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SOME CONSIDERATIONS ON THE USE OF LEONTIEF'S MODELS IN NEW ECONOMIC REALITIES

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Abstract. Today's researchers periodically refer to the extensive scientific heritage of Wassily Leontief, one of the outstanding economists of the 20th century, in order to find solutions to individual problems, both in the global and in the economies of individual countries. The object of consideration of this article is the Leontief differential model. The authors substantiate the need for further development of this model and offer specific forms of its mathematical interpretation. A new reading of Leontief's differential model, the authors believe, will reveal the impact of investment flows from developing countries and emerging markets on various national economies and their groups.

Keywords: Leontief differential model, investment flows, transitional economies, economic policy

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НЕКОТОРЫЕ СООБРАЖЕНИЯ ОБ ИСПОЛЬЗОВАНИИ МОДЕЛЕЙ ЛЕОНТЬЕВА В.В. В НОВЫХ ЭКОНОМИЧЕСКИХ РЕАЛИЯХ

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Аннотация. Исследователи наших дней периодически обращаются к обширному научному наследию Василия Леонтьева, одного из выдающихся экономистов XX века, с целью поиска решений отдельных проблем, как в глобальной, так и в экономиках отдельных стран. Объектом рассмотрения данной статьи является дифференциальная модель Леонтьева. Авторы обосновывают необходимость дальнейшего развития данной модели и предлагают конкретные формы ей математической интерпретации. Новое прочтение дифференциальной модели Леонтьева, как полагают авторы, позволит выявить воздействие инвестиционных потоков из развивающихся стран и формирующихся рынков на различные национальные экономики и их группы.

Ключевые слова: дифференциальная модель Леонтьева, инвестиционные потоки, переходная экономика, экономическая политика

Финансирование: Статья подготовлена в рамках гранта РФФИ № 20-010-00279 «Комплексная система оценки и прогнозирования рынка труда на этапе перехода к цифровой экономике в развитых и развивающихся странах».

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Introduction

The scientific legacy of the outstanding economist of the 20th century, Nobel Prize winner in economics, Wassily Leontief, is multifaceted and diverse. In addition to the theory and methodology of input-output balance, he left remarkable works in such areas of economic science as the efficiency of production concentration, economic evaluation and the choice of directions of technical progress, relations between developed and developing countries (Granberg, 1999). It should be noted that the input-output method proposed by him is widely used today in economic research to solve various problems of economic practice, including in the post-Soviet space ((Ksenofontov et al., 2018); (Cherniavsky and Chepel, 2021)). American researchers have used this method to assess the environmental impact of industrial activities (Duchin, 1992). However, as academician Granberg A.G. noted, “The input-output method in the form in which it was developed by W. Leontief himself and his students has some “generic” restrictive features” (Granberg, 1999). Here, first of all, he meant the use of linear dependencies, the absence of optimization models and intersectoral models of economic development.

With the transition of Western economies to monetarist theories and recipes, articles devoted to intersectoral balance models (IBI) have practically ceased to be published in the special economic literature. And if there were references to them, then to a greater extent, as some relic approaches that are no longer possible in the context of globalization processes.

To a certain extent, this corresponded to the objective processes that have taken place in the developed economies of the world in the last 30-40 years, when the free movement of capital, goods, technology and labor has become one of the main drivers of economic development. The apotheosis of this trend was the American manufacturing industry, where between 2000 and 2010 the number of employed people decreased from 12 to 8.2 million people, i.e. by about one third. If we take longer time intervals, we can note that in 1970 the share of manufacturing in GDP ranged from 21% (Canada) to 30% (Japan), but by 2015 this figure was much lower: 22% (Germany) and 10% (Great Britain and Canada) (Gorbashko et al., 2021). The most recent data from the UNCTAD statistical database shows that in 2020 this figure at the global level was 16.5%, including in the UK - 9.6%, Germany - 16.0%, Canada - 10.5%, USA - 11.1% and Japan - 20.5% ("UNCTADstat," n.d.). To date, a non-trivial situation has developed in the world economy, when China has become the world leader in the production of industrial goods, in fact, taking on the burden of the "workshop of the world".

Geopolitical changes of recent times are laying a new trend in world economic development. Now several centers are being formed in the world, which will follow different scenarios of economic policy. It can be argued that a process of limited globalization has begun, with some return to the "rules" of discrete production. In the conditions of such a new "watershed" of the world economy, a completely natural question arises: what areas of research by V. Leontiev can be in demand in the new economic realities and under what conditions?

It seems that the development of V. Leontiev's differential model, proposed by B. Khusainov in 2005, may be of some interest in this context (Khusainov, 2005). In particular, the implementation of the model will reveal the impact of investment flows from developing countries and emerging markets on various national economies and their groups.

New reading of Leontief's differential model

W. Leontief's differential model aims to assess the impact of foreign capital on the economic growth of the recipient country (Leontief, 1990). Leontief's simple dynamic system describes in a simplified aggregated form dependencies between capital value, transferred from developed countries to developing, rate of savings and investments in both group of countries and their growth rates. Statistical information that is available is used in the system. General values of coefficients "capital-output" and rate of savings for developed and developing countries, as well as share of gross national product of developed countries, transferred to developing countries, are assumed constant for the ten-years period for which economic growth is calculated.

Since aggregated values of the coefficient of capital intensity and rate of savings could be assessed especially for developed countries - only with significant error, and also taking into account that the goal is assessment of potential influence of change in values of foreign capital, received by developing countries, on their growth rates, in Leontief's model not one, but several choices are considered. All of them are calculated based on the same equations, however, each is defined by own hypothetic combination of values of structural parameters mentioned above.

It is acknowledged, that Leontief's dynamic model made an important contribution to the understanding of patterns of international economic interaction of different countries. At the same time, it has several issues that excessively unfit the economic reality. In the aggregated view disadvantage of the given model could be shown as the following.

1. Scale of exported capital from country-donor directly linked to the rates of the economic growth. Recently, it became obvious that it is not always true. The most illustrative example of this dependency was displayed during world financial crisis of 1997-1998 when significant capital overflow took place, including foreign, from Asian-Pacific countries to North America, in particular to the US. This thesis also

could not be applied to the countries with transitional economy. Indeed, stable high level of export of national capital abroad was typical for several countries (Russia, Kazakhstan, and others) of this group exactly during deep economic crisis. Thus, relation between production growth rates in countries, that export and import capital, turns quite ambiguous. Hence, Leontief's model could be weakly applied to the analysis of the modern tendencies.

2. Imported capital assumed homogeneous. At the same time countries with transitional economies "illustratively demonstrate that truth, that not only values of imported capital are important but its structure. Thus, for instance, considerable part of foreign investments in Russia was spent on purchase of short-term government-papers and not allocated to the real sector of the economy" (Balatskyi, 1999). This thesis is also supported by research of authoritative Russian scientists ((L'vov, 1999); (L'vov, 2000); (Glinkina, Kulikova, 2006)). Understandable that such financial investment favor most likely to slowing down rather than to acceleration of economic development of the country-recipient. In this sense applied calculations on Leontief's differentiated model could strongly misinform researcher on real role of foreign investment.

3. National and foreign investments are assumed of the equal effect. In this case W. Leontief assumes that foreign capitals - are just supplementary financial resources, return on which is defined by national conditions of production. But this case does not match today's reality. Firstly, deep economic meaning of foreign capital attraction is the following: together with foreign capital new technologies are coming to the national economy as well as new organizational forms of production, that give absolutely different economic effect comparing to domestic entrepreneurship. At the same time experience of transitional economies on foreign capital attraction witnesses that foreign investors are not trying to reach these goals. Moreover, market of countries with transitional economies often becomes base for "trash" of obsolete technologies and manufactures. Secondly, experience of system transformation in the countries with transitional economy shows that at the certain stage of economic development of the national economies foreign capital plays determinative role due to limited opportunities of domestic public savings, lack of own capital, deepening of crisis processes in the mentioned period. However, as far as growth of the economy and accumulation of own investment resources ratio of foreign investments in total value of investments to the main capital is certainly decreasing (World Development Report 2005, 2004). Saying in this situation that effect of domestic capital is lower than effect of foreign capital is hardly reasonable (Khusainov, 2005).

4. When Leontief's model was under development crucial demonstrations of modern stage of development (for instance, globalization of the world economy, impetuous development of its transnational sector and etc.) were not playing such an important role on dynamics of economic growth of different countries. However, registration of these factors including influence of globalization on development of national economies through its crucial demonstrations becomes extremely important task in order to develop adequate economic policy and assess subsequences of taken decisions.

5. Finally, given model pays great demand to the informational supply. In particular, apart from national statistics, availability of statistical data on many countries is needed. And this could be serious technical obstacle for the realization of the given model.

Our interpretation of the differential Leontief's model

From the moment of development of the model in the world economic system certain changes had happened (in particular, caused by globalization) and appeared absolutely new group of countries, classified as transitional economies. Taking this into account, appropriate changes were introduced to the development of Leontief's dynamic model by the author (Khusainov, 2005), in particular, system of equations was included, which reflect influence of capital flows from developed and developing countries on dynamics of economic growth of transitional economies.

Let's use the following set of aggregated variables (in each moment of time t) (table 1) in order to describe state of economy of three groups of countries - developed, developing and transitional economies.

Table 1. Aggregated variables of W. Leontief's modified model

Variables	Developed countries	Developing countries	Transitional economies
Gross domestic product (GDP)	$Y_1(t)$	$Y_2(t)$	$Y_3(t)$
Industrial investments (total value)	$I_1(t)$	$I_2(t)$	$I_3(t)$
GDP growth rate $\overline{Y}(t)/Y(t)$	$r_1(t)$	$r_2(t)$	$r_3(t)$
Capital transfer from developed countries to transitional economies	$H_1(t)$		
Capital transfer from developing countries to transitional economies	$H_2(t)$		

Developed and developing countries

Let's use the following theoretical dependencies to derive and solve equations, which describe growth in developed and developing countries:

Equation of savings for two groups of countries:

$$I_1(t) = i_1 Y_1(t) \tag{1}$$

$$I_2(t) = i_2 Y_2(t) \tag{2}$$

where i_1, i_2 – rate of investments to GDP in developed and developing countries.

Accelerator's principle:

$$\overline{Y_1}(t) = I_1(t) / b_1 \tag{3}$$

$$\overline{Y_2}(t) = I_2(t) / b_2 \tag{4}$$

where b_1, b_2 – coefficients of capital intensity (ratio of capital to output), that is value of capital investments needed to produce additional unit of annual GDP in respective group of countries.

Equation of the growth rates, received based on (1) – (4)

$$\overline{Y_1}(t) = (i_1 / b_1) * Y_1(t) = 0 \tag{5}$$

$$\overline{Y_2}(t) = (i_2 / b_2) * Y_2(t) = 0 \tag{6}$$

Exponential growth equations, received based on (5) and (6):

$$\overline{Y_1}(t) = Y_1(0) e^{\lambda_1 t}, \lambda_1 = i_1 / b_1 \tag{7}$$

$$\overline{Y_1}(t) = Y_2(0) e^{\lambda_2 t}, \lambda_2 = i_2 / b_2 \tag{8}$$

where $Y_1(0)$ and $Y_2(0)$ – GDP value in base year 0.

λ_1, λ_2 – GDP growth rate, that remains constant at fixed i_1, i_2 and b_1, b_2.

According to the conditions of dynamic model it is assumed that value of capital transferred to transitional economies from developed and developing countries form constant shares h_1 and h_2 out of GDP of the countries that export capital.

Thus, increase of values of transferred capital $H_1(t)$ and $H_2(t)$ received from (7) and (8) will have the view of exponent with the growth rate that equals GDP growth rate of developed and developing countries.

Ratio of the value of transferred capital from both groups accordingly:

$$H_1(t) = h_1Y_1(t) = h_1Y_1(0)e^{\lambda_1 t} \tag{9}$$

$$H_2(t) = h_2Y_2(t) = h_2Y_2(0)e^{\lambda_2 t} \tag{10}$$

Countries with transitional economies

According to the logic of Leontief's model let's assume that industrial investments in countries with transitional economies are formed based on three sources: rate of savings (i_3) of their own GDP $Y_3(t)$ and imported capital $H_1(t)$ and $H_2(t)$:

Equation of investments:

$$i_3(t) = i_3Y_3(t) + H_1(t) + H_2(t) = i_3Y_3(t) + h_1Y_1(0)e^{\lambda_1 t} + h_2Y_2(0)e^{\lambda_2 t} \tag{11}$$

Accelerator's principle:

$$\overline{Y_3}(t) = I_3(t)/b_3 \tag{12}$$

where b_3 – coefficient of capital intensity, that shows value of investments needed for the production of additional unit of annual GDP in this group of countries.

Equation of the growth rates, calculated based on (11) and (12):

$$\overline{Y_3}(t) - (i_3/b_3)*Y_3(t) - (h_1/b_3)*Y_1(0)e^{\lambda_1 t} + (h_2/b_3)*Y_2(0)e^{\lambda_2 t} = 0 \tag{13}$$

at that $(i_3/b_3) \neq \lambda_1 \neq \lambda_2$.

Equation of growth that was received as a result of solution of differentiated equation (13):

$$\overline{Y_3}(t) = [Y_3(0) - H_1(t)/(b_3(\lambda_1 - \lambda_2))]e^{\lambda_1 t} + [Y_3(0) - H_2(t)/(b_3(\lambda_2 - \lambda_3))]e^{\lambda_3 t} + \\ + H_1(t)e^{\lambda_1 t}/(b_3(\lambda_1 - \lambda_3)) + H_2(t)e^{\lambda_2 t}/(b_3(\lambda_2 - \lambda_3)) \tag{14}$$

To check adequacy of the last equation it is possible to substitute its right side in its first derivative in (13). Expression in the left side of the equation (13) will turn into 0.

Conclusion

The growth of the economy in transitional countries could be described by combination of three components, each of which is changing on exponential dependency. First reflects effect of domestic savings, second - contribution of investments, transferred to the economy from developed countries, third - contribution of investments, which are financed by import from group of developing countries (Lehtonen, 2004; Mayer, 2001; Rudskoy et al., 2019). Respectively, growth rate of the first component depends on rate of domestic savings and coefficient "capital - output", while the second and third are growing along with GDP growth rates of the developed and developing countries.

Certainly, observed comments do not contradict the possibility of adaptation of the Leontief's model for the macroeconomic analysis. Its adaptation is quite reasonable, especially in order to identify qualitative characteristics of the development of international relations by country groups (or regions). But for detailed quantitative calculations by each certain country, we believe, usage of the other model is preferable.

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IMPLEMENTATION OF PROJECT AND PROCESS MANAGEMENT IN MINING ENTERPRISES

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Abstract. The article considers and justifies the necessity of project and process approach in development of mineral deposits. Each approach has a number of advantages and disadvantages, and in practice is applied separately. This often leads to the fact that they not only do not complement each other, but in the case of illiterate use, thereby reducing the efficiency of both the mine development and the management of the mining enterprise as a whole. The authors propose to change this situation by combining the project and process approach and considering these approaches as a single management system. The proposed approach (model) allows to build a management system in real conditions for a mining enterprise consisting of both a single mine and a system of deposits (hub). Its universality is that it is applicable to all stages of its development: preparatory, construction and operation. In addition, the methodology allows to assess the contribution of mineral reserves and resources to the total market value of the mining enterprise.

Keywords: mine development, investment, project approach, process approach

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ВНЕДРЕНИЕ ПРОЕКТНО-ПРОЦЕССНОГО УПРАВЛЕНИЯ НА ГОРНОДОБЫВАЮЩИХ ПРЕДПРИЯТИЯХ

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Аннотация. В статье рассматривается и обосновывается необходимость проектно-процессного подхода при разработке месторождений полезных ископаемых. Каждый подход имеет ряд преимуществ и недостатков и на практике применяется отдельно. Это часто приводит к тому, что они не только не дополняют друг друга, но и в случае неграмотного использования снижают эффективность как разработки шахты, так и управления горным предприятием в целом. Авторы предлагают изменить эту ситуацию, объединив проектный и процессный подходы и рассматривая эти подходы как единую систему управления. Предлагаемый подход (модель) позволяет построить в реальных условиях систему управления горным предприятием, состоящим как из одного рудника, так и из системы месторождений (хаба). Его универсальность заключается в том, что он применим ко всем этапам его разработки: подготовительному, строительному и эксплуатационному. Кроме того, методика позволяет оценить вклад запасов и ресурсов полезных ископаемых в общую рыночную стоимость горнодобывающего предприятия.

Ключевые слова: разработка месторождений, инвестиции, проектный подход, процессный подход

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Introduction

The development of mineral deposits is an organizationally complex and costly activity. This imposes a certain responsibility on the subsoil user and requires him, on the one hand, to invest significantly in launching and on the other hand, to be flexible and appropriate to the time and nature of the management system. Increasing competition caused by rising prices for mining products, development of complex and hard-to-reach deposits, resulting in an increase in unit capital costs, is a powerful incentive to improve the management system.

The development of an approach (model) of the management of the mine individually and of a mining enterprise, which would allow a potential investor to effectively manage all resources, is of great importance both in our country and abroad.

Existing hierarchical practices tend to try to interact and resolve issues through reports and letters to management, committees and meetings, without trying to establish a clear system and algorithms of decision-making. This approach, based primarily on the functions of the division and performer, is suitable for a small organization. But over time, an organization can grow and grow organizationally, and therefore needs a systematic approach to management. These are two approaches: project and process management. This raises the question: Which of the approaches to be applied at the mining enterprise, which one is preferred given the stages of development of the mine.

The mining enterprise is a complex and dynamic system. As a rule, it may include several mines implemented within the framework of projects, and in turn several sites where repetitive processes occur continuously: extraction, transportation, processing (Dychkovskyi ye al., 2018). At the same time, mining operations change in time and space, so the activity of the operating enterprise can be characterized by two types of activity:

1. recurring processes.
2. single processes that will no longer repeat in this form.

The first type of activity is a process, the second one is a project. That is, the business process, unlike the project, is a certain kind of conveyor to perform certain functions, whereas the project is repeated only once (Aguilar-Sav n, 2004). Thus, managing a company's activity means managing its processes (Process Management) within the project. In practice, it is quite common for project activities to become project activities and vice versa.

Thus, for the effective management of the mining enterprise in the implementation of projects, clearly defined processes are necessary. This work is devoted to finding the optimal combination of process and project management approaches in the implementation of mining projects.

Materials and Methods

In order to understand project and process management, it is necessary to define their definitions.

