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INTEGRATION TECHNOLOGIES AND THEIR PROBLEMATIC ASPECTS IN INFORMATION SYSTEMS

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Abstract
The formation of a digital economy on a global scale has an impact on the development of all aspects of society. Under the influence of digital technological solutions, production and business processes and the social sphere of society are changing. Digital development also has a huge impact on the competitiveness of companies, including the improvement of their production activities. The article discusses the main directions for improving the activities of companies in the context of digital transformation of the economy.

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In this article, the authors provide an analysis of various methods and problems of information systems integration, and present the advantages and disadvantages of one or another method.

Keywords: Digital technologies, information systems, information infrastructure, software interface, software products, integration methods, functional and application level, classification of integration problems, business processes.

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Introduction

One of the factors that determines the technological level of development of an organization is the degree of use of information technology, because it allows you to quickly and accurately process information obtained on the basis of accumulated knowledge and prepare rationales for decision-making. Integration refers to the development and support of an interface for working with heterogeneous data obtained from various sources.

Currently, the company's competitiveness is ensured by the presence of an information system. Multifunctionality of work may imply specificity, which implies the presence of not one, but several systems and for the effective management of business processes the need for their integration.

Integration is necessary to establish connections between information systems in order to create a single information business space and support end-to-end business processes.

Research methodology

The main barrier to integration is that each system has its own information base, and if the data is located in another independent information system, then it can be very difficult to obtain the data. When it comes to big data, transferring and retrieving data often turns out to be a labor-intensive process and takes up a lot of resources.

The works of foreign and Russian scientists present various approaches to data integration in a unified information system of enterprises and organizations, as well as industries and spheres of the economy. While writing this article, the authors reviewed the works of O.A. Morozova. [1], Dumchenkov I.A. [2], Belalova G.A.[3], Chinaeva T.I. [4], Shaw N., DeLone W., Niederman F. [5], Mayorov E. E., Tayurskaya I. S.T. [6], Belokurov S.V. [7], Takiy E.F. [8], Xashimxodjayev Sh. I., Belalova G. A. [9], Kamalov Sh.K., [10] etc.

Let's consider the main methods of integrating information systems presented in Figure 1.

The most popular integration method is at *the interface level.*

This method combines various software applications located in the information space. Integration can be carried out both on the software and on the physical and user interface.

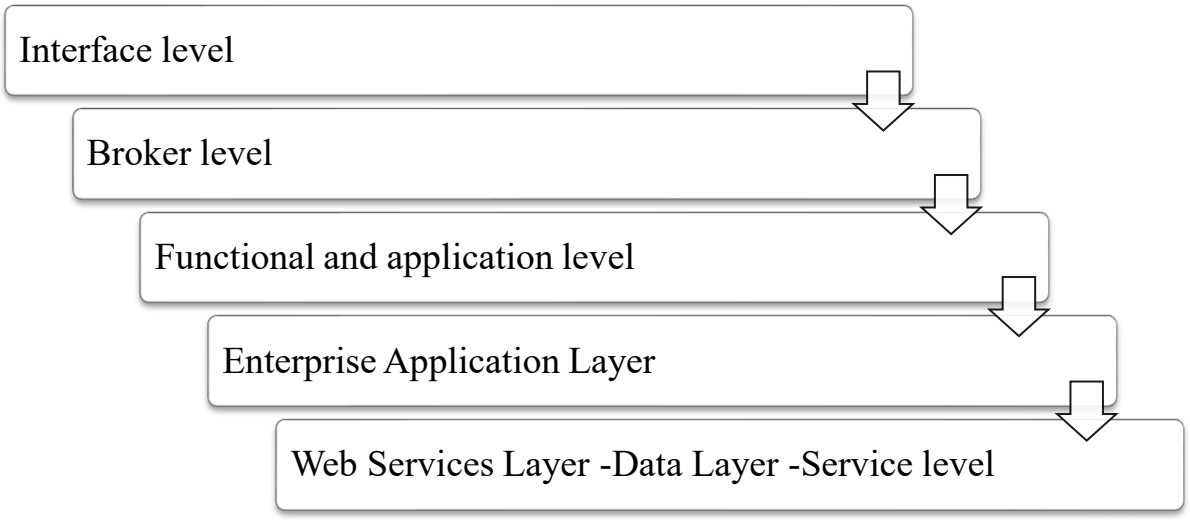

Fig.1. Basic methods of information systems integration [1]

