to the definition of material production, the fundamental position is the consideration of key factors of production: labor, capital, natural resources, entrepreneurial abilities, information and time. At the same time, of course, the possibility of clear regulation of production activities plays a decisive role in the goals of digitalization. If management is viewed from a similar perspective, there is plenty of reason to see it as a production activity.

Management activities can be considered from the point of view of an equal production process that uses as resources the information, competence of management personnel, and as a result of management getting a finished product - management decisions and impacts [4].

In this regard, the digitalization of management, traditionally considered as a creative, poorly formalized process, does not cause any doubts about the possibility of its conversion into digital format, which implies strict formalization and codification.

For this purpose, it is necessary to preliminary form prototypes of standard management processes for further digitization and development of digital doubles [5]. Such prototyping will make it possible to visualize management algorithms for further digital transformation. It is also important to note that the visual prototype allows you to optimize a specific management process with sequential iterations.

For example, a typical enlarged algorithm of offering and promoting a new product [6] can be adapted to digital prototyping in the following way (Table, Picture). The offer of a new product (work, service) in any sphere of economic activity is the most informative process [7]. Therefore, this example is of value in terms of visualizing the process of prototyping a digital double of any other process.

The expediency of the structural approach to the prototype construction is explained by the need to detail the enlarged stages of the process, reflecting the logic of actions. In this case, each local step embedded in the algorithm as an operation (for example, 1.1., 1.2., 2.1.), data (for example, 1.3-1.5, 3.1.-3.3.), logical block (for example, 2.11, 5.2) or result (for example, 1.6., 2.12., 6).

Moreover, the prototype, on the one hand, is a model, a simplified, visual imprint of reality. But, on the other hand, prototyping is also aimed at dispatching and optimizing the process. At each stage of the process, the purpose of the digitization tool (technology) is indicated [8] for further transition to digitization of the prototype.

As you can see from the example, Big Data [9] – a technology for processing large amounts of data on the principle of a "single window" is being actively implemented.

In this regard, the basic setting of the preliminary stage of digitization is to identify and systematize the necessary information aggregated into arrays and databases.

Prototyping allows you to identify and propose those databases that will be formed into information support for the management process. At the same time, Big Data technology allows you to cover not only selective, but also such volume of information that maximally reflects certain information necessary for decisions. At the same time, of course, data arrays can be redundant for solving certain local problems, but this does not slow down and slightly complicates their processing when implementing a new digital tool.

Neural networks [10] will provide and accelerate the forecasting process based on effective recognition of signals for instant response to them and preventive risk management.

TABLE I. PROTOTYPE OF A DIGITAL DUPLICATE OF A NEW PRODUCT OFFER

Process progress	Digital tools	Content
1. Generating new ideas 1.1. Analysis of consumer needs 1.2. Evaluation of competitor activity 1.3. Systematization of consumer claims and offers for traditional products 1.4. Assessment of consumers' vision of a new product 1.5. Generalization of ideas for competitors' products 1.6. Selection of promising ideas by filtering lists	Big Data	Database (DB): - government programs; - scientific and research teams (including educational institutions); - regular customers; - dealer sealers; - competitors'; - advertising agencies; - research personnel; - licenses of other companies; - independent researchers, etc.
2. The Concept of a new product and its evaluation 2.1. Compilation of options for implementing a promising idea 2.2. Assessment of possible profitability 2.3. Identifying competitors for a new product 2.4. Assessment of market capacity 2.5. Assessment of capital investments (including R & d) 2.6. Assessment of the level of patent protection of a new product 2.7. Building a schedule of work stages for a new product 2.8. Risk assessment and risk management measures 2.9. Estimation of the payback period 2.10. Life cycle (LC) forecast of a new product 2.11. Selection of acceptable projects 2.12. Creating installation batches of goods	Big Data Neural networks Blockchain	DB: - sales markets for related ("parallel") products; - patents of comparable products; - social, economic, political, physical-geographical and other characteristics of potential sales territories Compilation capabilities Market signal forecasting and recognition Building chains of information (for example, building a schedule of work stages, life cycle forecasting, etc.)
3. Economic analysis 3.1. Forecast of costs for product development, release and sale 3.2. Forecast of turnover volume 3.3. Profit forecast 3.4. Uncertainty analysis 3.4.1. Optimistic 3.4.2. Moderate 3.4.3. Pessimistic	Big Data Neural networks	DB: - storage for standard cost calculations; - empirical data on the turnover of comparable goods for previous periods; - storage of typical forecast templates Forecasting and recognition of uncertainties
4. Product development 4.1. Product design solution 4.2. Development of the brand 4.3. Package proposal	Big Data 3D - printing Blockchain	DB: - template storage for standard solutions for new compilations Samples of goods, packaging Creating chains of technological information
5. Product Testing 5.1. Trial sale of goods in small lots 5.2. Feedback 5.3. Making changes	Big Data	DB: - general population and representative sales outlets; - customer surveys by product characteristics; - channels of mass communication
6. Commercial implementation		