The concept of a business process, like a project, is interpreted differently, but in this case it can be based on the definition given in ISO 9000: Process is a set of interconnected and interacting operations (actions) that transform inputs into outputs (Karapetrovic, 1999). Processes can be standardized because any methodology contains the following controls: initiation, planning, execution, analysis, management, completion. The approach, when the resources and activities of an organization are managed as a process, is called a process. In practice, a functional approach is most often used when the functions of the entity are the objects of control. However, in the case of a process approach, the objects of control are processes that focus on achieving intermediate results. The most commonly used standardized methodologies, including project management processes, include: PMI PMBOK, OGC PRINCE2 and APM APMBOK.

There are several definitions of the concept of the project, but the most comprehensive is the following: The project is a set of measures and activities aimed at changing a system by achieving certain goals, under resource and time constraints (The Open Group, 2018; Amalia et al., 2017; Ilin, Levina, Iliashenko, 2017). In other words, the project is a unique process, consisting of a set of one-time activities, as a result of which a unique product is created. Projects can be divided into two categories: development projects and ongoing projects. The projects of the first category are aimed at the creation of new assets, which can include the construction of processing facilities and the development of new mines. In turn, the projects in the second category are aimed at modernization and reconstruction of already existing assets as well as active processes of the management system. In essence, each project is a unique activity and can differ in the scale, complexity, composition and number of participants, terms of implementation, goals and tasks, object of investment activity, requirements for quality and ways of its provision. When the project is managed, it is a project approach.

For some elements, the project and the business process are similar (see table 1).

Table 1. Compare common project and process elements

Element	Process	Project
activity	repeating	one-time
term	unlimited	limited
content	implementation	planning, implementation, control, completion
assignment	converting resources to a product	creation of new assets, development of existing projects and functions, converting resources to a product
uniqueness	missing	present

Conclusion: Process management focuses on the implementation stage and project management at all stages of the life cycle.

The composition of the organization's processes and projects depends on the nature of its activities. A trade organization, for example, is process-oriented because its activities are based on purchase-sale processes. And it may not change for years. At the same time, the construction organization, rather in its activity, is guided by the project approach. As a rule, a new construction facility may differ in its location and complexity (Levina et al., 2018; Bril et al., 2017; Dubgorn et al., 2018). But there are organizations where the project and process approach will work together. Such organizations include mining enterprises. This enterprise is a unique project by definition, as each mine is created by nature itself and cannot be repeated. The mines or group of mines form a project, the management and development of which is based on a process basis. In this case, the mining management model can be considered as a process-based project model. In terms of the tasks to be solved, the project defines the development strategy of the organization, while the process is a tactical tool for its implementation. Thus, processes are a project component and the process approach complements the project approach. In this case, we can see the addition and promotion of two approaches. A well-built management system can create synergies.

Many researchers (Lankhorst, 2017; Ermolina et al., 2015; Zaychenko et al., 2018; Burke, 2013) explicitly note the need to include in the enterprise architecture a component responsible for working with changes and transformations. The TOGAF emphasizes that the enterprise architecture among other elements should include "transition processes to implement new technologies in response to changing business needs." Because the enterprise architecture is a dynamic management tool, it requires a built-in mechanism for change management that differs from routine operating processes. These arguments prove the necessity of introducing the project slice into the model of the business architecture of the enterprise.

Results

The efficiency of any enterprise is based on the choice of its process management tools. One such management tool is the value chain. The value chain is a strategic analysis tool aimed at detailed analysis of the business for strategic planning purposes. The author of the concept is Professor Michael Porter, who has determined that it is the value chain that is the best helper in the choice of the strategy of enterprise development (Mozota, 1998; Ilin et al., 2014; Maydanova et al., 2018). This is because the concept allows us to understand what is happening in the organization, who is responsible for it, and what is the final product. Analysis and reorganization of the value chain allows to determine the efficiency of the business model of the enterprise/project as a whole, to analyze the processes separately, to highlight the necessary modernization, to increase the competitiveness of the enterprise, its profit, and return on capital. Based on the results of the analysis, the decision can be made to create additional value chains as well as to make changes to the organizational structure of the enterprise.

The process of development of the mine involves the following value chain based on the stages of its industrial development (presented in fig. 1).

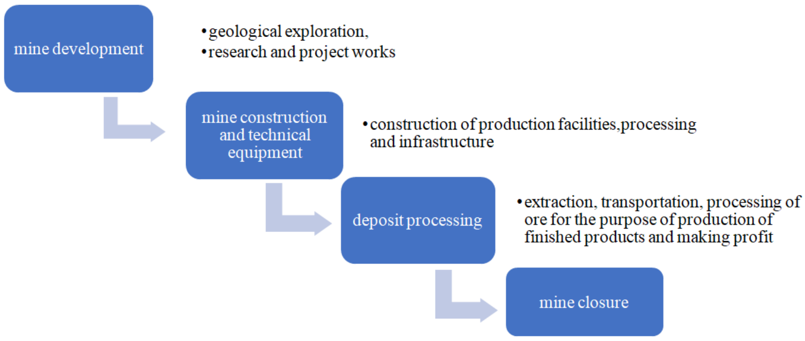

Fig. 1. Industrial development stages

The figure showcases a process of four stages, each of which can be considered separately. This is a simplified scheme, since during the mine's processing, the processes specified in the scheme can be carried out, for example, at one of its sites. Each step is independent but not independent. The fact is that without exploration it is impossible to determine the value and value of the mine itself. The absence of reliable information on reserves and potential resources of the deposit, mining-geological, mining and technical conditions and other conditions, it is impossible to make decisions on its industrial development, to start designing, construction, extraction and processing. Each of these processes has a responsible functional manager, thus it directly influences the result of the organization's activity as a whole. On the one hand, the area of his responsibility ends where his business process ends, on the other hand, the activity of one unit can affect the other, and lead to the reduction of its performance. In this regard, in the mining enterprise it is particularly necessary to coordinate the actions of all the participants of the process. In the project approach, each project has a manager who is responsible for the final result. At the same time, not only the functional units responsible for the main processes under the scheme 1, but also the units supporting the activities of the enterprise in the areas of personnel management, logistics, technology development and infrastructure can participate in the project.

Analysis of investment projects shows that these are complex and long-term projects, implementation of which requires management in order to be effective implementation.

Business project management methodology can be considered at the main stages of the project life cycle (Labuschagne et al., 2005; Orlova et al., 2018; Ilin, Iliashenko, Borremans, 2017; Meredith et at., 2017):

3. Development of project proposal;
4. Project planning and preparation;
5. Project implementation;
6. Close the project.

Thus, the life cycle stages fully reflect the development stages of the mine. The lifecycle involves tracking and directing the project at all stages of the life cycle before its completion to achieve the intended outcome.

In addition to the current activities the company regularly implements development projects, it seems advisable to create a permanent unit in the organizational structure responsible for the implementation of project activities - a project office. To manage such projects, it may be much easier to apply the appropriate project office model.

A team of project executives led by the project manager is formed by the project office from among the company's employees or external specialists depending on the directions and competences required for project implementation.

The supervisor of the project office is the person responsible for allocating resources for the project implementation. These powers are vested in the head of the company.

The head of the project office is the person who manages its activities in the interests of society in the part of:

7. project activity administration - workflow,
8. project competences management-methodical support.
9. analysis of projects for feasibility of implementation and formation of a balanced portfolio of projects;
10. resource management-planning, allocation, monitoring, monitoring and analysis of the use of resources for current and potential projects;
11. interaction with performers (design, expert analysis), contractors (construction, outsourcing services), representatives of authorities, including when receiving tax benefits within the framework of the project being implemented, for example, TOSER, RIP.

The functional model of the company's project office is presented in figure 2.

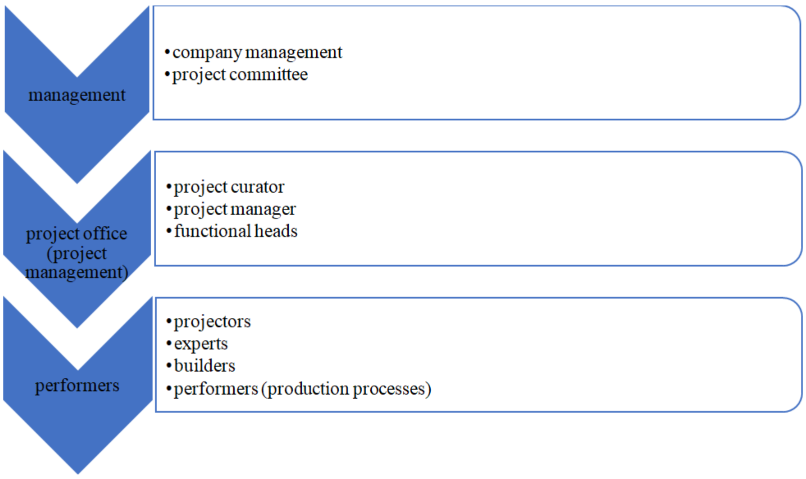

Fig. 2. The functional model of the company's project office

The project office will allow to manage individual projects, portfolio of projects (project programs) in the company. Depending on the size and complexity of the projects, the project office may create project management units of a particular type, such as IT projects. The listed functions must be presented in the project (software) office.

The creation of a process office should help to increase the operational efficiency of the business, as well as for the successful implementation of projects and programs. The main objective of the office is to improve processes, as well as to monitor and build business process performance reports for the relevant process owners and senior management. The process office can be located inside and outside the company, working on outsourcing, which is determined by the scale of the company's organizational structure. In practice, however, there is more often a mixed method of organization, where there is a small internal division that knows the specifics of the enterprise, and external expertise and resources are used to solve certain tasks.

Thus, it can be concluded that project approach combined with process management is the most suitable for a mining enterprise.

Conclusions

In previous decades, the project's success has been linked to three variables: cost, time and quality. However, the modern world is not standing still and new variables related to governance are beginning to appear in the projects. They are mainly the result of model studies that have yet to be tested in various organizational and cultural settings. In this regard, it can be argued that in order to achieve the necessary results and sustainable development the enterprise needs to form an effective management system. In this regard, it is most appropriate to organize operational activities as well as ongoing mining projects based on business processes within the project (mines). The development of the enterprise, connected with the development of new mines and construction of processing capacities, is more convenient to build on the project approach. All this in the complex will allow faster development and commissioning of deposits.

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IMPACT OF THE INDUSTRY 4.0 PARADIGM ON KEY SOFTWARE REQUIREMENTS

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Abstract. The main characteristic of the Industry 4.0 concept is the increased intelligence of the technologies used. Innovative technologies impose new requirements on products, on production processes and, accordingly, on the requirements design methodology. This article discusses the key technologies specific to the Industry 4.0 paradigm, their associated key requirements, the impact of these requirements on the composition of requirements engineering documentation, and the key business analyst skills required to work within the Industry 4.0 concept. The object of the study is the impact of the key technologies of Industry 4.0 on the process of forming and changing product requirements. The research method is the analysis of the available scientific literature on this issue and the construction of a hypothesis on this basis. As a result of the study, key product requirements were identified in terms of Internet of Things (IoT) technologies, and the necessary skills for business analysts to work with these requirements were formulated.

Keywords: Industry 4.0, Internet of Things, IoT, requirements development, RE, cyberphysical system, CPS

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ВЛИЯНИЕ ПАРАДИГМЫ ИНДУСТРИИ 4.0 НА ОСНОВНЫЕ ТРЕБОВАНИЯ К ПРОГРАММНОМУ ОБЕСПЕЧЕНИЮ

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Аннотация. Основной характеристикой концепции «Индустрия 4.0» является повышенный интеллект используемых технологий. Инновационные технологии предъявляют новые требования к продукции, к производственным процессам и, соответственно, к методологии проектирования требований. В этой статье обсуждаются ключевые технологии, характерные для парадигмы Индустрии 4.0, связанные с ними ключевые требования, влияние этих требований на состав документации по разработке требований, а также ключевые навыки бизнес-аналитика, необходимые для работы в рамках концепции Индустрии 4.0. Объектом исследования является влияние ключевых технологий Индустрии 4.0 на процесс формирования и изменения требований к продукции. Метод исследования заключается в анализе доступной научной литературы по данному вопросу и построении на этой основе гипотезы. В результате исследования были определены ключевые требования к продукту с точки зрения технологий Интернета вещей (IoT), а также сформулированы необходимые навыки бизнес-аналитиков для работы с этими требованиями.

Ключевые слова: индустрия 4.0, интернет вещей, IoT, разработка требований, RE, киберфизическая система, CPS

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Introduction

The fourth industrial revolution (Industry 4.0) involves a new approach to production based on the massive introduction of information technology into industry, large-scale automation of business processes, and the spread of artificial intelligence. Industry 4.0 is based on the Industrial Internet of Things (IIoT) and cyber-physical systems - intelligent autonomous systems that use computer algorithms to monitor and control physical objects such as machines, robots and vehicles. A further development of the paradigm is the involvement of the end consumer in the process of developing new products, forming requirements for them, i.e. a certain level of customization of production. Accordingly, the process of developing product requirements and the overall approach to change management is changing. The purpose of this article is to identify how the key technologies of industry 4.0 are changing the process of creation and subsequent operation of requirement engineering (RE).

Literature Review

There are nine fundamental technologies (autonomous robots, simulation/digital twins, horizontal and vertical systems integration, industrial Internet of Things, cloud computing, additive manufacturing, big data and artificial intelligence analytics, cybersecurity, augmented reality) in Industry

4.0 (Thames and Schaefer, 2016). Their unification into one coherent system will allow to develop the concept of Industry 4.0 and ensure a new level of production efficiency, uniting partners in a common value chain and implementation of innovative business models (Roblek et al., 2016).

Industry 4.0 makes processes faster, more flexible and more efficient, which ultimately increases a company's competitiveness (Mohamed, 2018). The data obtained from the IoT sensor system and other sources and the subsequent analytics of the received data are used for decision support and thus directly affect the requirements engineering process. The applied technologies make it possible to speed up prototyping, increase flexibility, and introduce equipment that will adjust its parameters (Russmann et al., 2015). In a broad sense, Industry 4.0 characterizes the current trend in the development of automation and data exchange, which includes cyber-physical systems, the Internet of Things and cloud computing. It represents a new level of organization of production and management of the value chain throughout the entire life cycle of manufactured products (Rossini et al., 2021).

The concept of Industry 4.0 affects consumer perception of innovative products, quality, variety and speed of delivery. To increase the value of the product, the Product Service-System (PSS) is being implemented, self-learning algorithms and intelligent decision support systems are used. Cybernetic systems such as Product-Service System (PSS) and Cyber-Physical Systems (CPSs) are based on the use of information and communication technologies in the implementation of business models. All this makes it possible to reduce uncertainty, increase work efficiency, and timely detect bottlenecks (Zheng et al., 2018). The result is intelligent manufacturing, allowing many new features to be added to existing products. Customers have the opportunity to order a product with their own design, change their requirements and, as a result, receive a unique and relevant product in real time (Chawla et al., 2020).

The success of Industry 4.0 depends solely on engineering that can combine existing technological and digital solutions into a single complex, into what is called “cyber-physical systems”. Industry 4.0 is a challenge primarily for companies operating in the field of industrial engineering (Sony, 2020).

The main competitive advantages of Industry 4.0 are associated with the exclusion of the human factor as the weakest link in the production process (Brozzi et al., 2020):

1. High product quality due to automation and robotization of production, the absence of rejected products, in case of unprofitability of robotic solutions in the transition period - preventive elimination of defects through the digitalization of production processes.

2. High production efficiency due to accelerated automated implementation of new technological and production solutions.

3. High planning of future workload of enterprises, cost reduction due to optimization of resource-intensive processes, planning of operating costs, use of predictive analytics.

4. The transition to horizontal integration of production processes, in which the production cycle is distributed among several companies that produce similar goods / services in the same production niche.

5. High flexibility of production processes, fast automated changeover leads to customization of the product line.

6. Full production load by minimizing equipment downtime and industrial accidents.

7. Direct interaction "product - consumer", automatic collection and machine processing of data, incl. marketing. Optimization of production both for the production of non-standard products with specified technical characteristics (personalized production), and for performing standard operations.

CPS is an infrastructural foundation that should become the basis for the implementation of the scenario for the development of future production. The main task of the development of cyber-physical systems can be called a deep interaction between the physical and digital elements of the system. Hence, the main technological areas that critically affect the formation of CPS are IoT / IIoT data exchange technologies (Kl tzer and Pflaum, 2015). Information processing is provided by a whole range of tools from analysis based on Big Data and more complex tools of predictive analytics and Data Mining, focused on logical sequences that are already inaccessible to humans, to artificial intelligence with its inherent self-learning methods (artificial neural networks, deep/shadow learning). The issue of including the listed analysis technologies in CPS is debatable, they are redundant for the implementation of a typical technical process, but, on the other hand, change management in these processes is impossible without them. The executive body in the system can be a person or a machine: a machine is a robot or machine, here the interaction is based on M2M technologies, now such tasks are effectively solved by machine learning (Mishra and Tyagi, 2022). A person in CPS is redundant, although interaction with the digital world at this level is not difficult and is built on the basis of traditional interfaces or solutions VR, AR, MR (virtual, augmented, mixed reality), nevertheless, this level is no longer included in the CPS technosphere.

From the point of view of practice, we are talking about the integration of information and operational technologies. Integration can be carried out in two directions:

1. Business applications use technological data;
2. Technological tasks are optimized taking into account business information

One of the fundamental technologies on which the concept of Industry 4.0 is based is the Internet of Things. Building an IoT system requires taking into account new specific requirements, such as scalability, interoperability and a new level of security. Security and privacy are the most important requirements, therefore, they should be taken into account at an early stage of the requirements engineering process (Gulzar and Abbas, 2019). In addition, resource control, energy awareness and efficiency, quality of service, flexibility are considered as one of the important issues in requirements engineering (Yaqoob et al., 2019). As the number of devices increases, accounting for and meeting these requirements becomes more difficult.

The process of forming requirements and managing them is one of the most important stages of preparation, on which the success of creating and completing engineering projects depends (Ilyin and Ilyashenko, 2018). How accurately the requirements are formulated, and how the requirements engineering process is organized, depends on the success of creating complex systems and products. Requirements define the goals, constraints, necessity, functions, and prerequisites for the product to be developed (Ilin et al., 2018). Requirements engineering combines requirements generation and management. The first part is the collection, extraction, fixation, transformation, specification and analysis of requirements using various approaches, methods and notations. The second part is systematization (distribution) and building links between requirements using attributes. Its purpose is tracing to control and analyze changes. The requirements management process is part of requirements engineering and is divided into several parts, including the identification, discovery, documentation, analysis, tracing, and prioritization of requirements. It also covers requirements agreement and change management with notification to relevant stakeholders, is continuous, and spans the entire development project lifecycle (De Lucia and Qusef, 2010; Kasauli et al., 2021; Shah and Patel, 2014).