Since software products in the information system were developed by different developers at different times, it may be difficult to combine them into a single complex. Therefore, this approach is convenient for a small number of software applications. For a large number of applications, it is ineffective and does not provide the construction of qualitatively new queries to the combined data.

Currently, the interface method is implemented based on standard applications with open software interfaces.

Integration at the broker level is universal. Since it is possible to implement an additional software module that will access other systems in different ways, such as remote call of procedures or information base. This method also has a disadvantage - it is difficult to implement and high development cost.

Integration at the functional-application level. This method uses the combination of several functions of the same type or similar ones into macrofunctions in which resources, data flows, control and execution mechanisms are redistributed. This method entails the reorganization of business processes, information storage and document flow. The advantages of this type of integration are the manageability of business processes, reduction in the number of personnel and the number of errors. The downside is the complete transformation of all processes, which can undoubtedly entail certain risks. This method is recommended to be used before implementing a corporate information system, as well as in the case of reengineering the company's business processes.

Integration at the level of enterprise software applications. This integration method involves sharing executable code with internal data of the integrated applications. Integration occurs using standardized software interfaces and specialized middleware. This allows you to create a universal software platform that can be used by all applications. Each application will have only one interface to interact with this platform, which makes it easier to administer, maintain and scale the information system. Reusing functions will significantly reduce the time and cost of application development. However, the process of analyzing the internal content of software applications for which interaction is carried out presents a certain difficulty.

Integration using Web services. This integration method is developing rapidly. It is based on providing a standard Web services interface for accessing applications and their data. Web

[1] Developed by the authors

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services are more unified and standardized, and are also based on common standards (for the W3C consortium) and can work anywhere there is access to the Internet.
Using standard protocols you can (fig.2):

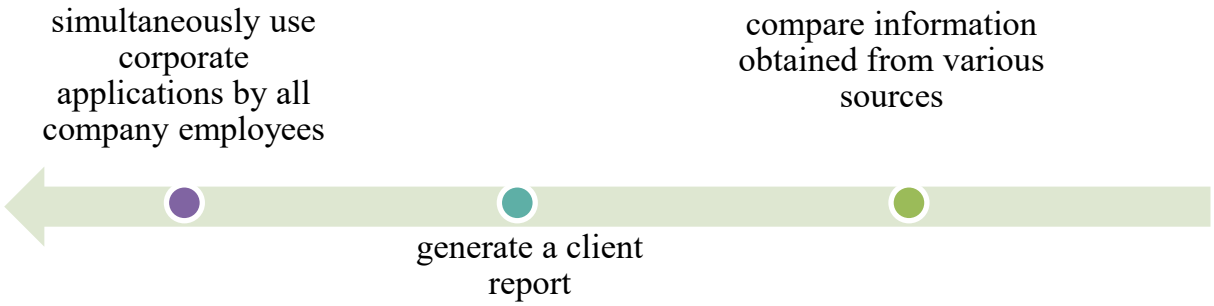

Fig.2. Integration capabilities using standard protocols[2]