Moreover, the technological implementation of the principles of neural networks by means of branched algorithms (similar to the work of the human brain, networks of nerve cells of a living organism) helps to compile various options and scenarios of actions based on the specified conditions. For example, in this way, it is possible to solve transport problems for optimizing logistics using neural networks, by the way, also having a branched structure. At the same time, options for movement between the specified points are possible along different paths, which can be reflected in scenarios which are estimated on the chosen criteria (for example, time).

The Blockchain tool [11] is considered as a technology for building information chains, systematization and information variation of process stages for optimizing management in terms of time, costs, importance, urgency, delegation opportunities, complexity, for rational logistics, etc.

3D printing [12] serves as a simulation tool for creating a prototype or small batch for experimental study of the properties and performance characteristics of a new product in comparison with the design parameters. At the same time, there is a possibility of rapid, relatively low-cost single production aimed at materializing the technological idea and, more importantly, revealing of latent features of the product in the process of its test operation. Of course, such technological solutions contribute to preventive risk management in terms of ensuring the quality of the product before its mass sale on the market and, accordingly, managing the risks of competitiveness, image, etc.

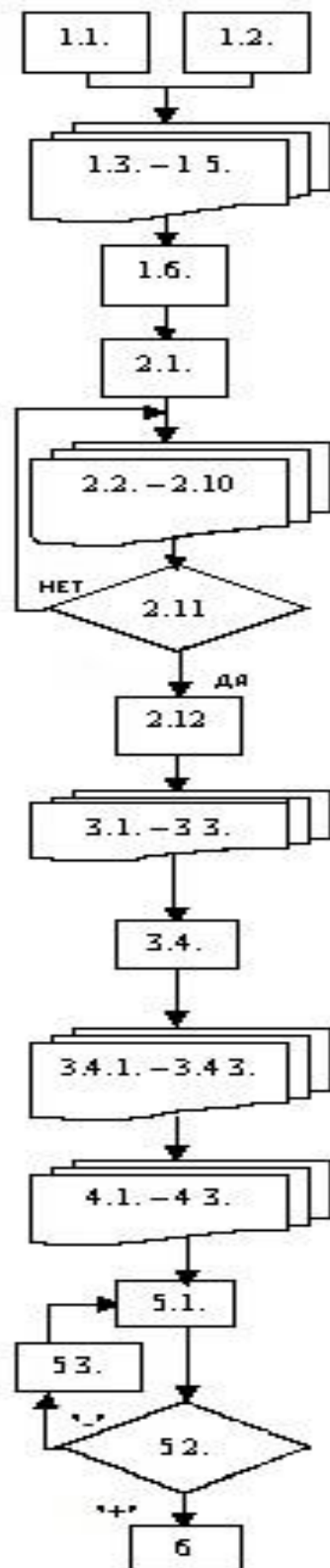


Fig. 1. Digital Duplicate Algorithm Prototype

IV. CONCLUSION

Thus, the research is aimed at creating digital duplicates of standard management processes [13], information support for management activities with the ability to minimize economic risks of economic entities.

Building prototypes of digital duplicates of any product, process, or system is based on the following General logic:

- description of the modeled object (product, process, system) with a list of elements, parameters, and characteristics;
- visualization / algorithmization of the logic of relationships between elements, parameters, and characteristics of the modeled object;
- the purpose of a digitization tool that allows for effective digital transformation and maximum reflection of the real object in the virtual model;
- building an integrated model of a real object-a digital double.

Thus, the digitalization of management activity is preceded by a preparatory stage of algorithmization of typical management processes. It is important to note that the algorithmization of management activities by analogy with traditional production processes is based on the principles of the pipeline. As a basis for identifying standard management processes, enterprise standards (ENS) can be used [14], considered from the point of view of adaptation to the management goals of specific economic entities. On the basis of the received scientific result it is possible to construct imitation models [15] of administrative behavior for the purpose of forecasting and preventive reaction to various combinations of conditions and factors of influence.

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