Materials and Methods

The purpose of the study is to analyze existing information, generate ideas and conduct new research. The research approach is to create a theory. Data collection was carried out by collecting materials (scientific articles) on the topics of Industry 4.0, cyber-physical systems and, mainly, the Internet of things. The data found was then analyzed and selected based on its relationship to requirements engineering and relevance to the current state of development of CPS and IoT technologies.

First, the Industry 4.0 paradigm has been expressed through another CPS entity that is at its core and has some more specific attributes that can be described. The basics of CPS were learned and then further decomposed into IoT technology, which has even more specific attributes related to functional requirements. After that, the relationship between CPS, IoT and requirements engineering was analyzed, and ways to change RE within Industry 4.0 were obtained.

Results and Discussion

In order to understand the relationship between the Industry 4.0 paradigm and requirements engineering, it is necessary to understand the components of Industry 4.0.

According to Drath and Horch, "Industry 4.0" can be understood as the application of the general concept of cyber-physical systems to industrial production systems (cyber-physical production systems) (Drath and Horch, 2014). A cyber-physical system is a complex system of computational and physical elements that constantly receives data from the environment and uses them to further optimize control processes. Networks and computers monitor and control physical processes, typically with feedback loops in which physical processes affect computations and vice versa (Alguliyev et al., 2018; Lee et al., 2019). CPS provides a number of benefits to the industry. First, CPS allows to see the most important data that is generated in real time. This helps to understand critical issues and take preventive action or make some other important decision. Secondly, the level of automation of various processes is increased through the use of autonomous decision-making algorithms that can work in situations with an obvious solution.

There are the following predictions that represent the future of Industry 4.0 and drive the development of CPS:

1. The communication infrastructure in production systems will be implemented everywhere.
2. Field devices, machines, plants, factories and even individual products will be connected to the network (Internet or private network) and will be able to store knowledge about themselves outside their physical body on the network.

Based on these forecasts, the most important components of CPS and the Industry 4.0 paradigm can be identified:

1. Physical objects (instruments, machines, plants, factories, products).
2. Tools that connect physical objects to the network.
3. Network to which physical objects are connected.
4. Virtual data models of the specified physical objects.
5. Services based on available data.

According to Camarinha-Matos et al, the Internet of Things can be considered as a subset of CPS (Camarinha-Matos et al., 2013). The IoT can be represented through the first three components of the CPS highlighted above. IoT has more specific attributes than CPS, which helps to understand its impact on requirements engineering (Camarinha-Matos and Katkoori, 2021). Thus, we will focus more on IoT in terms of results as shown in the figure below.

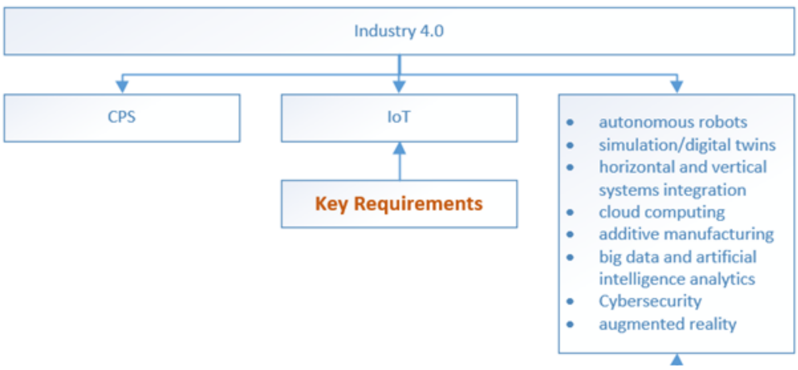

Fig. 1. The place of key product requirements in the Industry 4.0 paradigm

The idea of the Internet of Things is to connect not only people and computers, but also everyday objects to the Internet. This can be achieved by equipping things with computing and communication capabilities, thus fully matching the physical world with the digital one (Yaqoob et al., 2019). IoT components include sensors, controllers, actuators that help generate data from a physical object, process and transmit it, and perform appropriate actions. All these things and the network that provides communication between them form the IoT architecture. Each IoT application has its own optimal architecture, but there are some basic requirements that apply to almost any project. These requirements differ from those considered in pure software development projects due to some new components - smart things (Kim et al., 2016). Thus, IoT is associated with such functional requirements as scalability, flexibility, interoperability, diverse support for quality of service and, most importantly, security (Hazra et al., 2021).

The requirements of scalability, interoperability and security in the IoT concept can be considered as the main ones that can change the RE process.

The term "scalable" means managing the connectivity of a large number of network devices. The requirement for scalability is important because an IoT application involves the installation of many smart things: sensors, controllers, actuators. These devices must be synchronized and connected to each other and/or to the server/cloud. The number of devices dependent on each other and using the same network can be huge, which can lead to performance degradation.

Interoperability ensures compatibility between different devices and networks. In the IoT paradigm, enabling communication between devices from different vendors is a key requirement (Aftab et al., 2020; Kim et al., 2016). Nowadays, there are many vendors who produce and sell all kinds of smart things with different price, quality and features. Therefore, it is likely that businesses may use devices from different manufacturers (Ilin et al., 2019). This can lead to a serious issue where devices do not sync and communicate properly. Another problem that can lead to failure in the exchange of data between smart things is related to the network and, in particular, to the adaptation of network protocols that allow communication between devices (D. Borremans et al., 2018). Presetting the compatibility requirements with all the necessary details helps to avoid this problem.

Security is an important requirement in the IoT environment. Data generated by smart things can get to attackers and be used to harm a company using IoT. This situation can easily outweigh the benefits of the technology and force a company to stop using it. This is why the IoT architecture must be secure enough to prevent devices from being activated by unauthorized means. In addition, security mechanisms should be lightweight, since the resources of most devices are limited (Ilin et al., 2017).

As mentioned above, these requirements can be classified as functional. Based on this fact, it is possible to conclude that the main requirements document that is changed by the IoT application is the Software Requirements Specification (SRS). The SRS differs from other documents in that it contains a very specific description of the requirements rather than a general idea of the system. In SRS, business analysts describe in detail the solution being created, including functional and non-functional requirements. Thus, when creating an IoT solution, the focus in SRS should be on scalability, interoperability, and security.

It has been found that the SRS document changes to meet the requirements of the IoT, but this change is not the only one that affects the RE. To be able to create SRS documents, business analysts need to understand in detail all aspects related to the most important requirements. Therefore, they require new knowledge and skills related to scalability, interoperability, security. To solve the problem of scalability, business analysts must gain knowledge in the field of systems analysis. Systems analysis can be viewed as a problem-solving technique that breaks down a system into its component parts in order to study how well these component parts work and interact to achieve their goal (Fayoumi and Williams, 2021; Tilley, 2019). Knowledge in this area is necessary when considering a complex system with a large number of different components in detail. Business analysts also need to be familiar with system architecture. The architecture of systems is closely related to all stated requirements. It allows to connect many smart things and make them work together, helps to integrate devices from different manufacturers into one network, and makes it possible to protect data from unauthorized access.

The system architecture helps to establish relationships between all the components so that it becomes clear to all stakeholders how all the components of the system will function together. The problem of interoperability is mainly related to the integration of various devices into a single system. Another area requiring the attention of business analysts is cybersecurity. Knowledge in this area helps to specify the requirements so that the end system can be classified as secure enough to process and store data from IoT sensors.

There are challenges that arise when developing requirements for IoT solutions.

For a system with a huge number of components that can be randomly integrated into different systems at different times, the complexity of defining requirements, in particular security and privacy requirements, is a significant problem.

The main barriers to defining and analyzing IoT privacy and security are:

1. The complexity of determining the composition of the information that needs to be protected, determining to whom to provide / restrict access and the moment of information protection.

2. The difficulty of accurately determining the mutual influence of Internet of Things technologies and determining what new risks and problems this mutual influence can lead to (Sutcliffe and Sawyer, 2013).

3. The changing nature of the environment plays an important role in dealing with IoT privacy and security vulnerabilities.

This study focuses mainly on IoT technology, since it is one of the key parts of Industry 4.0 and has the most specific attributes that change the development of requirements. Further research related to this topic is possible, with a focus on other key Industry 4.0 technologies such as the digital twin, decision-making algorithms, and machine learning.

At the moment, there is a lack of a sufficient amount of archival material on the topic related to the impact of these technologies on the requirements of the engineering field. It is also promising to discuss how CPS affects the collection and analysis of non-functional requirements. There are many points of view on how Industry 4.0, CPS and IoT relate to each other. This issue is also of interest for further research.

Conclusions

The future of manufacturing is moving towards Industry 4.0. This paradigm is closely related to IoT technology. The use of IoT is associated with the increasing importance of functional requirements such as scalability, interoperability and security. This requires several changes in how requirements are developed. The major changes affect the documentation of the Software Requirements Specification and the skills that business analysts need to have in order to understand the identified requirements in detail and, as a result, give a consistent and complete description of the system being developed.

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INTEGRATED BUSINESS PLANNING CLOUD SYSTEM IN THE MEDICAL ORGANIZATION

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Abstract. Every medical entity is complex and consists of many divisions which should be properly connected through information systems. One of the main fields for constantly improving in the healthcare institution is supply chain and inventory management. The aim of this research is an analysis of the medical organization's main features and considering the Integrated Business Planning (IBP) concept as an efficient planning tool for the healthcare institution's supply chain. An enterprise architecture approach and the case study are defined as the main research methods. The medical institution's key stakeholders and information systems, inventory management's features, definitions of the IBP concept and main stages of implementing SAP IBP cloud system in the multifunctional medical center are considered in the research. SAP IBP cloud system is a real-time planning solution which will allow the medical institutions to optimize inventory management and supply chain. A comparative analysis of ERP and IBP systems, the case studies regarding implementing IBP system in the healthcare sector are the keyways for further research in this field.

Keywords: the healthcare sector, the medical institution, enterprise resource planning, inventory management, integrated business planning, SAP Integrated Business Planning cloud system

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КОМПЛЕКСНАЯ ОБЛАЧНАЯ СИСТЕМА БИЗНЕС-ПЛАНИРОВАНИЯ В МЕДИЦИНСКОЙ ОРГАНИЗАЦИИ

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Аннотация. Любая медицинская организация сложна и состоит из множества подразделений, которые должны быть надлежащим образом связаны между собой информационными системами. Одним из основных направлений постоянного совершенствования в медицинском учреждении является управление цепочками поставок и запасами. Целью данного исследования является анализ основных особенностей медицинской организации и рассмотрение концепции интегрированного бизнес-планирования (ИБП) как эффективного инструмента планирования цепочки поставок медицинского учреждения. В качестве основных методов исследования определены подход к архитектуре предприятия и тематическое исследование. В исследовании рассмотрены ключевые заинтересованные стороны и информационные системы медицинского учреждения, особенности управления запасами, определения концепции ИБП и основные этапы внедрения облачной системы SAP ИБП в многофункциональном медицинском центре. Облачная система SAP IBP — это решение для планирования в режиме реального времени, которое позволит медицинским учреждениям оптимизировать управление запасами и цепочкой поставок. Сравнительный анализ систем ERP и IBP, тематические исследования по внедрению системы IBP в сфере здравоохранения являются ключевыми направлениями дальнейших исследований в этой области.

Ключевые слова: сектор здравоохранения, медицинское учреждение, планирование ресурсов предприятия, управление запасами, интегрированное бизнес-планирование, облачная система SAP Integrated Business Planning

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Introduction

The key purpose of the healthcare sector is continuous maintenance of health through the prevention, diagnosis and treatment of diseases, physical and mental disabilities in human beings (Arora and Gigras, 2018). Healthcare institutions are complex, multi-functional, information intensive organizations that require sophisticated integrated clinical and business management information systems. This integration was hardly achieved by the information systems used by hospitals throughout the 1980s and in most of the 1990s. However, the emergence of the enterprise resource planning (ERP) software radically transformed the computing platform of most organizations, including hospitals (Stefanou and Revanoglou, 2006).

Although integration success in ERP implementations is questionable, ERP systems functionality and integration greatly improved over the last decade by incorporating specific industry solutions. For example, the Hospital Industry Solution developed by SAP (IS-H), designed to integrate the clinical, financial, and administrative functions, provided an incentive for hospitals worldwide to implement SAP's R/3 ERP software (Stefanou and Revanoglou, 2006).

Nowadays digitalization of the healthcare sector is continued worldwide. This process was even more accelerated by COVID-19 pandemic. According to the CB Insights, in 2020 investments in digital medicine was 45 % higher compared to the previous 2019 year. The number of investments in the healthtech industry in the world was equal to $26,5 billion (Moro Visconti and Morea, 2020).

The article focuses on the role of the Integrated Business Planning in healthcare (ant its automation) as an approach for effective planning and management of the healthcare organization resources.

Literature Review

Complexity of the healthcare institution in terms of information objects and interacting different divisions are illustrated by (Domain reference model for hospitals version 2, 2012). This domain reference model for hospitals was developed and presented in 2012 by Netherlands Association of Hospitals and National IT Institute for Healthcare in the Netherlands for supporting the organization of information technology in Dutch hospitals.

Advantages of implementing ERP system in a healthcare organization in terms of operations (ERP enables to reduce costs and cycle time), finance (it can help to identify solutions to cut costs, improve managerial reports, reduce risks and anticipate results), IT infrastructure (build business flexibility for current and future changes in the organization, IT costs reduction and increased IT infrastructure capability), central database (every business unit will have access to the information readily available when needed) and its disadvantages (ERP systems may have too many features and modules that users need to consider; expensive implementation and maintenance; dependence on the ERP vendor; organizations using ERP systems risk breaks in their services when their ERP systems break down, thereby causing interruptions in various services) were summarized by (Mucheleka and Halonen, 2015).

A case study about integrated Computerized Order Entry (COE) system implemented in Papageorgiou Regional General Hospital in Greece utilizing SAP R/3 software was described and evaluated by (Stefanou and Revanoglou, 2006). It was the first ever implementation of ERP software in a hospital in Greece which resulted in a number of considerable benefits: improvements in information quality, data integrity and procedures, visibility and timeliness of information, increasing quality of communication between nurses and the storage locations' personnel, common data definitions and procedures among departments, automated generation of the list of requirements resulting from clinic orders, decreasing transaction costs and complete and accurate billing procedures. As for difficulties, according to the authors, the two main sources of difficulty in implementing the process were the following: first, the existence of small warehouses of medical materials in some departments, which operated in addition to the main warehouse of the hospital. Secondly, the existence of different units of measurements of drug doses among ERP system's stakeholders (e.g. pharmacy and clinics). Although it is not very difficult to handle technically both issues, which had been implemented rather easily after all, the mere mention of them implies that some technical issues during requirements analysis may have been overlooked (Stefanou and Revanoglou, 2006).

In (Igor V. Ilin et al., 2020) a reference model of service-oriented IT architecture of a healthcare organization was given. According to (Igor V. Ilin et al., 2020), IT support of a medical organization includes following basic components of applications and their services: electronic medical record (including dental medical card); the system of providing outpatient care; the system of providing inpatient care; clinical monitoring system; anesthetic monitoring system; the accounting system; personnel management system; POS-system pharmacy; Laboratory Medical Information Systems. The leading concepts of the modern healthcare system such as value medicine, personalized medicine, the concept of Health 4.0 were also explained by the authors.

A detailed analysis of IT and technological architecture of a healthcare organization based on the TOGAF architecture description standard was given by (I. V. Ilin et al., 2020). The presented reference model consists of the next main classes of systems for the medical institution: ERP, MIS, BI. The model also indicates the software of medical equipment and the equipment itself, including personal wearable devices. All these systems supported by technological elements and information exchange is established between them (I. V. Ilin et al., 2020).

As for research articles about supply chain and inventory management in the medical institution, supply chain in healthcare can be defined as the sequence of physical and technical resources required in order to deliver a good service to patients with complete satisfaction in a cost-optimized manner. Based on their functions, stakeholders in the healthcare supply chain can be divided into four groups: manufacturers, purchasers, distributors, and providers (Arora and Gigras, 2018). Different aspects of hospital as medical strategies and service excellence, patient reception & admission, diagnosis and patient treatment, medical record maintenance, patient discharge and rehabilitation services are considered for need of supply chain management by the authors. Hospital management had been categorized in following categories as check-in patients details (vital patient information), inventory control, billing and collection department, medical records, information system (staff, patient), patient information safety. Key objectives and functions of pharmacy supply chain, blood bank supply chain and patient safety supply chain were also characterized by (Arora and Gigras, 2018).

In (Leaven et al., 2017) the authors discussed inventory management applications for healthcare supply chain under seven specific themes: 1) recent trends, issues, and solutions to inventory management from a logistics perspective; 2) pharmaceutical supply chain inventory management; 3) perishable inventory management in the healthcare sector; 4) influence of conflicting goals among stakeholders on managerial decision making; 5) new trends in the health care supply chain (VMI - Vendor Managed Inventory, RFID - Radio Frequency Identification technologies, the centralization of Hospital Inventory); 6) outsourcing, which is another cost savings tool used in the health care supply chain; 7) inventory rotation systems, which utilize the perishable medical supplies before they pass their expiration date to reduce the amount of waste incurred in healthcare facilities (Leaven et al., 2017).

As for future research in this field, the following themes were defined by the authors: the effect of demand uncertainties on workloads; outsourcing vs. in-house distribution network; trade-off between the predetermined service level throughout the entire system as well as the predetermined service level at the department level; the trade-offs between the desired target inventory levels for warehouses based on incremental echelon cost and the desired target inventory levels which are based only on installation cost (Leaven et al., 2017).

Overall, IBP concept and implementing IBP systems in the medical institution are new topics in research. Basic ideas of IBP concept were considered, for instance, in the following research works: in (Luoma, 2021) the author studied how the implementation of the concept affects inventory management related processes in the case company that operates in telecommunication and security industry, a detailed description of SAP IBP cloud system was given by (Kepczynski et al., 2018a).

The aim of this research is an analysis of the medical organization's features and considering the Integrated Business Planning (IBP) concept as an efficient planning tool for the healthcare institution's supply chain. In order to achieve this goal, the following tasks were defined: determination of the research main materials and methods; an analysis of the medical institution's key stakeholders and information systems; specification of inventory management's features in the healthcare sector; definition of the IBP concept and main stages of implementing SAP IBP cloud system in the multifunctional medical center; formulation of the further research directions in this field.

Materials and Methods

The methodological basis of the research is an enterprise architecture approach which can be defined as an overarching plan describing organizations from the integrated business and IT viewpoints. Enterprise architecture takes a holistic perspective and shows the relationship between business goals, strategies and processes, and IT capabilities, systems, and technologies (Kotusev, 2017). Nowadays there are several basic standards and methods for building enterprise architecture, but only one of them contains an architectural design method that answers the question of "how?". That standard is TOGAF, The Open Group Architecture Framework, developed by The Open Group consortium. At the core of TOGAF is the Architectural Development Method (ADM), which describes a step-by-step cyclical approach to developing an overall enterprise architecture (I. V. Ilin et al., 2020).