Integration at the data level. This method is based on the ability to access one database or several databases. The advantage of this type is low integration costs. There are also disadvantages, such as the occurrence of failures and errors, due to the lack of protective functions and restrictions in the process of interaction between applications and the information base.
Integration at the service level. This method is based on fixing interfaces and data formats on both sides. The advantage is the organization of rapid development of inter-corporate business logic. This integration approach also has a drawback: since it is initially based on "memorization" or fixation, when data, structures or processes change, problems and errors arise, which leads to the development of narrowly focused, proprietary solutions.
The company's information infrastructure is constantly changing. Various changes can occur both purposefully and unplanned, under the influence of external factors and business needs. As a result, a company's information system may contain software applications from different manufacturers, which are implemented on different platforms and have the same functions.
Linking disparate enterprise applications requires a special infrastructure to move data between systems. In some cases, it is necessary not only to move data, but also to support certain business logic for the interaction of applications, that is, to automate a distributed business process or provide a single point of access to information provided by individual applications. Despite the variety of integration tasks and methods for linking applications, we can distinguish integration solutions that use a template language. Essentially, the template acts as a reference model and is an abstract description of a typical problem and methods for solving it.
Modern information systems require reliable integration with a number of related information systems for their full functioning. However, very often, when implementing projects to create information systems, developers solve integration problems to a minimum extent, at best creating the possibility of correct data exchange only between directly interfaced systems by providing a kind of "local" integration, which involves a minimum number of systems.

Research results
In general, data integration in information systems is understood as providing a single unified interface for access to a certain set of heterogeneous independent data sources.

[2] Developed by the authors

As a result of the policy of independent development and implementation of information systems, problems arise that can be classified into the categories shown in Figure 3.

