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DEVELOPMENT OF INNOVATIVE DIGITAL TECHNOLOGIES FOR ENTERPRISE MANAGEMENT

Abstract: The efficacy of the organization and corporate strategy are substantially impacted by enterprise resource planning (ERP) technologies. However, it might be difficult to manage and apply the anticipated benefits of ERP. Workarounds further complicate outdated and evolving business procedures, which impedes the ongoing development of ERP. As a result, reaping the rewards is sometimes challenging. The complexity of realizing advantages also rises when subsidiaries are not able to discover new benefits on their own, even though benefits may differ from subsidiary to subsidiary. ERP systems, which integrate, synchronize, and centralize corporate data, are frequently viewed as a key resource for businesses that thrive in a fast-evolving global market. The selection of ERP systems is a crucial and challenging strategic choice because of the high cost of purchasing, installation, and implementation as well as the variety of offers. Because there are many different tangible and intangible requirements. This paper presents data on the development of innovative digital technologies in enterprise management. The main theoretical concepts of innovative digital technologies are described, as well as automated control systems and methods of their development are studied. This paper presents a model of innovation management in an industrial enterprise, an analysis of the ICT market, and developed recommendations on the methodology for implementing an ERP (Enterprise Resource Planning) system.

Keywords: Enterprise Resource Planning, Information, and Communications Technology.

Introduction

The automatic management system is designed for automatic data processing and selective preparation of management opinions in order to increase the efficiency of specialists and managers by increasing the level of efficiency and reasonableness of decisions. Nowadays, it is difficult to imagine a business without automated enterprise resource planning and management systems (ERP - Enterprise Resource Planning). The principle of the purpose of

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ERP system development is the organization of effective enterprise management based on the strategy of its formation. The following questions remain open: what advantages does the implementation of an ERP system give the company and how to select, develop and configure a system that is optimal for business development?

The relevance of the presented study is justified by the fact that in order to increase the productivity of enterprise management, automated ERP class systems are used more and more often, capable of grouping all internal and external resources of the company and forming an entire information space.

In this regard, there is a problem of the correct development of an ERP system for a specific enterprise. ERP is a complex information system that is used by the company's personnel to account for all resources at a given enterprise, both in commodity and monetary terms. This includes purchasing raw materials, receiving orders and applications, and manufacturing products. Thanks to ERP systems, a single information resource or data warehouse is formed, which contains all information about the work of all departments and services, about the needs for material and financial resources, about the production and sale of products. All departments and services of the enterprise interact within the ERP system [1].

The object of the study is digital innovations in Kazakhstan, including the production company KazMunayGas JSC, which has implemented an ERP system.

The subject of the research is the development of a business planning system at an enterprise as a tool for digital innovation.

The purpose of the work is to develop the introduction of domestic digital information technologies of business management for an enterprise.

The scientific novelty consists in the development of practical recommendations for the introduction of innovative digital technologies at large enterprises and the generalization of theoretical and practical material on the implementation of business planning at enterprises.

Literature review

Since the initial ERP systems were established in the 1990s [17], the ERP research and related literature are not only recent, but also extensive. The ERP literature can be divided into four major categories: ERP selection, ERP implementation, ERP risk management, and general ERP projects. The published research on ERP system selection (as in this study) and implementations accounts for approximately 75% of all published studies [16]. There are several research papers that analyze ERP-related difficulties, ranging from selection to adaptation, while others examine the phenomenon's research landscape.

For instance, Juell-Skielse et al. introduced an agile technique for ERP selection (AMES) that better leverages the capabilities of service-oriented ERP, as traditional on-premise ERP installations are fast being replaced by ERP as a service. AMES is intended to reduce selection lead time, assist in the discovery of critical system needs, raise learning throughout the selection process, and increase control over the following ERP. AMES is divided into three stages: envision, iterate, and decide. Though the researchers offered a unique strategy for ERP selection, it has only been tested in one small business; the method has to be tested in other organizations of various sizes, organizational structures, and industries [18].