The second main approach which was applied in order to achieve the research's results is the case study of the multifunctional medical center. Implementing SAP IBP cloud system in the healthcare organization was illustrated based on AS IS model of this medical institution.

Results and Discussion

1. The medical institution: key stakeholders and complexity, inventory management's features and Integrated Business Planning (IBP) implementation

1.1. The medical institution's key stakeholders and complexity

Any medical organization, as was considered in the introduction part, is a complex, multi-functional and information intensive institution, which consists of different stakeholders (Table 1).

Table 1. Key stakeholders (in alphabetical order) and their main concerns (Tummers et al., 2021)

	Role	Concerns
1	Administrative staff	Wants easy data entering and retrieval
2	Automated data source	A protocol to safely upload data from heart rate monitor, wearable technology, medical robots, etc.
3	Care professional	Wants system to be easy to use such that information can be quickly entered, retrieved, and shared
4	Government	Wants the system to comply with all their regulatory standards
5	Healthcare manager	Needs system to provide overviews and reports
6	HIS (healthcare information system) developer	Develops system in time within the planned budget
7	Insurance company	Wants compatibility with their system for reimbursement
8	Laboratory	Wants compatibility with their measurement devices
9	Other HIS	Needs to be able to communicate with HIS and exchange data
10	Patient and/or representative	Wants data to be stored safe and secure. Wants care professionals to have the right information at the right time. Wants reimbursement of care
11	Pharmacist	Needs medication management to be an integral part of the system
12	Plug-in developer	Wants easy to use platform for plug-in development
13	Research institute	Needs system to provide structured data such that it can be used for research
14	Secretary	Needs system for making appointments and administrative tasks
15	HIS administrator	Wants system that is easy to maintain and adequately documented

A list of key stakeholders can vary considering type and specialization of the medical organization. One of the main purposes of HIS (healthcare information system) or MIS (medical information system) is providing continuous interaction between stakeholders.

Complexity of the healthcare institute in terms of information objects and interacting different divisions is illustrated by (Domain reference model for hospitals version 2, 2012) on the Figure 1. This domain reference model for hospitals was developed and presented in 2012 by Netherlands Association of Hospitals and National IT Institute for Healthcare in the Netherlands for supporting the organization of information technology in Dutch hospitals.

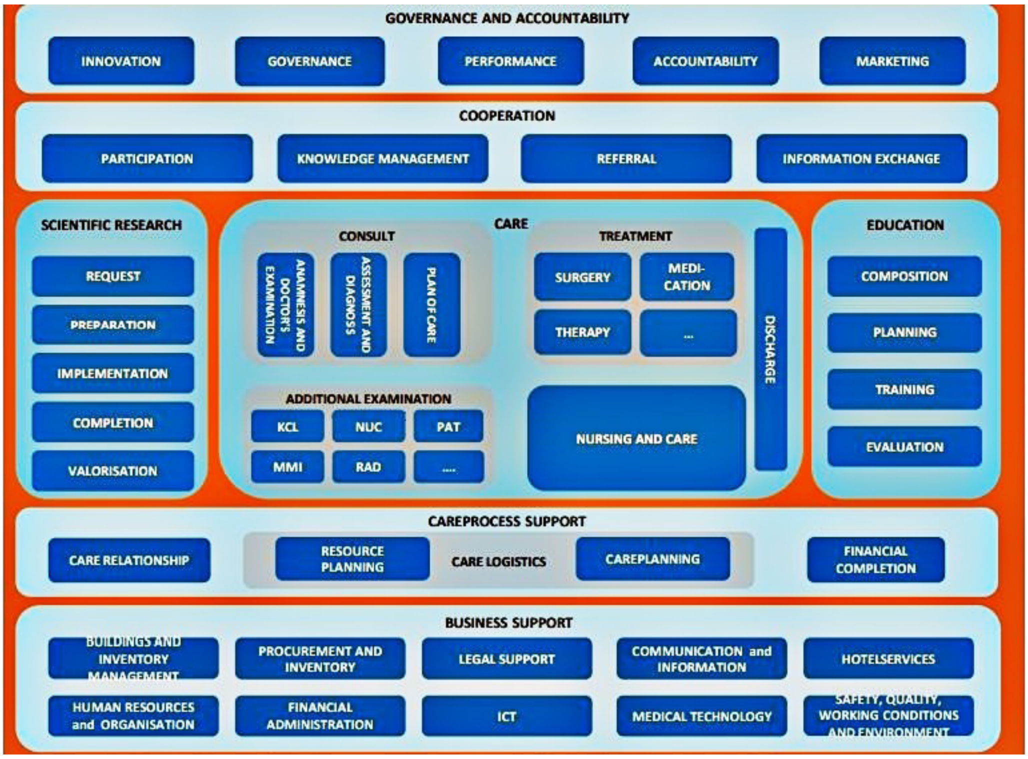

Fig. 1. Domain reference model for hospitals (Domain reference model for hospitals version 2, 2012)

Looking into details, the given domain reference model consists of governance and accountability domain, which includes the domains of governance, performance, accountability, marketing, and innovation. It includes not only the strategic governance and accountability from senior management, but also the governance and accountability at the tactical and operational levels. Cooperation contains the domains of participation, referral, knowledge management and information exchange. A core domain part of the model is care, which consists of key processes in hospitals: medical consultations, additional examination, treatment, nursing, and care. These processes should be supported by care relationship, resource planning, care logistics, care planning and financial completion. Scientific research and staff education are also an important part of any healthcare institute, which should be supported by legal support human resources and organization, financial administration, procurement, and inventory and etc. (Domain reference model for hospitals version 2, 2012).

1.2. Inventory management for the medical institution's supply chain

One of the crucial domains in any medical institute is inventory management which is responsible for coordinating the purchase and maintenance of instruments, keeping track of the expiry period and reorder status, finding economical suppliers (Mucheleka and Halonen, 2015; Stefanou and Revanoglou, 2006). The inventory management is an important function of the supply chain system in a hospital since it can affect its current activity (Nabais, 2010).

The satisfaction of the clinical needs of a hospital requires the existence of stocked drugs and other materials. Inpatients have a need for medication; doctors use gloves, masks, and tools whenever surgery is carried out; likewise, hospitals also provide specific medicines for external patients, such as those used to treat diseases like AIDS and cancer, which are not supplied in retail pharmacies. These are just a few examples of the hundreds of activities performed in a hospital (Maestre et al., 2018). To a certain extent, some of these activities are foreseeable. For example, many surgeries are programmed weeks in advance. Others, however, are as unpredictable as accidents and heart attacks. Given the critical nature of the activities performed in a hospital, a certain number of stocked drugs and materials is necessary to avoid shortages that may have fatal consequences. Hence, inventory management is one of the most important activities carried out in the pharmacy department of a hospital. However, due to the high prices of some of these medicines, whose cost can scale up to hundreds or thousands of euros per unit, this activity also has a substantial impact on the hospital's budget: approximately one-third of the hospital's expenses in goods and services are originated at the pharmacy department (Maestre et al., 2018).

The organizations need to keep stocks in the warehouse due to several reasons, being the most known the quick demand satisfaction, to avoid stock outs, to minimize the forecast demand fluctuations, or get quantity discounts. In the case of hospitals, many materials are essential to keep the health quality or even the life of patients. On the other hand, the over stock affects the competitive power of organizations, through the impact on product costs. Thus, an efficient inventory management can balance several costs in association to it (Nabais, 2010). Besides, hospitals should take in consideration the wide range of different products, being the clinical consumption materials of high financial importance. Hospitals maintain stocks of an uncountable number of products with a lot of references and suppliers for the same product. This is sometimes comprehensible, as hospitals cannot dispense of having materials to ensure the patient' lives. But this need to be reviewed, otherwise it does not allow reaching scale economies or better negotiations with suppliers. In addition, the clinical consumption materials are very heterogeneous, in volume, value, and number of suppliers; hence a specific inventory management for each group of items is necessary (Nabais, 2010).

A supply chain in healthcare can be defined as the sequence of physical and technical resources required to deliver a good service to patients with complete satisfaction in a cost-optimized manner (Arora and Gigras, 2018). Based on the function's stakeholders in the healthcare supply chain can be divided into four groups: Manufacturers, Purchasers, Distributors, and Providers (Figure 2). Logistics is involved in handling different operations: demand/supply management, Production control, Operation, Inventory management, Warehouse management, Distribution and Transportation management. Logistics is responsible for two functions, first is of Managing resources i.e., Capacity management (Wheelchair, Stretcher, Ambulance), Warehouse management (Medical Equipment, Devices, Drugs), And second is for Managing workflow i.e. Shipping, Routing (patient, wheelchair, stretcher, ambulance) (Arora and Gigras, 2018).

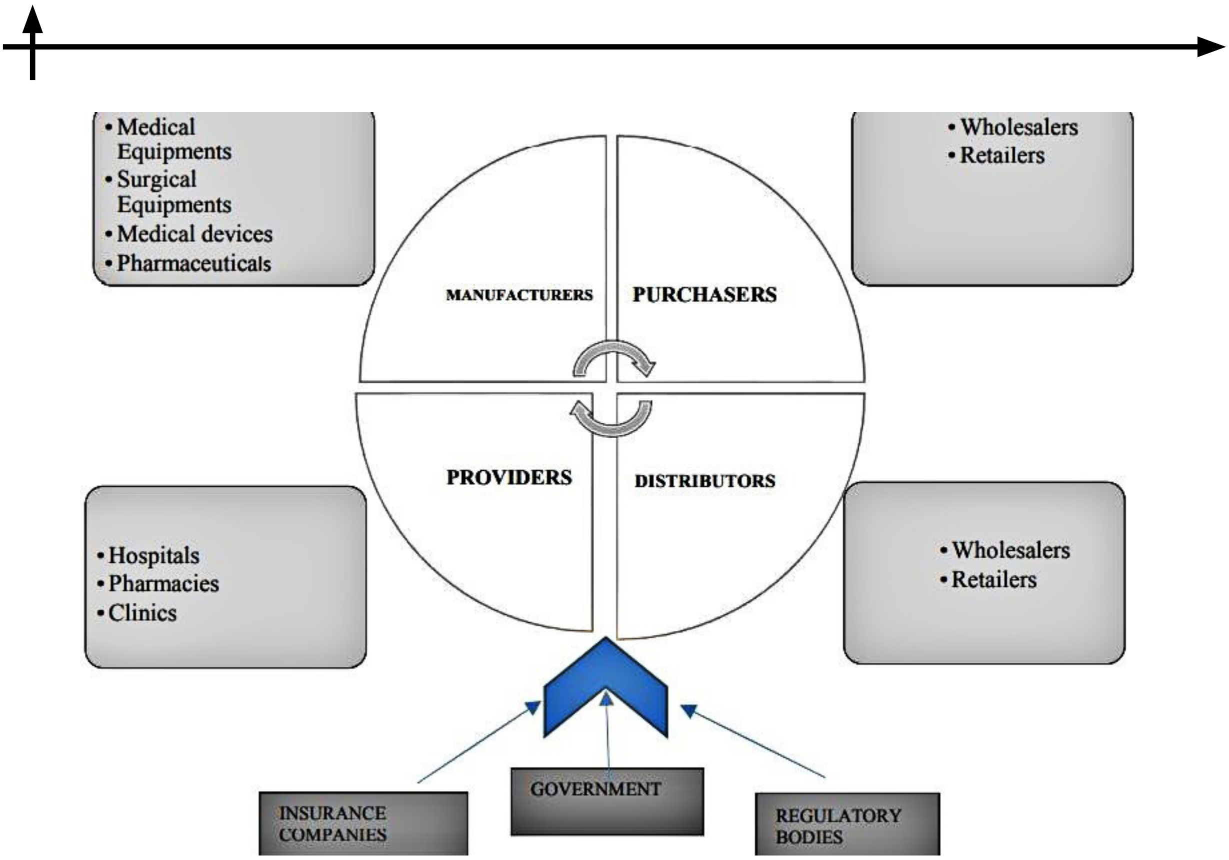

Fig. 2. Stakeholders of Healthcare system (Arora and Gigras, 2018)

1.3. Integrated Business Planning (IBP): definitions and SAP IBP applications overview

As one of the efficient tools for improving inventory management and supply chain management in the healthcare institute the Integrated Business Planning (IBP) concept can be considered. There are several definitions of IBP:

1. IBP is a management's planning tool that links a company's operations and strategy. It evolved from sales and operations planning (S&OP), which was not able to offer solutions to the multiple problems that companies are facing because of the lack of integration and structured cooperation between different business functions. The IBP process is led by senior management and gives them guidelines to execute a business strategy and make decisions proactively based on reliable supply and demand figures. It provides executives and management the ability to integrate business planning and forecasting. These will result in improved coordination in creating plans that are consistent with the corporate strategy. Managers can use IBP to leverage the company's information assets and use it evaluate activities based on the actual economic impact of each consideration. IBP covers the whole organization – not just one business function – in an integrated fashion and is more than anything about planning (Luoma, 2021).

2. IBP is a business management process which aims to connect strategic, tactical, and operational planning on local (market, sites), regional (incl. production sites), and global level, to assess risk and opportunities, to verify assumptions and to generate with cross-functional collaboration a feasible integrated business plan in volume and value (Kepczynski et al., 2018a).

The second definition was given in (Kepczynski et al., 2018a) by SAP employees in the context of description of implementing SAP IBP system which is a real-time supply chain planning solution purpose built to profitably meet future demand by optimizing the supply chain. Built natively on SAP HANA and deployed in cloud, SAP IBP provides the flexibility, agility, and performance to meet complex planning requirements of the next generation supply chain ("What is SAP HANA?," n.d.). SAP IBP is used by many customers in strategic, tactical, and operational planning on a unified integrated data model supporting sales and operation planning, demand planning, inventory optimization, response and supply, and control tower (Figure 3) (Kepczynski et al., 2018a).

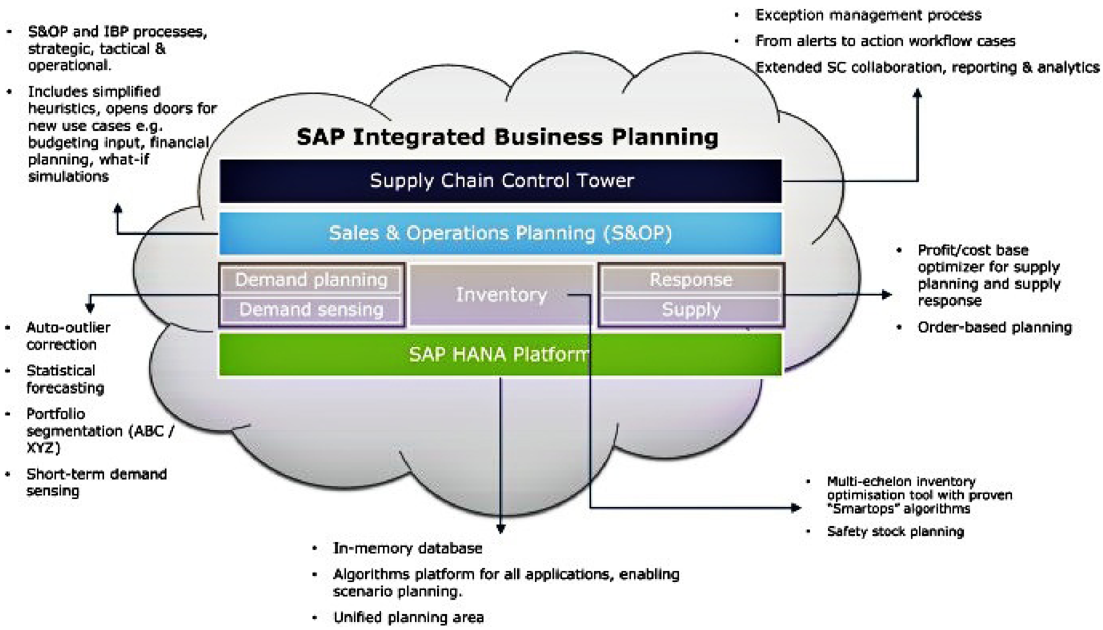

Fig. 3. SAP IBP applications overview (Kepczynski et al., 2018a)

Effectiveness of implementing SAP IBP system in the healthcare industry in Russia was proved by the company 'Nicamed' (Никамед) in 2021. This company is a representative on the market of medical orthopedic products in Russia. Implementing SAP IPB enabled the company to reduce actual stocks by 20% (by 500 million rubles on average) and improved the accuracy of planning and forecasting. They also managed to increase the SLA (service level indicator) by 1%, and the benefit from lost revenue amounted to 50 million rubles per month. SAP IBP cloud-based tools helped the company to organize the process of planning sales and purchases for 12 months, taking into account the target stock calculated by the system. A toolkit has appeared for monthly review, analysis and collegial approval of the sales and purchase plan, the ability to automatically calculate insurance and target stocks for each orthosalon. More than 60 reports have been developed for all groups and levels of planning. The sales and purchasing planning system is now linked to the company's annual budget plan (Kepczynski et al., 2018b).

2. Implementation of SAP IBP cloud system in the multifunctional medical center

2.1. IT and technological architecture of the multifunctional medical center

The IT and technological architecture of this multifunctional medical center was built on TOGAF, The Open Group Architecture Framework, developed by The Open Group consortium. At the core of TOGAF is the Architectural Development Method (ADM), which describes a step-by-step cyclical approach to developing an overall enterprise architecture (I. V. Ilin et al., 2020).

As a reference model for visualization of implementing SAP IPB cloud system the IT and technological architecture of the healthcare organization which was done by (I. V. Ilin et al., 2020) was chosen. This reference model was a little changed taking into account characteristics of the multifunctional medical center (Figure 4).

IT architecture of the considered medical center consists of the following systems:

1. ERP (enterprise resource planning);
2. MIS (medical information system);
3. Business intelligence system;
4. Medical equipment software.

Information is a crucial aspect of the healthcare sector. Year by year sharing well-prepared information and knowledge has become important in order to improve medical services and to reduce medical organization's costs. As one of the efficient tools for achieving these goals implementing ERP (enterprise resource planning) system into IT architecture of a medical organization can be considered. This application can automate activities for personnel management, relationship with patients, procurement of medical equipment and consumables, logistics, and financial activities, as well as project management (I. V. Ilin et al., 2020).