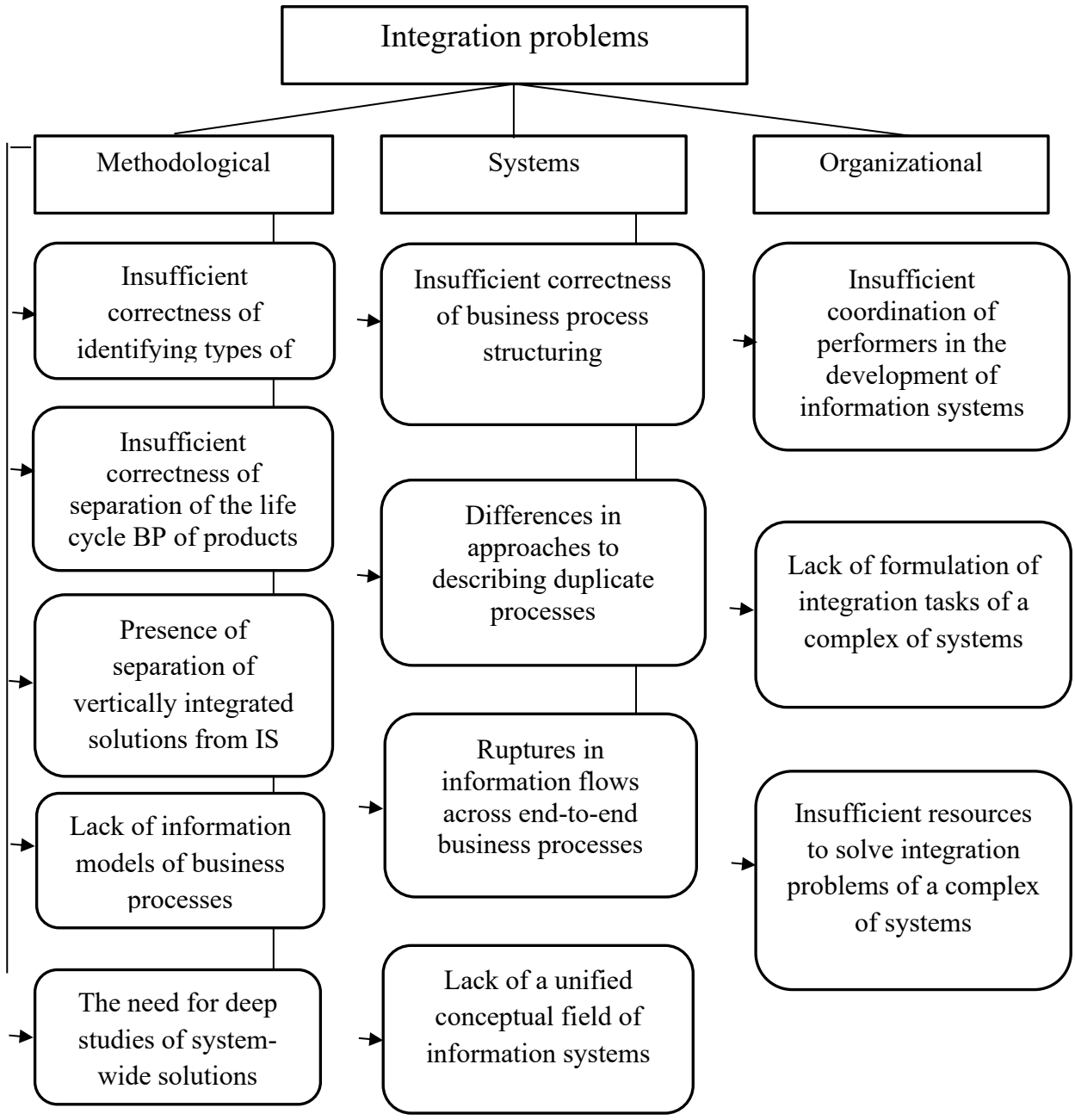

Fig. 3. Classification of integration problems[3]

The problems noted in Figure 3 can be characterized as follows.

1. Problems of systemic integration:

– insufficient correctness of structuring business processes at different levels of the management hierarchy of corporate centers - the formed structure of business processes may

[3] Dumchenkov, I. A. Review of methods for integrating information systems, their advantages and disadvantages // Young scientist, 2018. - No. 23 (209). — P. 176-177.

have insufficient depth of elaboration, and the business processes themselves are not always identified correctly enough. The consequence of this may be a mismatch of both production and supporting (functional) processes;

– differences in approaches to describing repeating processes during the autonomous creation of information systems - the presence of this problem may be caused by the lack of criteria and rules for typing business processes within various types of activities. If you refuse to carry out methodological developments that define standards and recommendations for describing business processes, typification work will have to be carried out anew each time in each project;

– the presence of gaps in the information flows of end-to-end (covering several management levels) business processes - process descriptions often do not contain information models and, accordingly, do not consider the transformation of circulating information during data processing and preparation. Only the exchange at the level of classes and individual types of documents is recorded, while at various levels the processing and preparation of various fragmentary information is carried out, subsequently summarized by the generated documents. This significantly complicates the integration of end-to-end business processes in various projects for creating information systems;

– lack of a unified conceptual field of target information systems - within the framework of company informatization strategies and concepts, as a rule, basic reference books are developed, which must subsequently be used in informatization processes. Directories generated in various systems creation projects are often not integrated and, as a result, both completeness and integrity, as well as consistency of the conceptual field of the informatization process, are not ensured;

– the need for more in-depth studies of system-wide solutions - system-wide solutions covering the entire complex of information systems of an organization or enterprise, first of all, should include corporate data warehouses and systems of regulatory and reference information. It is these objects that are defined as the main tools for integrating the created complex of information systems. The success of creating a Unified Information Space is based on them. Delays in the development of system-wide components during the execution of projects for the creation of individual information systems subsequently lead to the impossibility or, at best, serious difficulties in coordinating the operation of systems, as well as to unreasonably high costs for the modification of already created systems.

2. Methodological problems of integration:

– insufficient correctness of identifying types of activities - the classification of types of activities of a company or enterprise is usually clarified during the implementation of individual projects. Thus, updating and subsequent detailing of the basic classifier of activities is required, since it is used as a starting point both in the process of planning informatization processes and in the development of new projects, and for the integration of already created information systems;

– insufficient correctness of separation of business processes of the life cycle of products and assets - in program documents on informatization of a company or enterprise, entities such as

