Information systems in the strategy of digitalization of the Russian enterprise

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Abstract. The article detail with the application of the probabilistic approach to the calculation of the expected performance indicators of the digitalization strategy is substantiated. The process of formation of intellectual assets in the course of implementing this strategy has been analysed. The influence of distributed information systems on increasing the share of intellectual assets of an enterprise is proved. **Keywords**: distributed information systems, distributed technologies management, distributed control technologies, strategy of digitalization, indicators of digitalization.

1 Introduction

The success of the transition of Russian enterprises to the digital economy is determined by the use of modern technologies and organizational and production structures, but also by the possibility of integrating modern software-communication means into various spheres of the enterprise. For this purpose, the enterprise needs an appropriate strategy for the transition to digital production (see [1, 2]). Such a strategy, embodied in a set of plans and concrete measures, provides a fundamental increase in productivity, sustainability of operation and, ultimately, an increase in the fundamental cost of the enterprise. The development of the digitalization strategy is preceded by the establishment of strategic goals, the main of which is the transition of the enterprise to leading positions in global markets of knowledge-intensive products.

In order to implement the digitalization strategy, the enterprise needs not only resources, but also an effective system that allows for the implementation of distributed management mechanisms. Distributed Control System (DCS), combining technical and software solutions, enables decentralized data processing. This is achieved by using a single database structure and distributed input and output systems (see [9] for details).

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2 Materials and methods

However, factors such as the emergence of new strategic goals in the enterprise, changes in the business processes implemented, increased competition, lead to the need to constantly improve the established management system. In this context, the company focuses its efforts on the creation of unified means of data transfer, storage and processing, with a key focus on integrating the listed elements into the system formed on a single information platform. In addition, in the process of implementing distributed control mechanisms, there are tasks of processing large volumes of information. Subsidiary management technologies are an effective tool for solving such problems, the application of which allows to solve problems at lower levels of the management system (for more details see [10]).

The modern concept of digitalization of production, involving the creation of a single information space, is aimed at ensuring a high level of flexibility of the management system. This is achieved by reducing the time required to adapt the system to changes in the external and internal environment. Having a single information space implies that the data of various software applications of the enterprise information system are available in real time to all categories of enterprise personnel who are allowed access to these applications. The flexibility of the information system means that new applications can be added. The flexibility factor thus characterizes the ability of the system to upgrade.

3 Results

The creation of a single information space and the flexibility of the information system is a key factor in the effective management of the enterprise. In practice, this is achieved through the unification and compatibility of both data structures and interfaces at all levels of production process implementation. For this purpose, enterprises use distributed management systems.

In such systems, information is processed by several computers. Distributed data processing increases the efficiency of user information, as well as the level of flexibility of the information system and, as a result, the speed of decisions. Therefore, integration of distributed information systems implemented in the form of multi-machine computer complexes and computer networks into the digitalization strategy can be considered as a progressive form of production organization (see [3, 6, 7]).

For distributed systems, there are a number of properties that ensure the efficiency of such systems. Such properties are openness and scalability of the system, parallel functioning of elements. The openness of the system means that it can be expanded by adding new resources, and scalability involves using the system to solve more complex tasks. The parallel property of a distributed system allows multiple processes to run simultaneously on different computers in the network, and these processes can communicate with each other at runtime.

The presence of multiple computers in a distributed system provides information redundancy and increases system stability when various hardware and software errors occur. In this case, distributed systems can support partial functionality. A complete system failure occurs only when network errors occur.

The operation of distributed systems involves the sharing of different resources between the elements of the system. This applies to both hardware resources (hard drives, printers) and software tools (files, compilers). Having such a property in the distributed information system minimizes its resource redundancy.

However, from the point of view of systems theory, a distributed system is complex, i.e. consisting of a set of subsystems. A complex system is characterized by the emergence of new properties that are not inherent in its individual components. On the one hand, it increases the functionality of the system, and on the other, it makes it difficult to assess its

integral properties. System design, testing, and maintenance processes are also becoming more complex. In addition, the integrated performance of a complex system is a function of the speed of the network as a whole, not of its individual processors. Therefore, a mechanism for reallocating resources among its components is used as a tool to improve the productivity and efficiency of a distributed system.