As for MIS (medical information system), it is the most important application for medical organizations nowadays. MIS is a complex software product, the purpose of which is to automate all the main processes associated with the work of medical institutions of general and narrow specialization. Automated medical information systems allow you to establish electronic document flow quickly and efficiently, flexibly arrange work with patients, keep an operational record of the work of administrative personnel, etc. (Gusev, n.d.; I. V. Ilin et al., 2020). For instance, daily work of any medical organization nowadays cannot be provided properly without a patient monitoring and controlling, clinical decision support, document automation, staff communication, interaction with insurance companies.

Electronic patient records and the ability to exchange health information electronically are also the crucial part of MIS, which allows providers better manage care for patients and provide better health care by: 1) providing accurate, up-to-date, and complete information about patients at the point of care; 2) enabling quick access to patient records for more coordinated, efficient care; 3) securely sharing electronic information with patients and other clinicians; 4) helping providers more effectively diagnose patients, reduce medical errors, and provide safer care; 5) improving patient and provider interaction and communication, as well as health care convenience; 6) enhancing privacy and security of patient data; 7) reducing costs through decreased paperwork, improved safety, reduced duplication of testing, and improved health ("What are the advantages of electronic health records? | HealthIT.gov," n.d.).

One of the key trends in the healthcare sector worldwide is telemedicine, which refers to the provision of remote clinical services, via real-time two-way communication between the patient and the healthcare provider, using electronic audio and visual means. The real role of telemedicine at present lies in the convenience it offers to patients and practitioners by obviating the necessity for a physical visit to get medical advice or treatment. It is also cost-effective in comparison to the process of waiting to see a doctor or other healthcare provider ("What is Telemedicine?," 2010).

Another vital system necessary for providing daily work of a medical organization is a Business Intelligence system (BI). It is a set of tools, applications, and techniques used to help organizations taking the right actions and decisions. The implementation of BI in health care industry has enabled data to be delivered beyond administrative offices and directly to clinical staffs who can make the most use of it. The use of BI in healthcare enables decision making process to become more effective where users can access any type of information with a fast and consistent response time. Healthcare enterprises use BI to build management dashboards that help in managing business processes and monitoring financial and clinical Key Performance Indicators (KPIs) (Khedr et al., 2017).

Medical equipment software is also an important part of MIS which aims to collect more information about each patient, and, as a result, will provide a personalized approach to each patient based on his individual characteristics (I. V. Ilin et al., 2020).

The given IT architecture should be provided by a technological layer which consists of servers and databases of considered systems.

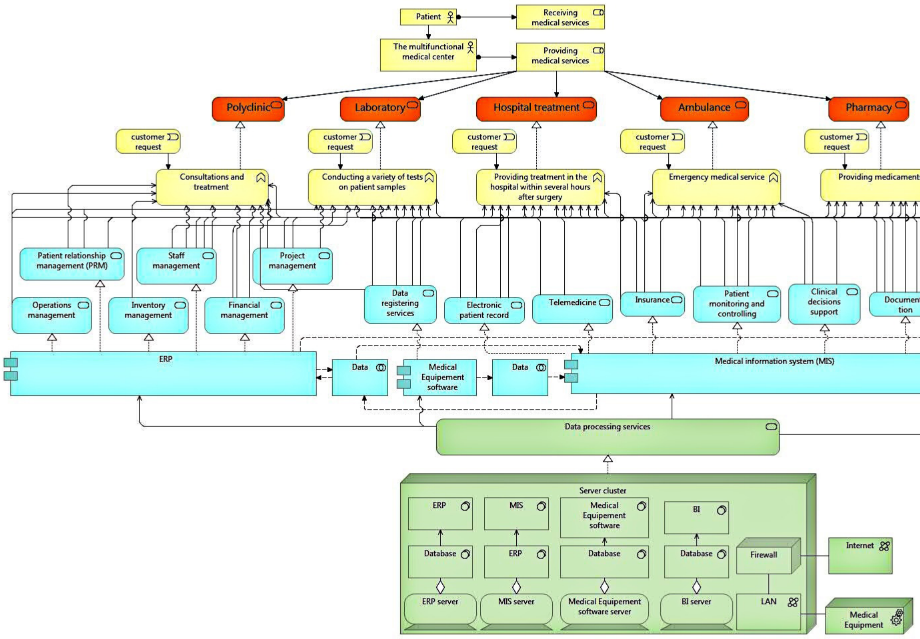

Fig. 4. AS IS model of the multifunctional medical center

2.2. Implementing SAP IBP cloud system in the multifunctional medical center

The process of implementing SAP IBP cloud system in the multifunctional medical center follows the scheme given on the figure 5 by (Kepczynski et al., 2018a). According to the authors, on the left side, there is the SAP Data Services Agent for SAP Cloud Platform Integration, which is installed behind the firewall of the customer's environment. The agent role is to provide secured connectivity and data transfer from on-premise sources (ERP, MIS, BI, medical equipment software) to the target in the cloud. The agent is able to operate without firewall exceptions, and the communication is always from the agent to the cloud which means that also when data is sent from IBP to on-premise, the agent will initiate the transfer. On the right side, there is the SAP Cloud Platform Integration for data services application, where the interfaces build and management takes place. Once the data has been extracted, transformed (if required), and mapped to the target, it gets loaded into IBP staging table. From here the IBP application starts the post processing activities to evaluate whether data is consistent or not. If yes, the data is moved to the core table and immediately available for access; if not, data is being rejected, and a rejection report can be retrieved from Data Integration Jobs app (Kepczynski et al., 2018a).

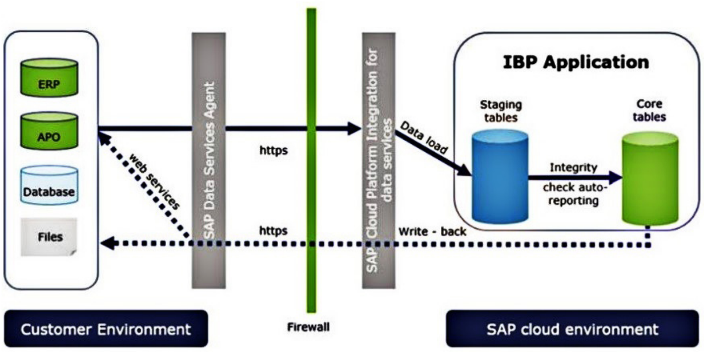

Fig. 5. Overview of integration with SAP IBP (Kepczynski et al., 2018a)

TO BE model of the multifunctional medical center with implemented SAP IBP cloud system is illustrated on the figure 6.

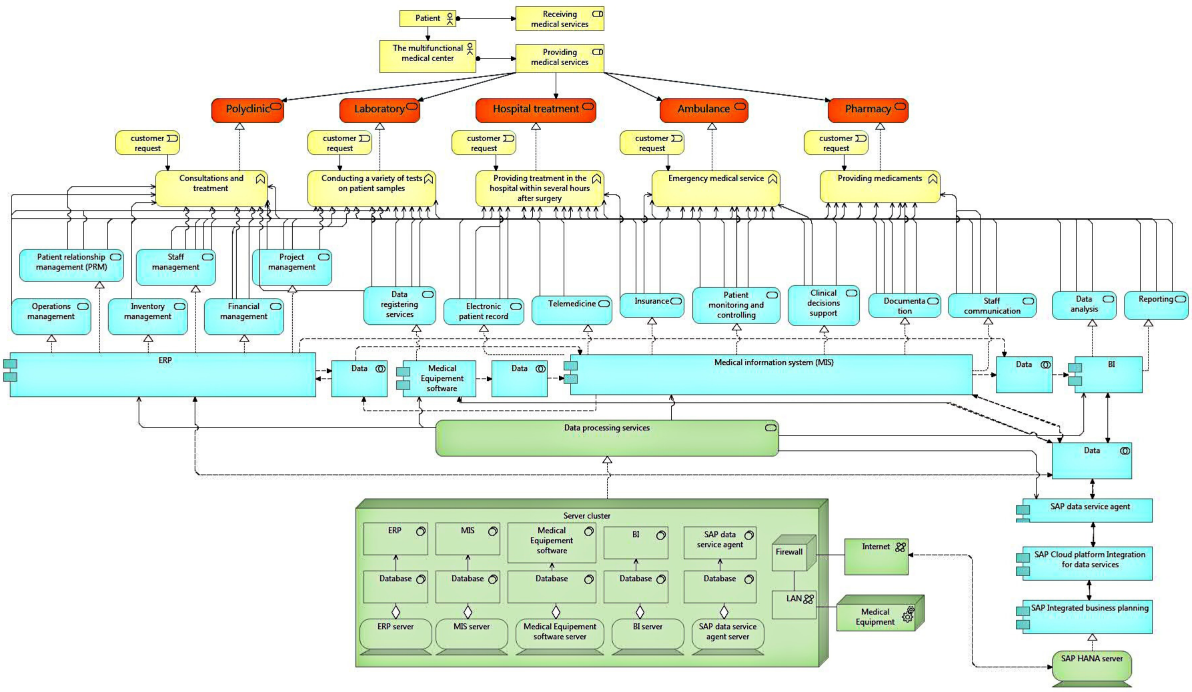

Fig. 6. TO BE model of the multifunctional medical center with implemented SAP IBP

Discussion

Implementing IBP concept in the medical institution is a new topic which requires further as theoretical, as practical research. The current studies in this field may be expanded and deepened by comparative research of IBP systems which are developed by different vendors, their advantages and disadvantages.

A detailed comparative analysis of ERP and IBP systems as the leading planning tools in modern companies can bring a positive impact on studying IBP concept. Theoretical research of the topic may be strengthened by case studies regarding implementing IBP system in the healthcare sector.

Conclusion

1. Digitalization of the healthcare sector is one of the fast-growing fields in terms of information technologies nowadays. This process was even accelerated by COVID-19 pandemic. Initially, first IT systems were implemented in the 1980s and in most of the 1990s (Stefanou and Revanoglou, 2006). Today this sector includes wide range of software: ERP, MIS, HIS, BI and other systems depending on the type and specialization of the medical institute.

2. One of the crucial domains in terms of implementing a new and efficient tool for improving the medical organization's daily work is inventory and supply chain management. In the case of hospitals, many materials are essential to keep the health quality or even the life of patients. Due to this fact, implementing IPB, for instance real-time SAP IPB cloud system, can be an efficient planning tool in the medical organization.

3. In the research paper the multifunctional medical organization's architecture was analyzed and built on TOGAF, The Open Group Architecture Framework, in terms of following key medical services for patients: polyclinic, laboratory, hospital treatment, ambulance and pharmacy. IT architecture of the considered medical center was based on the following systems: ERP (enterprise resource planning);

MIS (medical information system); Business intelligence system; Medical equipment software.

4. To successfully implement SAP IPB cloud system on the first stage it is necessary to install SAP Data Services Agent on the customer environment. The Agent is responsible for transferring data from on-premises sources (ERP, MIS, BI, medical equipment software) to the target in the cloud. On the cloud environment SAP IPB is supported by SAP HANA (High-performance Analytic Appliance) platform. It is a multi-model database that stores data in its memory instead of keeping it on a disk. This results in data processing that is magnitudes faster than that of disk-based data systems, allowing for advanced, real-time analytics (Gusev, n.d.). Due to this fact SAP IBP cloud system is a real-time planning solution which will allow the medical institutions to optimize inventory management and supply chain.

5. A comparative analysis of ERP and IBP systems, the case studies regarding implementing IBP system in the healthcare sector are defined as the keyways for further research in this field.

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THE DIGITAL ECOSYSTEM OF A HEALTHCARE ORGANISATION

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Abstract. The international experience of leading countries has proved the high efficiency of using digital platform solutions as part of developing their own ecosystems in many sectors of the economy, including the healthcare system. These solutions have significantly increased the value proposition for the state, business and society by reducing the level of transaction costs for all participants in the relationship. This paper presents a metamodel of medical ecosystem architecture that can become a basis for shaping and developing applied solutions as part of the implementation of strategies for digital transformation of the industry.

Keywords: ecosystem, digital ecosystem, digital platform, health ecosystem, digital ecosystem metamodel, digital ecosystem architectural model

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ЦИФРОВАЯ ЭКОСИСТЕМА ОРГАНИЗАЦИИ ЗДРАВООХРАНЕНИЯ

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Аннотация. Мировой опыт ведущих стран доказал высокую эффективность использования цифровых платформенных решений в рамках развития собственных экосистем во многих отраслях экономики, в том числе в системе здравоохранения. Эти решения значительно увеличили ценностное предложение для государства, бизнеса и общества за счет снижения уровня трансакционных издержек для всех участников отношений. В данной работе представлена метамодель архитектуры медицинской экосистемы, которая может стать основой для формирования и развития прикладных решений в рамках реализации стратегии цифровой трансформации отрасли.

Ключевые слова: экосистема, цифровая экосистема, цифровая платформа, экосистема здоровья, метамодель цифровой экосистемы, архитектурная модель цифровой экосистемы

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Introduction

The cross-cutting transformation of the global economy is now having a significant impact not only on individual sectors, but also on the development of entire countries, making them more competitive and attractive, both in terms of the investment climate and quality of life for millions of citizens. The scale of changes forces us to pay close attention to fundamentally new approaches to organizing and managing information structures based on innovative platform business models.

In the general paradigm of digital transformation, the key role today is played by those companies and countries that build their processes in the key of data-centric, client-oriented platform information ecosystems. Examples here are the BigTech giants represented by the FAMGA group (Facebook, Apple, Microsoft, Google, Amazon).

The leading concept under the influence of which the modern health care system is formed, including in Russia, is the value-based health care model proposed by the American economist, Harvard Business School professor Michael Porter (Porter and Guth, 2012; Porter and Teisberg, 2006).

The relevance of the topic considered in the paper is due to the requirements of modern challenges facing not only a particular medical organization, but also caused by the need to reengineer large-scale transformation processes that face the entire healthcare system of the Russian Federation today.

The article is devoted to the development of a metamodel of the medical ecosystem, as well as to the study of the possibilities of its application in the existing realities of the Russian Federation's digital economy.

The object of the study is a model of a digital medical ecosystem.

The subject of the study is the architecture of a digital medical ecosystem that can ensure the sustainable development of a medical organization in the existing conditions, contributing to building an effective system of interaction between its participants, reducing the level of transaction costs for each of them, subject to the provision of personalized, client-oriented services and services.

Materials and Methods

1 The term of medical ecosystem

The rapid development of end-to-end technologies and the process of globalization in the BANI world has become a key element in the transformation of not only market relations and business models, but also the socio-economic life of society, behavioral models have changed, new approaches to building social communities in cyberspace have been formed. Previously known types of social relations are acquiring different forms and scales, a completely new specificity in communications is emerging, decentralized network structures are being formed, and the location for communication is shifting to the digital plane (Shlyakhto et al., 2022). The place of interaction of subjects becomes extraterritorial, time boundaries are collapsing, new requirements are being formed for the participants in the interaction and the principles of managing relationships between them (Ilin et al., 2022). All this could not but affect the healthcare system, which today is one of the key elements of the sustainable development of the state, business and society.

Due to the integration of new business models of the healthcare system into a single digital circuit, which are formed taking into account platform and end-to-end technologies, it is possible to achieve important successes in the implementation of the vertically oriented concept of 4P medicine. At the same time, despite the fact that projects in the field of digital transformation of key sectors of the economy are developing at a rapid pace today, the conceptual apparatus of ecosystem solutions in this area is at the stage of its dynamic development.

The analysis of scientific sources (Dong et al., 2007a, 2007b; Dong and Hussain, 2007; Jacobides, 2019; Li et al., 2012; Saleh and Abel, 2016), which provide the authors' definitions of the digital ecosystem, showed the key regularities and common elements inherent in this type of network interaction, which can include: a digital platform, the components of which are IT infrastructure and digital services, business logic of value interaction of system elements and emerging communities.

Aggregating these components, a digital ecosystem is defined as a business model based on a data-centric digital platform that brings together a meaningful number of participants for the purpose of their effective interaction.

2 Components of the healthcare ecosystem

The digital transformation of healthcare is now a global trend, as evidenced by the following figures: according to Statista, the global digital medicine market was estimated at $106 billion in 2019 and is expected to grow to $639 billion by 2026 (Statista, 2022).

The growth dynamics of the telemedicine services market in the Russian Federation from 2017-2019 is illustrative. The volume of the telemedicine services market in Russia in 2019 was RUB 4399.10 million, an increase of 17.8% over 2018. In 2018, the market for telemedicine services was RUB 3,735 million, up 39.5% from 2017 (RUB 2,677.17 million) (GIDMARKET COMPANY, 2022). At the same time, the level of telemedicine in the Russian Federation is at its developmental stage.

The leading countries with a high level of digital maturity of healthcare systems are USA, Australia, New Zealand, Republic of Korea, Japan, England, Israel (Braithwaite et al., 2020).

At the same time, the Russian Federation, too, is paying great attention to the digital transformation of key sectors of the national economy.

It is noted that as part of the strategy for the development of digital health in the Russian Federation, it is planned to create a unified digital circuit in health care based on a unified state health information system and to develop medical platform solutions at the federal level.

The target model for the functioning of the unified digital circuit in healthcare is presented in Figure 1.

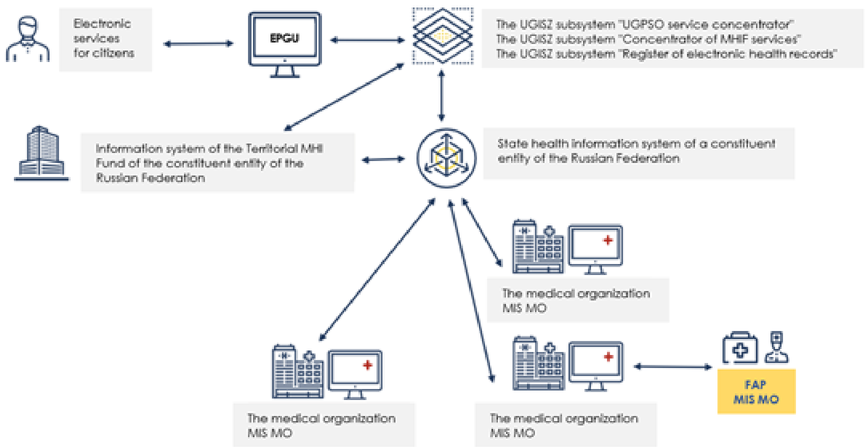

Fig. 1. Targeted model for a single digital health circuit in the Russian Federation (IMIS, 2018)

The key goals of the digital transformation of the Russian Federation's healthcare system are:

1. achieving a high degree of "digital maturity" of the system;

2. optimizing the working time of medical workers through the automation of management processes and the introduction of advanced technologies to improve the accessibility of medical care;

3. ensuring efficient and optimal patient routing;

4. inter-agency cooperation;

5. ensuring the high quality, necessary completeness and reliability of information on the patient's state of health;

6. increasing the proportion of early detection of illnesses.