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products of activities and assets of the organization are not always clearly identified. Only business processes are considered as management objects, despite the fact that during the activities of an organization or enterprise, products and assets can change their state, configuration and other characteristics related to a certain stage of their life cycle. Failure to take into account such characteristics and ignoring the possibility of considering their relationship can significantly reduce the effectiveness of business optimization within the framework of ongoing system creation projects;

– the presence of a separation of vertically integrated solutions from information systems - projects at the level of individual organizations and the upper level of holding structures are usually developed independently of each other. Such inconsistencies do not allow building an end-to-end methodology of related and correctly coordinated business processes, ensuring the feasibility of agreed upon architectural, technical and information solutions;

– lack of information models of business processes - when describing business processes, emphasis is often placed on the structure of the processes themselves, and a scheme for exchanging information at the level of document classes is provided. However, this is not enough, since in most cases it is of fundamental importance to designate the sources of appearance and storage locations of fragmentary information that is subsequently embedded in documents. In this regard, information models provide invaluable assistance in resolving issues of organizing data storage, placing the necessary information, as well as automating the process of generating documents;

– lack of quality criteria for business process models - developed business process models are often assessed by an expert method, which does not ensure uniformity of results both in content and quality. Some standardized modeling tools allow you to control the integrity and correctness of the created models, preventing possible errors of performers. However, the range of such modeling environments is not wide enough. In this regard, it is necessary to develop and implement methods for assessing the completeness, integrity and adequacy of models.

3. Organizational problems of integration:

– insufficient coordination of performers in the development of information systems - coordination of performers is carried out as planned only within the framework of ongoing projects. At the same time, separate funding for tasks that go beyond the scope of individual projects is, as a rule, not carried out. In addition, developers of individual functional systems are often not involved in the development of such key projects as a corporate data warehouse, a system of regulatory and reference information and other systems that determine the basis of the integrated complex. The lack of sufficient information on such basic systems further reduces the ability to coordinate work;

– lack of statements of integration tasks for a complex of information systems - program documents often provide for two main integration mechanisms: corporate data warehouses and a system of regulatory and reference information. In information systems design documents, a section can be developed that characterizes the interaction and participation of the created information system in the implementation of related business processes. However, as a rule, system developers add to this section only very high-level information about interaction with

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other systems regarding the scope of the information system project covering a specific set of business processes;

– insufficient resources to solve integration problems of a complex of information systems - within the framework of individual projects, funding for integration tasks, as a rule, is not provided. It is believed that integration issues should be resolved by project implementers independently. However, experience shows that linking systems is not a private task, but in many cases requires systemic solutions. In this regard, it is advisable to carry out a separate project to integrate a complex of information systems.

Conclusion and Suggestions

Modern realities are such that a company's competitiveness directly depends on the use of information technologies, which not only automate individual functions or business processes, but also ensure close integration of information systems and applications.

The authors analyzed methods for integrating information systems and identified a number of problems that may arise during the integration process. But the choice of integration method is the prerogative of the company, which depends on its needs and capabilities. Using the comparative analysis method, you can make the right choice and use the optimal software and tools. All methods have their advantages and disadvantages and are implemented using different technologies.

It should be understood that there is no universal approach to application integration, just as there is no single option for an integration solution, but you can always find the optimal integration method within a specific integration scenario.

As a suggestion, one might consider using a template language, that is, if the goal of the integration is to have a single view of enterprise data and create a single point of access to data from multiple sources, then one could use middleware architecture templates that focus on entity aggregation and portal-centric integration.

The purpose of entity aggregation is to enable applications to effectively use data distributed across multiple repositories, and the purpose of building an enterprise portal is to provide users with a single point of access to all corporate information. To complete many business tasks, users need to obtain information from a variety of sources. Building a portal is a relatively simple form of integration that is fairly easy to implement and has minimal impact on the linked applications.

For any modern enterprise, the use of integration technologies is strategic and provides undoubted competitive advantages. Developing an optimal integration strategy is impossible without knowledge of basic technologies and standards for remote interaction of systems. The use of templates documenting expert knowledge allows you to correctly classify a problem and compare possible solutions to it.

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