Hurbean provided an objective-oriented approach to ERP vendor selection, emphasizing that the selection process should include their potential to assist alter business processes in order to fulfill the customer's objectives [19].

Hurt applies numerous well-known management and information systems ideas in the case study: the value chain, expectation theory, change management principles, the capability maturity model, and the systems development life cycle. Based on Crawford and Nahmias research, they link eight qualities essential for successful change management, specifically

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to ERP initiatives. Leadership, stakeholder management, planning, team selection/team development, communication, decision making and issue resolution, culture management, and project management are among these capabilities [20].

Adams and Martin explore in detail the function of change management in an ERP implementation project to handle the People component, realize the route for bringing the new processes and ERP system into production operations, and gain'reach' throughout the organization in their online paper. It also discusses how change resistance impacts ERP installation and how to overcome these obstacles. During project execution, the report emphasizes the necessity of organizational alignment, skill evaluation, and training requirements. This excellent notion must be utilized in various implementations and outcomes analysis. There is a perceived need for the development of tools and procedures for improved assessment [21].

Kwak et al. provide an alternate model of ERP acceptability by users. The best practices of ERP system installation projects, internal support, external (consultant) assistance, and feature selection are incorporated into the extended technology acceptance model, which includes belief structures and socio-environmental constructs . The notion must be utilized in the manufacturing and other industries to provide essential management insights that enable end-user ERP system acceptance to be appreciated and improved [22].

Huseyin Selcuk Kilic, Selim Zaim, and Dursun Delen highlighted how a three-stage hybrid technique is offered to solve the constraints imposed by the problem's complex character. The process begins with the identification of the most important criteria through a series of brainstorming sessions with employees from various organizational units. Then, owing to the variable relevance of the criterion, a fuzzy Analytic Hierarchy Process is utilized to derive the relative importance/weights of the criteria, which addresses the ambiguity inherent in the decision-making process. These weighted criteria are then used to order the choice alternatives using the Technique for Order Preference by Similarity to Ideal Solution approach. The proposed technique is used to the ERP selection challenge at Turkish Airlines as a real-world illustrative scenario [23].

The literature given below is only an example of what has been researched in the field of ERP system selection. The amount and quality of studies published in this topic demonstrate to the relevance and complexity of the ERP system selection challenge. What differentiates our approach from past attempts is as follows:

First, we describe ERP systems include many different modules. Each module supports specific business processes, such as finance, purchasing, or manufacturing. Second, we analyzed ERP market, difficulties in implementing ERP, analysis of increasing budget and delay. Additionally, we proposed of evaluate the speed of the developed methods and algorithms.

Finally, we analyze ICT market globally and locally in Kazakhstan. Also, we proposed recommendations developing ERP system in a large company «KazMunayGas» JSC to illustrate its affordable and utility.

Main part

The correct and timely management decision significantly affects the development and efficiency of the enterprise. At the same time, well-structured management accounting is of great importance, which must be organized in such a way that the following tasks are simultaneously solved:

- ensuring the reliability, continuity and full registration of economic activities;
- identifying possible risks and forecasting the activities of the enterprise;
- using digital technologies and managing the big data.
- controlling and optimizing financial and material flows;

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- integrating various business processes and their automation;
- the interactions between different departments to obtain up-to-date information [2].

Investments in human capital do not always bring the expected result, in this regard, the most interesting for the company is the use of integrated technological solutions that allow you to automate some processes and thereby to promptly notify about all changes taking place in the company. At the current moment, in organizations of medium and large businesses, ERP class systems are widely used. These systems represent a system of unified planning, analysis, accounting and control that include information on sales, inventory, financial assets, human resources, etc., focused on optimizing all available resources of the company [3].