Based on the objectives of the integrated implementation of the elements of the digital health system, a priority solution has been formulated to effectively manage the communications of digital communities, which promotes the creation of information platforms of various types, allowing for the unification of an unlimited number of participants, with the aim of sustainable development on their basis of medical ecosystems (Popkova et al., 2018).

It is important to note that digital communities formed based on platform solutions allow the creation of unique communication groups for sharing experiences, discussing topical issues, solving complex problems and remote consultation, without reference to the location of its participants (Portuguez Castro and Gomez Zermeno, 2020), which acts as an important element for the progressive development of the health system and each participant in its network community.

The accessibility and ease of use of platform solutions opens new possibilities for targeting the required groups of participants with the required competencies while spending minimal time resources.

The flexibility of the architecture used in the design of digital platforms allows for rapid re-engineering, scaling and repurposing, if necessary, based on the needs of the project being implemented, allowing for a flexible and timely response to the emerging challenges of modern society.

Russian provider of digital services, Rostelecom, distinguishes the following types of digital platforms (Rostelecom, 2022):

Instrumental - software or software and hardware complexes for the development of application solutions. Such platforms include: Java, Android, Bitrix and a number of others;

infrastructure - data-centric IT systems based on end-to-end technologies that allow clients to automate their activities, while reducing the level of transaction costs. Prominent representatives of such platforms are: ArcGIS, Gosuslugi, EraGlonass;

Applied digital platforms are business models that facilitate algorithmic interaction of market participants through their interaction in a single information environment, thus reducing the level of transaction costs for each party. Examples of such platforms are the following services: Yandex Taxi, Avito, AliExpress, the tolling system for heavy vehicles "Platon".

The analysis of digital systems built on the platform model suggests that the elements of digital ecosystems are a digital platform with a microservices architecture, communities formed within the business logic of network interaction and digital data generated by the ecosystem participants. Thus, the conceptual model of the digital ecosystem will be as shown in Figure 2.

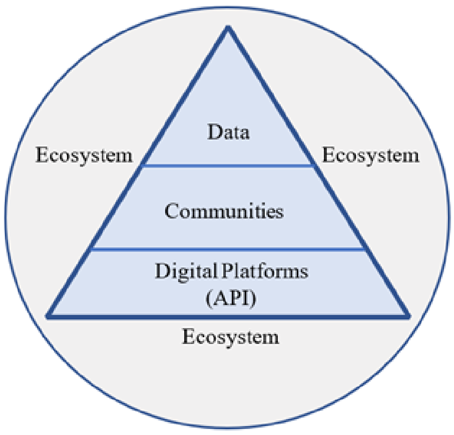

Fig. 2. Conceptual model of the digital ecosystem

Results

1 An architecture of the ecosystem basic elements

Most of the information systems currently used to automate and manage both business and government, in various sectors of the economy, have reached their peak of maturity. Successfully solving the automation tasks, they are still mostly solutions requiring, on the one hand, a considerable "intelligent" staff of IT-specialists to serve them, including the fine-tuning of "box solutions" to specific needs and requirements of the business, but on the other hand, they require continuous training of specialists who work with them every day, because their interface is quite a bulky structure that requires special knowledge and skills of the employee. If there is a need for their finalization or synchronization with third-party information systems, as well as the introduction of new computing systems or specialized application equipment in the IT loop, it may be desynchronization of business processes previously defined by the regulations of the organization, which in turn incurs significant costs for reengineering.

The relevance and timeliness of the solution considered in this paper is supported by the thesis of the President of the Russian Federation, voiced in 2017 at the St. Petersburg International Economic Forum: "The digital economy is the basis that allows the creation of qualitatively new models of business, trade, logistics, production, changes the format of education, healthcare, public administration, communications between people, and therefore sets a new paradigm of development of the state, economy and all society" (Bashkatova, 2022).

At the state level, there is a demand for a new generation of information systems that will meet the new paradigm of public administration, including in the health care system. In today's economy, digital ecosystems improve the quality of services provided and increase internal efficiency in both the public and private sectors, reducing the administrative burden on business and citizens and making interaction between actors more efficient. There are many views, both at the level of public institutions and academic schools, on what kind of architecture digital ecosystems should have.

This paper will consider one possible implementation of a digital ecosystem metamodel in health, based on which it is possible to create platform solutions for medical organizations of various forms of ownership.

By implementing a management concept based on the application of end-to-end technologies and data as an integral part of digital transformation strategies, additional economic and social benefits for society, business and government can be provided.

The unified digital platform of the Russian Federation "GosTech" deserves special attention.

The overall concept of GosTech platform development can be described as a digital ecosystem for the rapid and efficient creation of public services and information systems, which should become a key tool for the digital transformation of state organizations in the Russian Federation.

Considering the architectural approach to building digital ecosystems in terms of systems and software engineering, let us introduce the definition of the concept of architecture and its structure.

The Open Group Architecture Framework (TOGAF) methodology developed by The Open Group consortium will be used in this paper as one of the most popular and widespread high-level approaches to designing enterprise architectures based on IT solutions (The Open Group, n.d.).

The digital platform architecture modelling language in this paper will be ArchiMate.

When implementing high-load projects in the healthcare system, the architectural approach is a must, helping to achieve the targets of the organization's development strategy, a high level of cooperation and adaptability of all processes to new challenges, thereby contributing to the successful implementation of the process approach in the management of the organization.

To build a high-level architecture of a digital health platform in the ArchiMate language, we will use the conceptual model proposed by the authors Akatkin Y.M., Karpov O.E., Konyavsky V.A. and Yasinovskaya E.D. (Akatkin et al., 2017) conceptual model of digital ecosystem architecture, which can also be implemented in healthcare.

The conceptual model of the digital ecosystem architecture is presented in Figure 3.

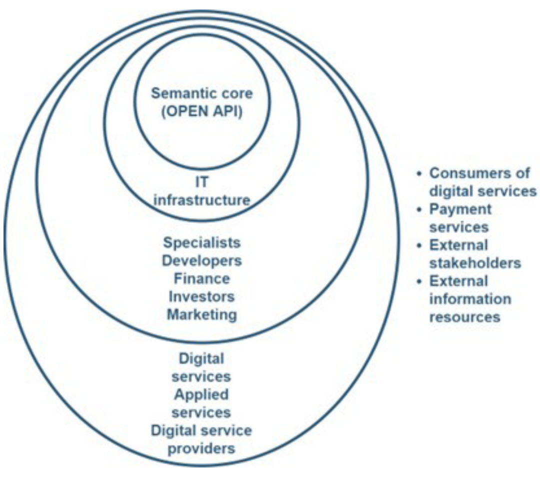

Fig. 3. Conceptual model for a digital health ecosystem architecture (Akatkin et al., 2017)

Before we proceed directly to the design of the digital health ecosystem architecture, let us turn to the key concepts of the ArchiMate.

For example, the core of the language consists of three types of elements: active and passive structure elements, as well as behavioral elements.

A key component of the descriptive part of this language is the multi-layered representation of the architecture of the object being formed, providing a natural way to describe service-oriented models.

In practice, there are three layers: the business layer, the application layer and the technology layer.

The business layer describes the essence of the organization's work and how the value proposition is formed when interacting with the customer. The key elements of this layer are products, processes, information and communication channels.

The application layer is used to describe the services that automate the organization's activities and data processing and is closely tied to the core business processes of the organization.

The technology layer describes the physical layer where application solutions are deployed, such as: computing and network infrastructure, server applications, data services, general services and information security infrastructure.

By correlating the two conceptual models of digital ecosystems discussed above, the new elements (services) that are integrated into an organization's business model not only exhibit their own individual properties and qualities, but also generate synergies with other elements, enabling the organization to exhibit its emergent properties.

Figure 4 shows a conceptual model of the architecture of a digital health ecosystem platform implemented in ArchiMate.

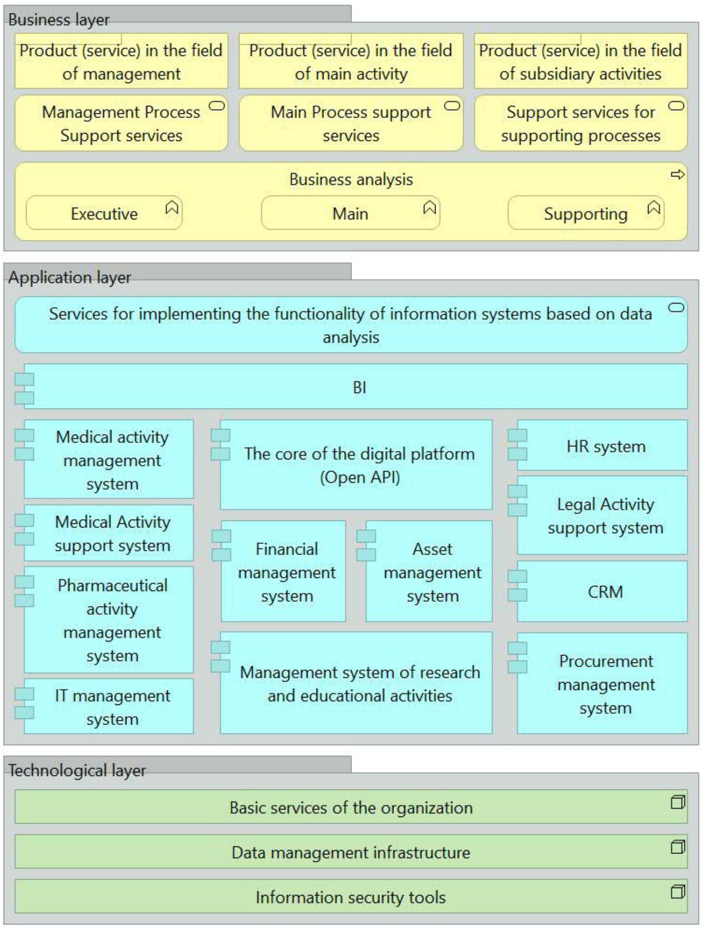

Fig. 4. Conceptual model for a digital health ecosystem platform architecture

An important element of building a successful self-developing ecosystem is designing an architecture that can accommodate the flexibility and adaptability features of modern information systems, thereby creating a client-centered approach in the value chain.

2 Requirements for elements of the healthcare ecosystem

Timely problem-solving, user-friendly interfaces, flexible control and management systems, and a unified digital environment are what advanced IT solutions can deliver today. Their use makes it possible to significantly improve such indicators as the quality of customer service and their satisfaction with the goods/services, reduce the number of hard-copy reporting documents by implementing electronic document management systems, prompt response to emergency situations and emergencies, end-to-end analytics of all business processes, reduce transaction and transactional costs, which have one of the key impacts on financial and socioeconomic indicators not only for organizations but also for the entire healthcare system.

Healthcare, as a strategically important element in the sustainable development of the modern state, has absorbed the most demanded IT solutions that help improve medical care, including ensuring high performance in increasing life expectancy.

A digital organization is nothing less than a networked business structure in which all interrelationships between relationship participants, both internal and external, are implemented in a digital environment, based on modern information and telecommunications infrastructure, enabling it to respond flexibly and quickly to changing market conditions, thereby increasing the effectiveness of the organization in the current reality.

For us, the key element of this definition, in the section under consideration, is the interaction of participants in business processes carried out exclusively using digital communication channels. Thus, we see IT infrastructure as a necessary foundation and one of the key elements in shaping the unified technological landscape of the digital health ecosystem.

Responding to the challenges of the modern world and implementing a unified system approach in shaping the digital medical ecosystem, it is important to consider and foresee the capabilities of the current and future IT landscape at the modeling stage, with the prospect of their flexible adjustment and possible operational scaling.

As stated by the authors Belyshev D.V., Guliev Y.I. and Mikheev A.E. in their paper "The Digital Ecosystem of Medical Care" (Belyshev et al., 2019), a modern digital health system should successfully address such tasks as:

1. digitization of business processes or digital transformation of a medical organization;
2. accumulating, storing and systematizing vast amounts of data of different nature;
3. ensuring the interoperability of different actors and processes;
4. ensuring financial relationships between the various participants in the processes;
5. expanding the range of services provided, not only through internal resources, but also through digital health market offers.

These tasks can be solved by creating a system with such qualities and properties as emergent, self-development, self-control, self-organization, which together can be interpreted as a digital ecosystem. One of the basic conditions for the successful functioning of a digital ecosystem is a seamless relationship between its participants, data availability and a unified digital information environment deployed on a high-performance modern IT infrastructure.

Compatibility and flexibility of software and hardware computing IT infrastructure are important elements in the development of a highly efficient medical ecosystem, allowing it to evolve and include new members, avoiding conflicts at both the service and technology layers.

We conclude by outlining the basic principles that a modern IT infrastructure for digital ecosystems must comply with:

1. modular structure of all components;
2. ease of use;
3. high speed of change, including redundancy of required capacities and services;
4. scalability;
5. high fault tolerance;
6. relevance to business needs;
7. strict compliance with regulatory requirements, industry and corporate standards; \
8. appropriateness of cost-benefit ratio.

We have thus reviewed the key requirements for elements of the medical ecosystem as part of the development of the medical ecosystem meta-model and the principles that a modern IT infrastructure for digital platforms must meet.

3 A meta-model of healthcare ecosystem architecture

Considering healthcare system and medical organizations from the perspective of digital high-loaded platform ecosystems, the core of which are IT solutions and service-oriented approaches, the issues of metamodel formation of different levels and details remain relevant and require comprehensive research.

The architectural principles on which service-oriented architecture (SOA) methodology is based include three main components: location-independent, implementation-independent and protocol-independent.

Location-independence describes an approach to obtaining a service regardless of the location of the consumer.

This approach has been successfully implemented in platform business models, where it is possible to obtain a service from any location with only two components: Internet access and a mobile device such as a smartphone or laptop.

Independence from implementation, interpreted as the absence of clear requirements for a specific platform or technical (technological) solution, thus giving the possibility to consider different scenarios for the construction of systems.

In line with this principle, the platforms known as low-code and no-code, which are actively developing today, can be considered (Woo, 2020).

This solution fundamentally transforms the software code development model, helping to address programming-related issues, and may also well act as an alternative to quickly solving business problems, such as the shortage of skilled IT professionals and their high cost in the labor market.

The notion of "protocol independence" is clearly represented by application programming interfaces - APIs, including the widespread Open API specification (OAS).

Open APIs allow internal IT systems to successfully establish communication channels with external IT solutions in the form of individual services, systems, platforms or ecosystems, thereby increasing the level of automation and efficiency in solving specific application tasks.

Given the importance of the architectural principles of the service-oriented approach, when implementing data-centric and client-centric digital platforms, including in the healthcare system, further analysis of the platform business model of the healthcare ecosystem will be carried out through the lens of the architectural metamodel.

By metamodel we will understand a model consisting of a set of objects, their properties and relations between them, to determine the possibility of designing a target model based on it.

The application of architectural metamodels helps to increase the efficiency and rationality of activities, leading to increased productivity of the entire organization. This approach helps to maximize the effectiveness of transformative interventions.

In the digital economy paradigm, architectural metamodels are a key element in achieving the goal of sustainable development of a healthcare organization.

The most common applications of architectural metamodels are:

1. building an enterprise architecture for the subsequent implementation of information systems or digital platform solutions;
2. replication of new business models;
3. analysis of re-engineering activities;
4. benchmarking.

Metamodels are one of the important basic elements in the transformational processes of an organization, and they require adaptation to the specific needs, considering the requirements and constraints of the external and internal environment (Iliashenko et al., 2019).

The development of the medical ecosystem architecture metamodel was carried out using the Archi business process modelling tool in the ArchiMate language.

Before describing the technological layer on whose infrastructure, it is planned to deploy the medical ecosystem digital platform, let us consider the architecture of information systems that can be used as part of the implementation of a medical organization's digital platform.

As described earlier, the basis for the formation of most modern digital platforms is the semantic core, through open APIs which is synchronized with application systems that are expressed by such modules as "Management Information Systems", "Core Information Systems", "Supporting Activity Information Systems" and "BI Systems". The semantic core element is implemented in the form of the "Digital Platform Core (Open API)" module.

The underlying asset of any modern information system is digital data, which is a key element in the sustainable development of platform solutions, as well as a source for making management decisions.

The diversity of data and its structure, as well as the periodicity of updates, require consideration of the process of working with it, applying in practice different approaches.

The Database module is nothing more than a set of structured data contained in an organization's information systems, with an application view. Relational databases are an example of this view.

The Data Warehouse module is designed to handle large data that is collected and aggregated from different sources, unlike the Database module, and has a different representation. At the same time, this module serves as a key element in the formation and analysis of complex queries.

As a result of evolutionary development and exponential increase in the amount of generated digital data, heterogeneous in its structure and sources, the concept of Big Data was formulated, but despite this, Big Data processing was not a challenge and methods like ETL and ELT were the key to success in this task.

A key and important element in the provision of management activities in today's realities are digital data solutions.

To implement this function, the Big Data Analysis module is provided.

The block "Services for the implementation of functional systems based on data analysis" is responsible for the functionality of the component through various application interfaces.

Thus, as part of the implementation of the medical ecosystem architecture metamodel, we considered a fragment related to information systems. The implemented model is presented in Figure 5.

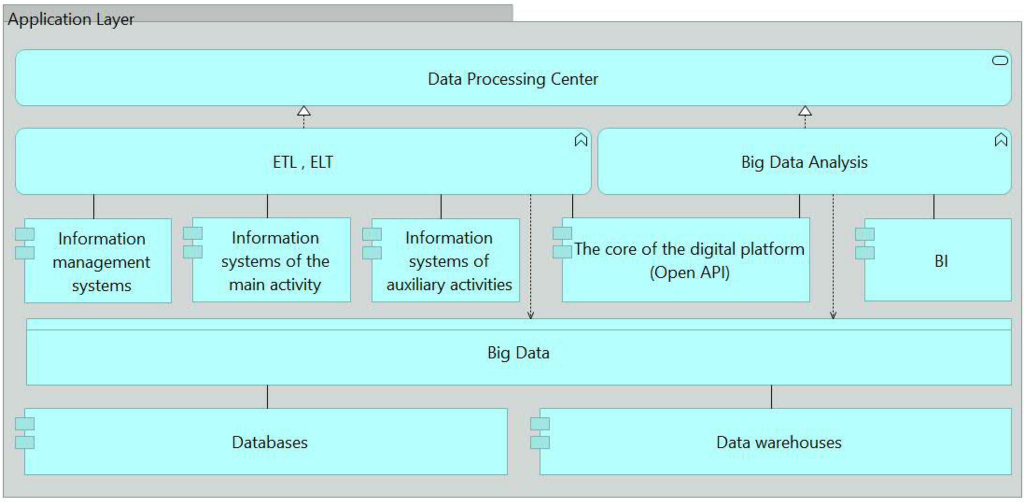

Fig. 5. Application layer architecture of the digital health ecosystem platform

Turning to the description of the basic IT landscape of a medical organization, the existence of which is conditioned by the need to deploy and implement a digital platform of the medical ecosystem, we will highlight several most strategically important elements (technologies) of its sustainable development: Internet of Things, big data, artificial intelligence, end-to-end real-time analytics.