The high complexity of distributed systems results in unpredictable responses to certain events that occur in the system. The speed of this reaction depends on such parameters as the architecture and loading of the system, the level of network load. A distributed system can include multiple computers with different versions of operating systems. In this case, there may be a risk of loss of manageability of the system. This risk is due to the possibility of errors on one or more computers. At the same time, the process of spreading errors can be unpredictable, which significantly affects the functioning of other elements and the distributed system as a whole.

Risk is a quantitative measure of the level of uncertainty caused by the possibility of errors occurring on one or more computers during the operation of the distributed information system. As a result, negative events appear in the digitalization strategy (see [4] for details). In order to operate when assessing the effectiveness of the system operation with a risk parameter, the probability of these events occurs must be known.

Using a probabilistic approach to assessing the events that occur within the framework of the digitalization strategy, it is possible to take into account the risk factor in the calculation of efficiency indicators. In this case, the expected effectiveness of the enterprise transition strategy to digital production is calculated. Such measures can be either the Expected Net Present Value (ENPV) or the Expected Internal Rate of Return (EIRR).

4 Discussing

In calculating such indicators, it is necessary to take into account various combinations of risk factors and characteristics of the strategy itself, which affect the level of uncertainty of future net cash flows and, accordingly, the efficiency indicators of the digitalization strategy. These combinations reflect scenarios. In this case, the calculation is carried out as follows.

First, a number of scenarios for implementing an enterprise digitalization strategy are described. Within each scenario, a system is established to limit the values of the strategy parameters. Cash flows and net discounted income are then determined for each scenario.

The financial feasibility of the scenario is then checked. For this purpose, the internal rate of profitability is calculated, which is compared with the weighted average value of the capital attracted by the enterprise for the implementation of the scenario. The implementation of the scenario from a financial point of view will be feasible if the internal rate of return exceeds the value of the weighted average cost of capital. Otherwise, the script is excluded from consideration.

Taking into account probability of implementation of each scenario, indicators of expected efficiency of digitalization strategy are determined. If the digitalization strategy does not contain effective scenarios, the losses that the enterprise will receive in implementing such a strategy are estimated. Such calculations can be performed within existing enterprise performance management systems (Corporate Performance Management - CPM, Enterprise Performance Management - EPM, Strategic Enterprise Management – SEM, Business Performance Management – BPM). Such systems cover integrated solutions, including methodologies, indicators, processes and information systems (see [5]). The set of these components provides monitoring control of the enterprise performance.

SAS software solutions (such as Financial Management, Activity Based Management, and Strategic Performance Management) can be used to build CPM at the enterprise level to automate business processes within the performance management cycle.

Thus, using distributed systems in the framework of the enterprise digitalization strategy, it is necessary to meet a number of conditions in their design, which will ensure efficiency not only of the system operation, but also of the whole strategy.

First, it concerns resource identification, which involves forming a set of resource names in such a way that users can open and reference the resources they need. Identification, reducing resource search time, increases system performance. An example of this consideration is the Uniform Resource Locator (URL) system, which defines web page names.

Second, it is necessary to have efficient ways to organize the interaction of computers in a distributed system. As such methods, it is possible to recommend the use of TCP/IP transport and network protocols (TCP - Transmission Control Protocol (IP - Internet Protocol), which are the basis of Internet operation and represent a network model of data transmission presented in digital form.

Third, distributed management should be characterized by a high quality system service. The importance of this condition is determined by the fact that the performance and reliability of the distributed system depend to a large extent on the level of service quality. This indicator is influenced by parameters such as the system resource allocation mechanism, the hardware used, and the ability to adapt the system to changing environmental factors.