Modern ERP-systems bear little resemblance to ERP ten years ago. They are now delivered via the cloud and use the latest technologies such as artificial intelligence (AI) and machine learning to enable smart automation, to improve efficiency and to instantly understand your entire business. Modern ERP software also links internal operations with business partners and networks around the world, giving companies the collaboration, flexibility and speed they need to be competitive nowadays.

ERP systems include many different modules. Each module supports specific business processes, such as finance, purchasing, or manufacturing, and provides the employees in that department with transactional information and the information they need to do their job. Figure 1 shows that each module is connected to the ERP system, which provides a single source of reliable and accurate shared data between departments.

Figure 1. ERP modules

Digital transformation is accelerating – and ERP is at the core. As businesses embrace digital technologies in all areas of their activities, they are fundamentally changing the way they work.

Gartner predicts that in 2021, IT spending worldwide will increase by 8.4% and will reach $4.1 trillion. For comparison, in 2020 the volume of the global IT market grew by only 0.5%. Panorama Consulting Solutions has published the results of its annual study of the global ERP market. Figure 2 shows the complexity of implementing ERP.

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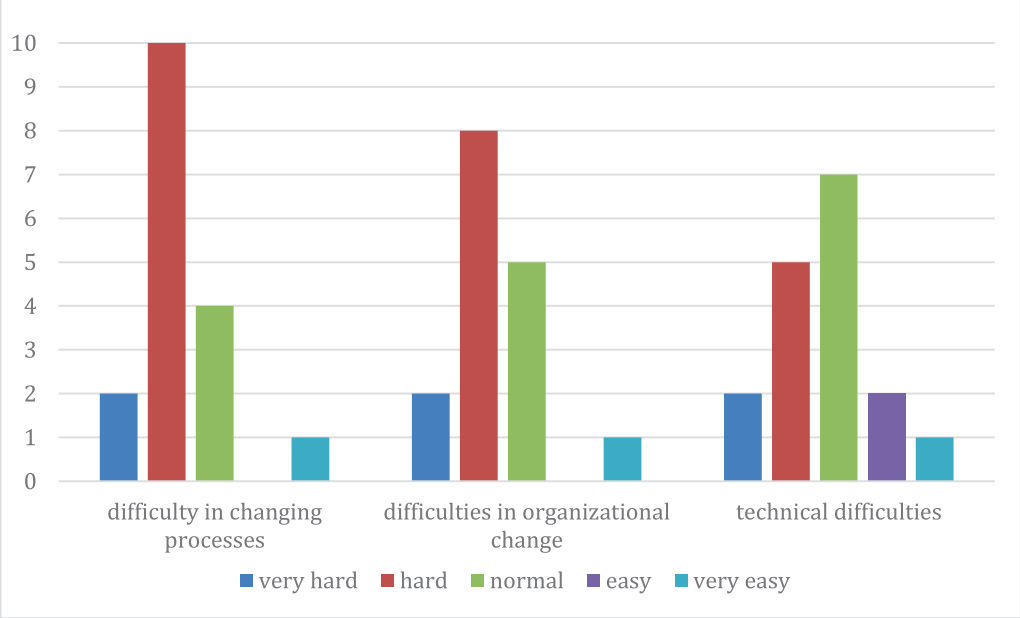