IoT is the technology of interaction between physical objects and systems and the physical world using various communication protocols (Lepekhin et al., 2019).

When implementing platform solutions, the inclusion of physical device (object) infrastructure in the digital organization loop using IoT technology allows the creation of a control system for intelligent equipment, both medical and general purpose.

Thanks to the data collected in this way and its analysis, the entire infrastructure is managed in real time, thereby reducing the risks of biased data, wasted time, etc.

The infrastructure that powers IoT devices is the data collection gateway interfaced to the cloud-based hardware management platform, the API application software interface, the communication channels and the devices themselves.

The Information Protection System node represents hardware and software products that implement comprehensive information security functionality both internally and when interacting with external sources when data is exchanged over unprotected communication channels.

Block "External data sources" describes the structure of data centers as providers of cloud computing or representatives of cloud infrastructure under various models, including cloud.

A technology service in the form of the "Platform or Service API Integration" block represents an element of behavior that provides functionality to access third-party systems or services by interfacing with the semantic core of the digital platform.

In shaping an organization's business model based on digital data, a critical element is the data itself, and more specifically its secure use and storage. To meet the challenge of creating a secure environment, a "Data Centre" is integrated into the organization's internal IT environment as a centralized repository, including all necessary hardware and application services to ensure the successful management, storage and processing of digital data circulating in the organization's information systems, as well as data analytics applications.

The proposed solution is based on the target IT architecture model implementing the integration of BI, ERP and MIS systems presented in the monograph "Management of Medical Organization: Smart Hospital Concept" edited by RAS Academician E.V. Shlyakhto, Professor I.V. Ilyin, RAS Corresponding Member A.O. Konradi (Shlyakhto et al., 2020).

The architecture of the "Data Centre" of the digital medical ecosystem platform formed based on a medical organization is a node in the form of an "Information Systems Database Server" and a "Business Intelligence Application Server" node. Let us consider this solution in detail.

The "Information Systems Database Server" node includes such components as "Management Information Systems Cluster Server Software", "Core Information Systems Cluster Server Software", "Supporting Information Systems Cluster Server Software", and "Metadata" itself.

As presented in (Shlyakhto et al., 2020), the successful integration of an organization's information systems with Business Intelligence systems is possible with a special software solution in the form of the "Connector" capable of automating the processes of working with data to the maximum extent possible.

In addition to Connector, the Business Intelligence Application Server node is supported by the following components: "Data Management Service", "Business Intelligence Solution Processor Service" and "Data Storage Service".

A key feature of modern data centers is their ability to handle both structured data stored in databases of information systems and big data, which have an entirely different nature of origin. While dealing with relational databases is trivial, dealing with big data requires more technological tools in the form of Business Intelligence solutions.

Working with data on the technological level is realized through access, extraction and processing services when it comes to classic structured data and using big data services when we are talking about digital data, different in its architecture and sources, in the form of information systems within an organization or information systems of external organizations, data from various information resources or communication tools, equipment using the Internet of Things technology, including personal media.

The result of the study of information processes in the digital ecosystems of medical organizations and the IT infrastructure of the medical ecosystem digital platform based on such technologies as the Internet of Things, big data, artificial intelligence and end-to-end real-time analytics was a metamodel of the medical ecosystem architecture in Figure 6.

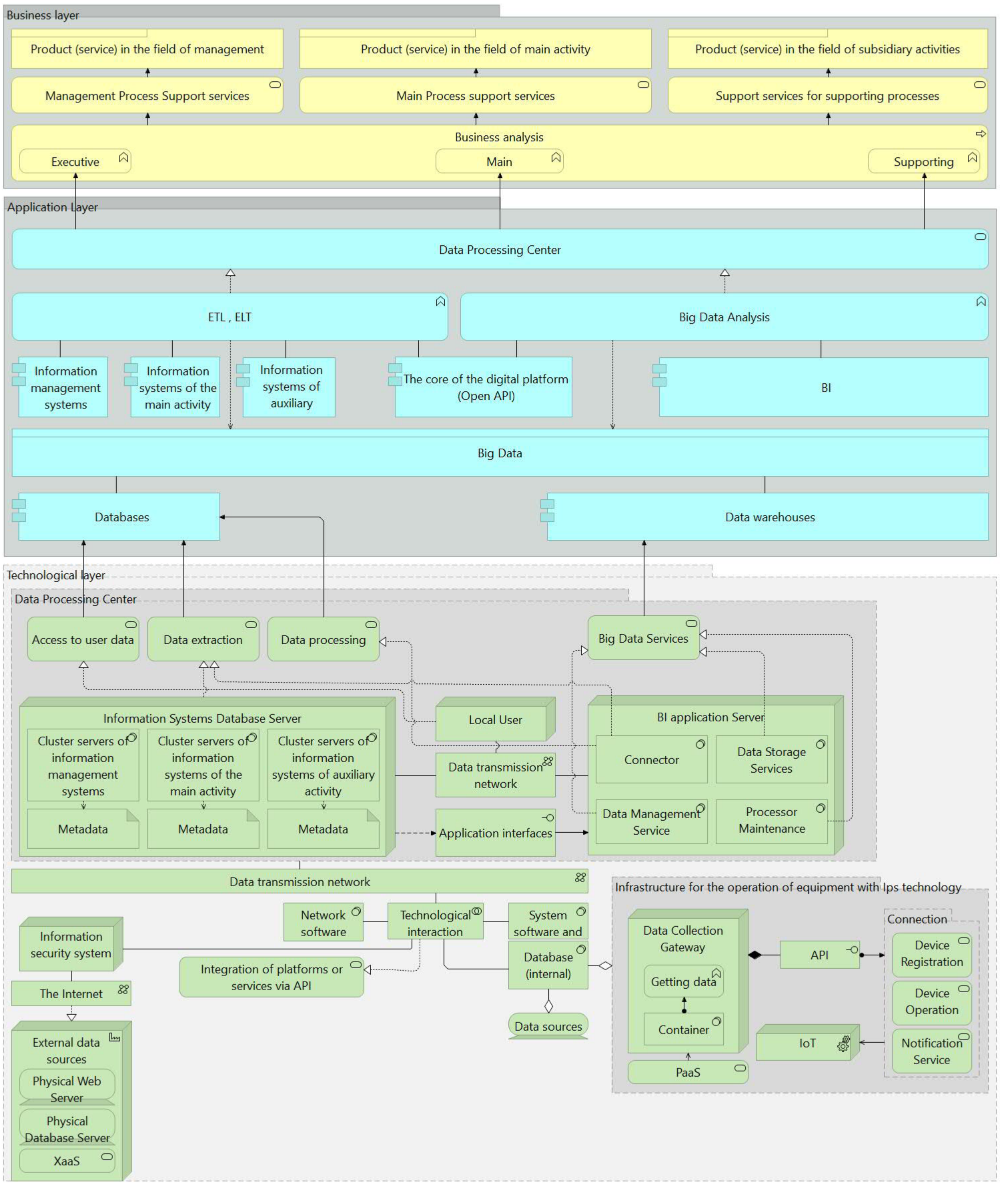

Fig. 6. Medical ecosystem architecture metamodel

The implementation of the medical ecosystem metamodel will enable a significant step in the development of new approaches and business models for medical organizations and become a base in the formation of world-class, high-tech and competitive medical centers.

Discussion

As part of the development of medical ecosystem model, analysis of existing architectural models of digital platforms was carried out, based on which a metamodel of medical ecosystem architecture was proposed.

The comparative analysis allowed to formulate the requirements to the elements of medical ecosystem, which made it possible to describe and develop a graphical representation of the architectural model of medical ecosystem in ArchiMate language.

Despite the relevance of this topic, not only within the framework of achieving the key indicators of national strategic initiatives and transition to digital platform economy in the Russian Federation, but also in the context of continuously improving business models of leading international medical centers, the degree of elaboration of issues of implementation of integrated IT solutions for medical ecosystems in our country remains at a rather low level.

From this point of view, the application of the developed medical ecosystem metamodel in the healthcare system will make it possible to take the next step in developing new approaches and forming innovative business models for medical organizations, thus contributing to the emergence of world-class medical centers in the Russian Federation.

Conclusion

The process of the emergence of the platform economy and the development of digital ecosystems in today's realities is an integral element of sustainable development of the state, business and society.

International experience of leading countries has proven its effectiveness in the use of digital ecosystems not only in business, but also in public administration, allowing for a significant increase in the value proposition for the customer and while reducing the level of transaction costs for all participants in the relationship.

This thesis is supported by the fact that many countries at the state level have approved their development strategies based precisely on platform solutions for digital ecosystems. The Russian Federation is an active participant in global transformation processes driven by trends in the development of the digital economy.

Considering the digital ecosystem of a medical organization as a key element of its sustainable development, and the IT landscape as a necessary basis for its formation, to correlate these goals and their successful achievement, it is necessary to have an architectural model of IT infrastructure that has absorbed the best practices and successful implementations of major organizations worldwide.

Despite the rapid development of digital ecosystems in various areas of activity, this area is still quite young and requires comprehensive reflection.

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HOTEL BUSINESS ENTERPRISE ARCHITECTURE: BUSINESS PROCESS MODEL

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Abstract. The article considers the methodology of developing a top-level business processes reference model for the construction of architectural solutions in hospitality industry. In this paper, the authors identify basic stages in the development of business architecture for hospitality enterprises and define the main differences between business functions and business processes. Classification of basic, managing and supporting business processes is also given. As a result of the research, the reference business processes model of top-level digitalization is developed. Development of a top-level business processes reference model allows to construct an optimal architectural solution that will create new opportunities for hospitality industry enterprises in the era of digitalization, when the increase of manageability, monitoring of performance indicators and security control will allow to move to predictive models and proactive (program-target) management of accommodation facilities.

Keywords: top-level business processes, basic business processes, supporting business processes, managing business processes, reference model, business architecture, architectural solution, business process modeling, accommodation, hospitality industry, hotel business, hotel chains

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АРХИТЕКТУРА ПРЕДПРИЯТИЯ ГОСТИНИЧНОГО БИЗНЕСА: МОДЕЛЬ БИЗНЕС-ПРОЦЕССОВ

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Аннотация. В статье рассматривается методология разработки эталонной модели бизнес-процессов верхнего уровня в предприятия гостиничного бизнеса. В работе авторы выделяют основные этапы развития бизнес-архитектуры предприятий отрасли и определяют основные отличия бизнес-функций от бизнес-процессов, дают классификацию основных, управляющих и обеспечивающих бизнес-процессов. В результате исследования предлагается эталонная модель бизнес-процессов верхнего уровня. Разработка эталонной модели позволяет построить оптимальное решение, которое создаст новые возможности для предприятий гостиничного бизнеса в эпоху цифровизации, когда повышение управляемости, контроль показателей эффективности и контроль безопасности позволят перейти к прогнозным моделям и проактивному (программно-целевому) управлению.

Ключевые слова: бизнес-процессы верхнего уровня, базовые бизнес-процессы, поддерживающие бизнес-процессы, управление бизнес-процессами, эталонная модель, бизнес-архитектура, архитектурное решение, моделирование бизнес-процессов, размещение, индустрия гостеприимства, гостиничный бизнес, гостиничные сети

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Introduction

Currently, the process of digital transformation has a significant impact on almost all sectors of the economy, but the hospitality industry in the Russian Federation has been undergoing dramatic changes since 2014. The main catalyst for the support of hotel business in Russia remains the placement of rooms in the cross-country areas. According to official data, almost 70 percent of industry is taken over by hotels in two Federal cities - Moscow and St. Petersburg (Oborin and Shostak, 2017; Voronova et al., 2019).

Enterprises of the hospitality industry in the Russian Federation continue to be in a rather difficult situation. According to official data, Russia continues to lag behind its European partners in terms of overall number of rooms per capita. However, most managers of the hospitality industry also noted the low level of customer demand. The result of low consumption is a sharp reduction in costs for hotels and, as a consequence, the deterioration of the services quality (Avilova and Lebedeva, 2017).

Competition in the hospitality market remains very high. External growth reserves are almost exhausted, special attention is paid to the optimization of companies own resources. In addition, the cost of hotel product continues to be an important factor for end users.

In these conditions, successful companies are the most effective in their business processes, in accordance with which, the main emphasis of the companies development is digitalization and even greater focus on consumers.

Materials and Methods

Effective management of business processes is impossible without the construction of process architecture, which is associated with construction of business architecture for the company as a whole (Lankhorst, 2013). The main stages of business architecture development within hospitality industry are shown in figure 1.

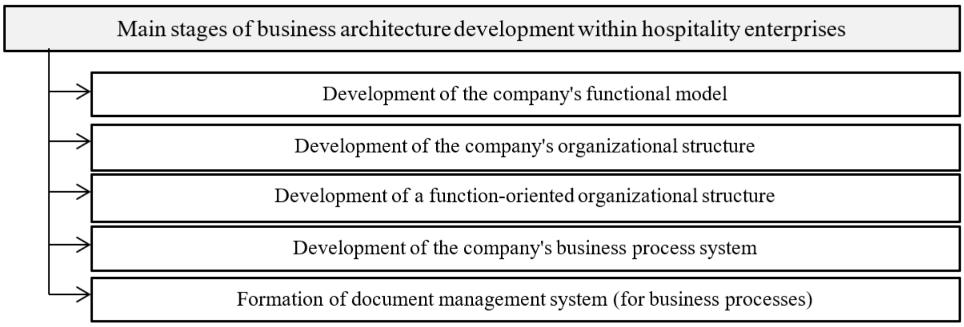

Fig. 1. Main stages of business architecture development within hospitality industry enterprises

The consumer value chain of each major hospitality company is implemented through the performance of its functions by individual structural units. Building a function-oriented model of the organizational structure is a fundamental element for designing the business architecture of the company. At the same time, according to figure 1, the next important step in the business architecture development is to build a model of business processes (Lankhorst, 2017).

At the initial stage of building a reference model, it is necessary to present the definition of business processes. Since the construction of a business process model is the stage following the development of a functional model, it is advisable to focus on identifying the differences between business functions and business processes (Dijkman et al., 2016).

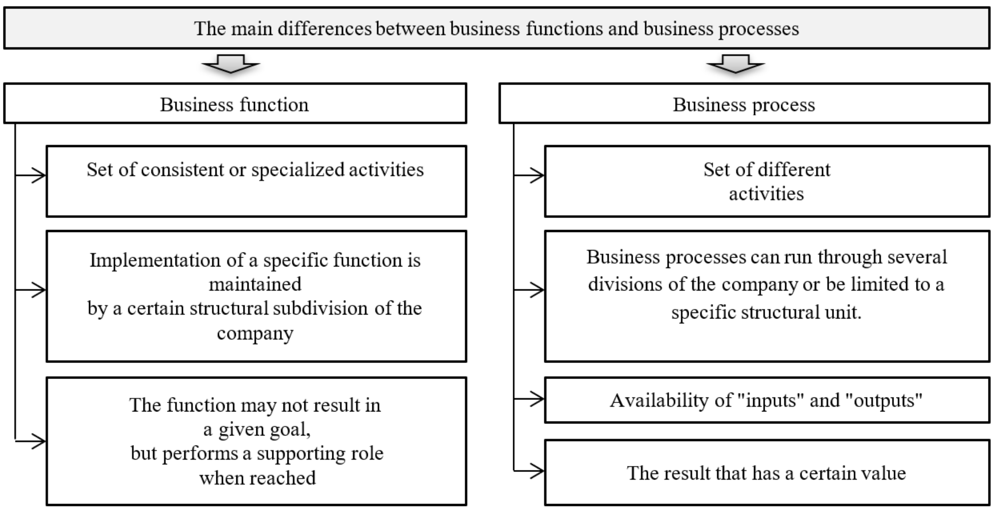

Fig. 2. Main differences between business functions and business processes

Business process is the cumulative sequence of actions to convert the resources received at the input into the final product that has value for the consumer at the output (Weske, 2007).

The consumer can be both external and internal in relation to the company. At the same time, external consumer is not part of the network company, and the internal consumer is inside the company (Tregubova and Zasenko, n.d.). In addition, it is important to know the consumer of the business process because it is he, who explicitly or implicitly sets the requirements for the process and, therefore, can have an impact even on the very existence of a particular process.

When considering business processes, it is necessary to take into account the levels of detail. Thus, at the initial construction stage it is essential to select top-level business processes.

Top-level business processes should be understood as key or most important business processes for the organization, which perform the target functions of the company and determine their structure (Ignatenko, 2018).

Building a top-level model is a tool for analyzing the company's activities used to form a system of processes. The top level business processes model is necessary, first of all, for reasonable formation of structure of process categories and groups in system of processes at the hospitality enterprises (Becker et al., 2003).

There are different classifications of business processes. Classification of business processes helps to determine how to distinguish a particular process from their total mass.

As a rule, the basic processes are based on the result that is valuable for the consumers. Supporting processes are allocated by the resource that they supply to the company, and control processes - by the object over which the control action is carried out.

While studying business processes of hospitality enterprises, the authors define a key feature that determines the belonging of specific business processes to a certain type, as which the directed action of each business process in creating consumer value is taken. At the same time, the flow of consumer value creation should be understood as a set of all actions to transform resources and information into an end product for the consumer. It should be noted that the value stream is better represented graphically — in the form of business processes map (“ArchiMate® Specification | The Open Group Website,” n.d.; “The TOGAF® Standard, Version 9.2,” n.d.).

According to this, basic business processes are the processes that directly create customer value, constitute the core business of the company and create the main revenue stream.

Managing business processes include processes that increase customer value, which cover the entire range of management functions at the level of each business process and the business system as a whole (Anttila and Jussila, 2013).

Supporting business processes are designed to provide basic and managing business processes and are focused on supporting their universal features.

Let us consider each separate type of business processes of the top-level hospitality enterprises in more detail.

The basic top-level processes of the hospitality enterprises are presented in figure 3.