The implementation of an effective digitalization strategy leads to a change in the structure of the property potential of the enterprise, in particular, the share of material and intellectual components of assets changes. Intellectual elements are beginning to dominate the structure of assets. This is due to a number of circumstances:

– through digitalization, the enterprise attracts highly qualified personnel, invests in training, develops a system of labor incentives, etc. In this case, the growth of intellectual assets is associated with an increase in the share of human capital;

– orientation towards digitalization changes not only the technology of production of products, but also organizational control processes. The consequence of this is the emergence of elements of organizational capital in the property potential of the enterprise. These elements, in the form of various instructions, methodologies, guidance technical materials, etc., are intellectual assets;

– use of distributed information systems in the digitalization strategy ensures generation of other elements of intellectual assets. In particular, by developing or acquiring intelligent information systems within the framework of license agreements, including intelligent databases, static and dynamic expert systems, self-learning systems, adaptive information systems, the enterprise generates the emergence of new intellectual property objects in the structure of intellectual assets. These objects can be patents, licenses, certificates for computer programs, know-how, etc.

Interacting with different categories of stakeholders, the enterprise forms the client component of intellectual assets. These can be methods and instructions for managing receivables and payables, tools for creating consumer loyalty, and so on. Formalization of processes of enterprise-consumer relations leads to integration into the strategy of digitalization of CRM-systems (CRM - Customer Relationship Management), which regulate processes of enterprise-consumer relations at the information level.

5 Conclusions

The intellectual assets created by the enterprise as part of the digitalization strategy consist of two elements. Similar to the evaluation of innovation results, these components can be interpreted as identifiable and unidentified intellectual assets (see [8] for details).

Identifiable intellectual assets will be enterprise-owned and registered as intangible asset elements patents, licenses, computer program certificates, databases and know-how. Currently, there are widely used methods for estimating the cost of such elements.

The greatest difficulties arise in determining the value of the enterprise 's unidentified intellectual assets. Integrally, these assets are considered as part of the business reputation of the enterprise. At the same time, unidentified intellectual assets can not only form part of business reputation, but also form it. This is due to the fact that from the point of view of valuation the value of the business reputation of the enterprise is considered as the difference between the market value of all assets and the value of the enterprise as a single property complex. The total value of this difference can be formed under the influence of various factors, including those that are not related to the intellectual assets available to the enterprise, so it is important to distinguish specific elements of intellectual assets from the integral indicator «business reputation of the enterprise» and to determine their market value.

An important element of an enterprise 's unidentified intellectual assets is the infrastructure component. Its formation is influenced by enterprise management technology. To estimate the value of an enterprise 's infrastructure assets, you can use an approach based on an analysis of the impact of management functions on the integrated results of an enterprise.

The method of calculating the value of an infrastructure asset can be based on another approach, in particular, on the correlation of the integral value of net discounted income with the benefits of using the asset. These benefits can be due both to cost savings in the implementation of various business processes and to the reduction of the duration of these business processes, which affects the turnover of assets.

Thus, integrating distributed information systems into a digital strategy enables you to effectively manage your enterprise's automated production environment. This is largely achieved by increasing the validity of management decisions in various areas of the enterprise. At the same time, the enterprise 's use of distributed systems of the next generation, meeting the requirements of the digital economy, provides for the implementation of the system components in the form of a Web-service, i.e. a software system with standardized interfaces. This applies equally to both software components and network resources (such as data stores).

Table 1. Risks, design conditions distributed systems, and changing the structure of the property potential of the enterprise.

Risks	**Design conditions distributed systems**	**Changing the structure of the property potential of the enterprise**
The complexity of the distributed system makes it difficult to assess its integral properties.	It concerns resource identification, which involves forming a set of resource names in such a way that users can open and reference the resources they need.	Growth of intellectual assets due to an increase in the share of human capital.
The high complexity of distributed systems results in unpredictable responses to certain events that occur in the system.	It is necessary to have efficient ways to organize the interaction of computers in a distributed system.	The emergence of elements of organizational capital in the property potential of the enterprise.
A distributed system can include multiple computers with different versions of operating systems. In this	Distributed management should be characterized by a high quality system service.	Use of distributed information systems in the digitalization strategy ensures generation of

case, there may be a risk of loss of manageability of the system.		other elements of intellectual assets.

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