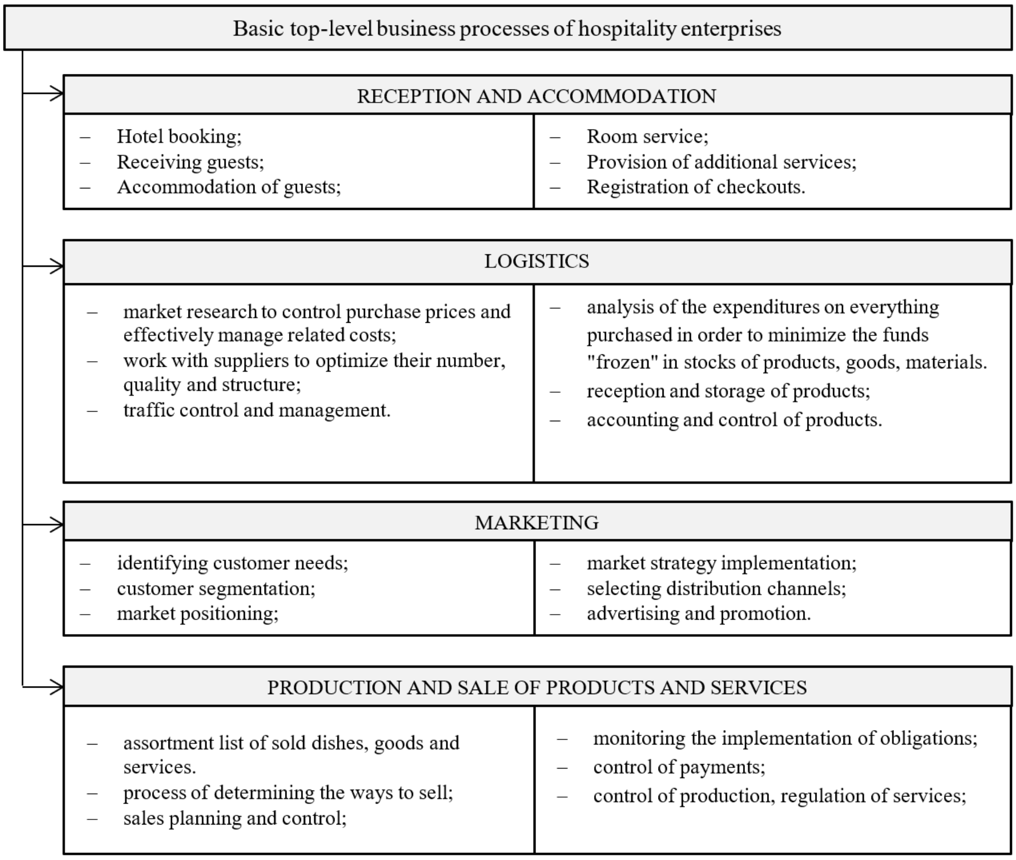

Fig. 3. Basic top-level processes of hospitality industry enterprises

The processes presented in figure 3 are referred to as the ‘basicones’, since they create the consumer value of the hospitality industry enterprises. Let us consider them in more detail.

Reception and accommodation. The technological cycle of service implies a process that covers the period of time from the moment when a potential consumer contacts the hotel by phone or otherwise, to the payment bill and the checkout. The process of guest service in hotels of all categories has the following stages (Saenko et al., 2017):

1. Preliminary hotel booking (reservation);
2. Reception, check-in and accommodation;
3. Providing accommodation and food services;
4. Providing additional services to residents;
5. Final payment and check-out.

One of the most important services in the hotel is to book a room, as it allows you to guarantee the accommodation in advance and stay in a particular hotel. When booking a room, the first impression of staff and the hotel as a whole is shaped. As an example, let us consider the "Booking" business process in more detail.

Elements of "Booking" include:

1. "input" – booking request, customer data, date of arrival, length of stay, availability, additional data, means of payment;
2. "output" – mark in the booking log, booked room, confirmation letter to the client, booking re-

port, payment for the room or a refusal to book;

3. "control" – journal of booking, booking manual;

4. "mechanism" – staff, office equipment (computer, telephone, MFP), software and Internet.

Business processes modeling of hotel reservation allows to:

1. determine what enters the service at the "input", which is important for a detailed understanding of the process;

2. what functions and in what order one's are performed within the department responsible for this process or sub-process;

3. what is the executor guided by when performing each process;

4. identify the resources that are required to implement certain operations and analyze their availability and quantity;

5. what is the result of the service (output).

In accordance with the established rules of hotel services, hotels must provide round-the-clock check-ins and check-outs. To make the stay comfortable for a client, hotels, in addition to offering rooms, must provide a certain amount of additional services according to its category, specialization, size, etc. Regardless of the functional characteristics, any hotel should set a main goal which is to bring the living conditions of the client to home ones during the entire stay of guests, to create conditions for effective work, recreation, entertainment. High level hotels require a business center, service bureau, spa-center, car hire, etc. Additional services are also important in ensuring the income of hotels. The share of income from the offer of additional services can reach 30%.

Logistics. Logistics or the organization of supply of the enterprise with products and expendables for production of dishes, goods for resale (alcohol, drinks, etc.), expendables for rendering services to guests and ensuring economic activity is the most important business process. This is explained by its costly nature. Therefore, the strictest formalization and control are extremely necessary in the process of managing this unit. When purchasing food, the hotels follow the laws of the country regulating this sphere of activity, internal rules and methods (for example, contracts concluded with suppliers, production technology used in this enterprise, service methods, etc.), norms of ethics, aesthetics and psychology, which are of particular importance in the subsequent stages, current orders and orders of the management (hotels and catering services).

Studies show that a 3% reduction in logistics costs results in a 1-2% increase in return on sales. This is achieved by a clear organization of a single process of raw materials movement from the supplier to the end user (guest), the purpose of which is to minimize costs for the purchase, transportation, storage of products and accelerate the turnover of capital by minimizing stored reserves. This solves the following problems:

1. development and implementation of a common procurement policy and strategy;

2. development and implementation of search methods, selection methods and evaluation methods of supplier, methods of contractual work;

3. creation and strict observance of the uniform cycle of the organization of deliveries and movement of production in the enterprise on points of production and sales;

4. formation of reports on logistics processes, including the balanced scorecard;

5. control of movement, safety and correct consumption of products within the enterprise at the points of production and sales.

Since the specifics of hospitality enterprises is that suppliers usually deliver products by their own vehicles, it is not advisable to consider the transport part of logistics in the main business processes. In any case, the management company performs delivery for individual restaurants in a chain, so it would be more correct to consider only two areas of logistics. The first is purchasing, the second is storage and movement of the purchased goods within the enterprise (Odoom, 2012).

Marketing. Marketing in the hotel business is often identified with the sale and advertising of hotel services. In fact, sales and advertising are the only components of "marketing mix", and often are not the most important. Advertising and sales are part of the policy of promoting goods and services to the market. There are other elements of marketing — the product itself, its price and distribution. Marketing also includes comprehensive research, information systems, planning and strategies. Development involves designing innovations that can provide new opportunities for sales. Such innovations should meet the needs and preferences of potential customers (Dagdgiev et al., 2017).

Monitoring involves the analysis of the results of activities to promote services to the market and checking whether these results reflect a truly full and successful use of existing opportunities in the tourism sector.

However, marketing expands its functions, placing special emphasis on relationships with consumers. Long-term relationships with customers are much cheaper than the marketing costs required to increase the interest of the new consumer to the hotel services.

Production and sales of products and services. Food service in hotels is an important structural subdivision in the formation of the main product of hospitality - the provision of food services and a number of additional services, which are determined by the functional type of catering establishments. The enterprises of restaurant economy in structure of hotel complexes public, however are obliged to serve first of all clients of hotel. In specialized accommodation facilities - boarding houses, hotels, clubs, hotels with treatment and other - services are provided only to guests of the institution. In the structure of hotel complexes the functional organization of food services is solved taking into account the category of accommodation.

In modern conditions, the management of the hotel company must be simple and flexible to be competitive. It should have the following characteristics (Karmysova, 2017):

1. a small number of control levels;
2. small units staffed by qualified personnel;
3. production and organization of work based on the principles of effective communication.

Strategic management of the hospitality industry includes the following (Bokareva and Yudina, 2020; Enz, 2009):

4. development of a strategy consistent with marketing strategies and analysis of the tourism market;
5. identification of economic factors affecting the efficiency and completeness of the hotel management implementation;
6. preparation of the budget plan and pricing policy; long-term and short-term planning of the structural units of the hotel;
7. assessment of risks associated with the hotel business;
8. planning of loading the number of rooms, seats at catering establishments, animation and health centers and vehicles.

Top-level management processes of the hospitality industry are shown in figure 4.

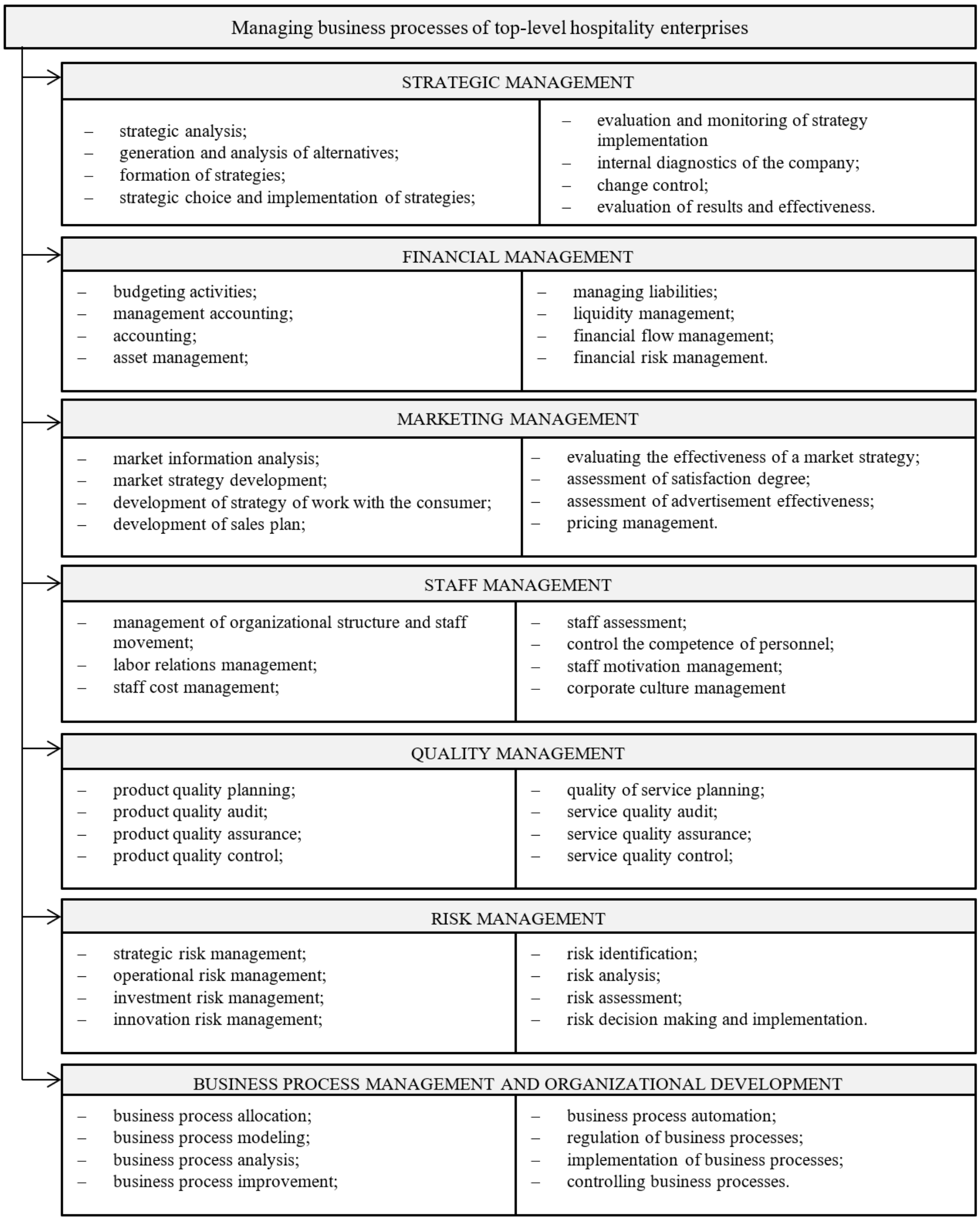

Fig. 4. Top-level management processes of hospitality enterprises

Supporting technological processes provide the conditions necessary for the implementation of the main processes: staffing, financial and accounting, security, control of technological and aesthetic condition of equipment and premises, their maintenance and repair. Supporting processes of top-level enterprises of the hospitality industry are shown in figure 5.

Supporting top-level business processes for hospitality enterprises

IT SUPPORT AND COMMUNICATION

- management of changes in the corporate information environment;
- providing configuration management;
- providing network management;
- server and application management;
- data storage management.

LEGAL SUPPORT

- provision of contractual activities;
- ensuring interaction with public authorities;
- providing claim-related work;
- ensuring representation;
- provision of registration activities;
- provision of consulting activities.

ADMINISTRATIVE AND ECONOMIC SUPPORT

- current provision of activities;
- interaction with landlords;
- interaction with tenants;
- organization of workplaces;
- maintenance of buildings, premises, territories.

STAFF PROVISION

- determination of staffing needs;
- staff search;
- staff selection;
- staff record;
- staff development;
- staff motivation;
- organizational development;
- evaluation of efficiency and quality of work.

FINANCIAL AND MANAGEMENT ACCOUNTING

- formation of financial statements;
- control of cash and non-cash payments;
- formation of management reporting;
- control over the fulfillment of contractual obligations, expenses and revenues.

SECURITY PROVISION

- Ensure economic security;
- Ensure information security;
- Providing anti-terrorist protection;
- ensuring efficiency and development of engineering and technical means: surveillance, security and access control systems.

INTERNAL CONTROL

- definition of performance standards;
- definition of evaluation criteria;
- determination of permissible deviations;
- measuring and evaluating results;
- adjustment of activities;
- verification and validation of operational efficiency and effectiveness.

RECORDS AND DOCUMENTS MANAGEMENT

- reception, registration, distribution and processing of documents;
- approval of documents;
- preparation of documents, coordination, execution (internal documents and documents for contractors).

Fig. 5. Supporting top-level processes of hospitality industry enterprise

Supporting processes are associated with the operation of equipment and premises (cleaning, cleaning), storage and movement of raw materials, semi-finished products, finished products. They are held in the hotel warehouse, transport, engineering and technical services. Service processes also include social services provided to employees in the enterprise (Evgrafov and Ilyina, 2017).

Supporting and servicing technological processes can be performed by other specialized enterprises, for which these processes are the main ones. Specialization leads to better service. The organization of such technology is beneficial for small businesses. However, the hotel supporting and servicing processes are provided by their own services (own Laundry, maid service, catering service, tourist information Agency, etc.).

Results

Consistent consideration of basic, managing and supporting business processes, as well as the identification of their relationships, allowed to build a reference model of top-level business processes, presented in figure 6, which is a necessary condition for the development of architectural solutions for the hospitality industry.

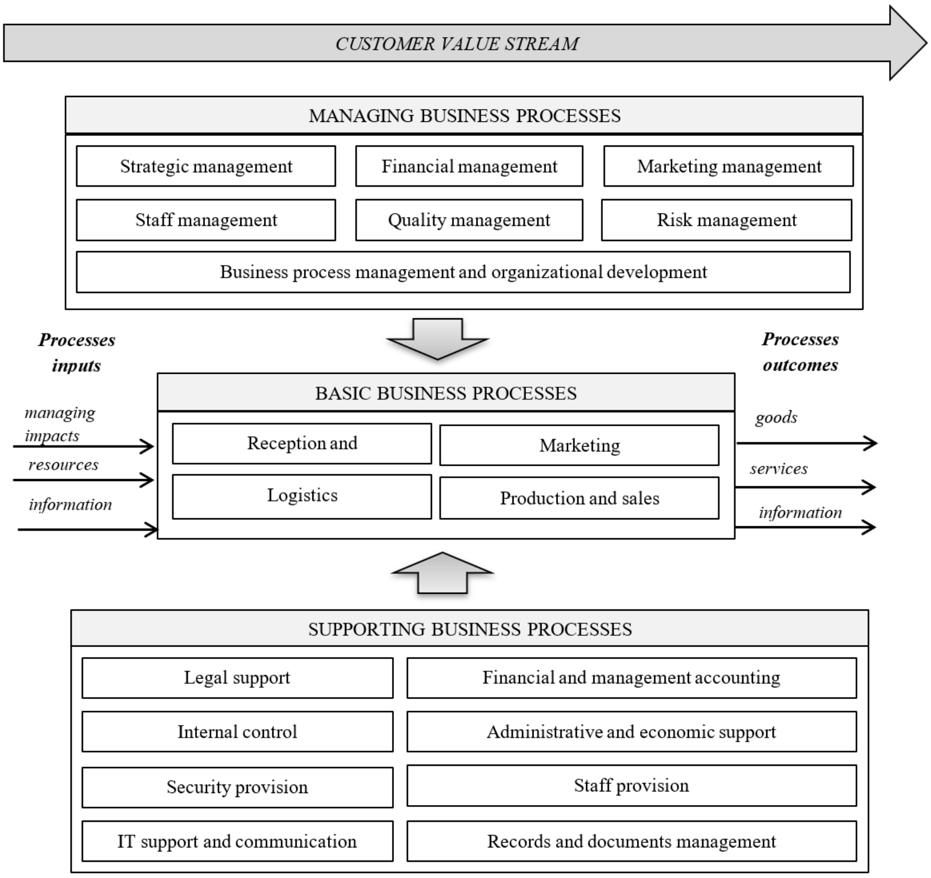

Fig. 6. Reference model of top-level business processes of the hospitality enterprises

The developed reference model of top-level business processes will allow to develop an optimal architectural solution that will create new opportunities for the hospitality industry enterprises in the era of digitalization, when the increase of manageability, monitoring of performance indicators and safety control will allow to move to predictive models and proactive (program-target) management of accommodation facilities.

Conclusions

Further modeling of basic, managing, and supporting business processes of enterprises of the hospitality industry on the basis of a reference business model, the upper level will allow optimizing the information with respect to the data describing the current or future (forecast) state of business processes and analysis and presentation of data in the form required to solve strategic and tactical challenges facing the hospitality industry. Underestimating business processes, hotels lose not only the opportunity to improve the quality of service, but also the ability to respond to customer criticisms. By noticing only individual "details" indicated by the guests and focusing on them, it is not possible to see the full picture until the entire business process associated with this detail has been carefully worked out and modeled.

The described processes are examined for the presence of empty points (when the staff does not know how to act with guests), critical points (when conflicts with guests occur most often) and points of inactivity (when the process begins to move in a vicious circle). After these points are identified, the processes are improved and put into practice (internal trainings, work standards).

The conducted research will provide an opportunity to gain a competitive advantage, reduce financial and commercial risks of business activity, to determine the attitude of customers to the provided service, to assess strategic and tactical activities of the hotel, improve the effectiveness of communication markets, to determine the optimal segment positioning processes and the nature of their life cycle.

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