Figure 2. Difficulties in implementing ERP

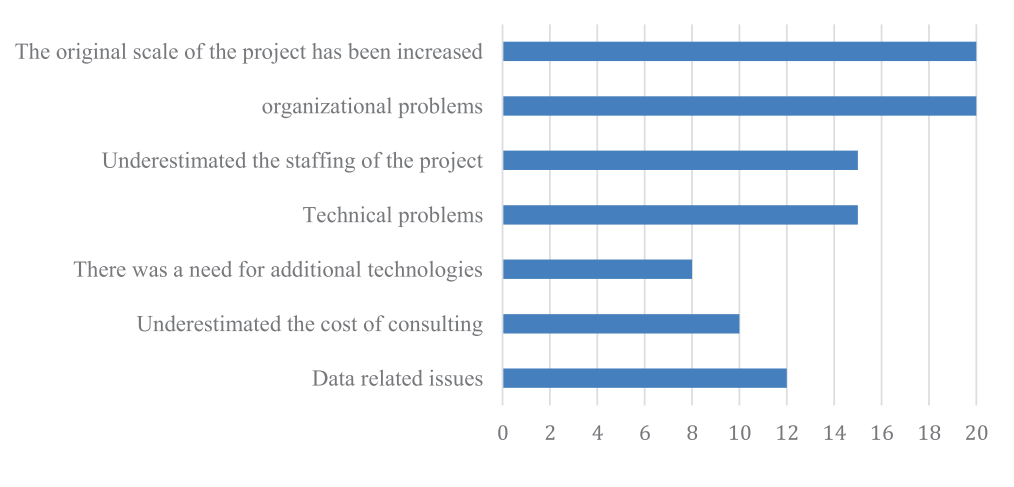

Figure 3. Reasons for increase budget.

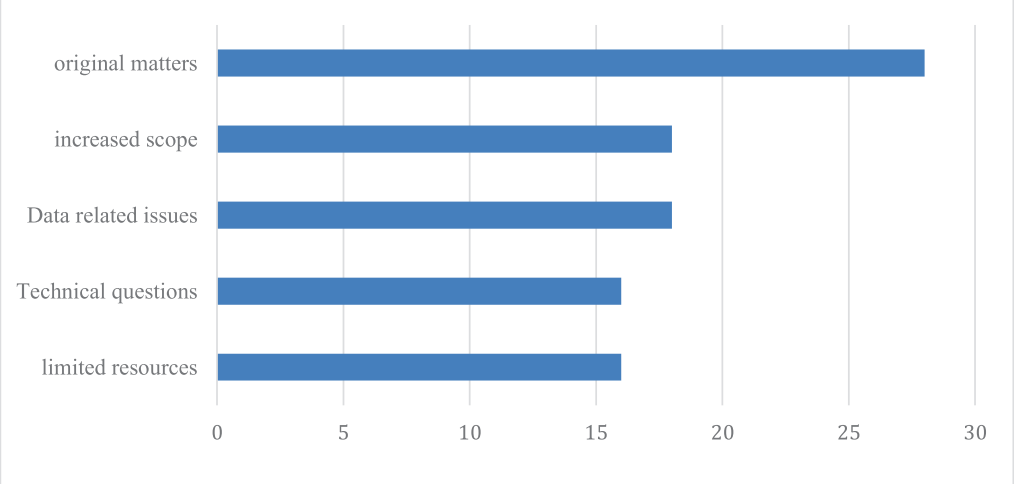

Figure 4. Reasons for the delay.

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As we can see, the main reasons for exceeding the budget and the causes for exceeding the deadlines are shown in Figures 3 and 4

Large and complex organizations often strive for digital transformation, while large but not so complex organizations strive for business optimization.

Digital transformation is a process of creating new business and operating models by laying the foundation for the adoption and integration of digital technologies. The goal is to unlock new data and organizational capabilities by transforming operational processes and improving the customer experience.

In the case of an ERP implementation, the project may simply include a current state assessment, selection and implementation. Most organizations are closer to this option, because most companies are not ready to change everything at once.

When implementing an ERP system, a company must have a clear digital strategy. The digital strategy coordinates the actions of people, processes and new technologies.

According to Panorama Consulting Solutions, the benefits of digital transformation include:

- Improving revenue growth through the use of digital technologies, such as innovations in mobile devices, e-commerce and digital sales.
- Providing uninterrupted customer service in all departments of the organization.
- Complementing traditional products with digital offerings and services.
- Improving strategic decision making through deeper data analyses and analytics that improve the customer experience.
- Creating a culture of autonomous, continuous improvement leading to competitive advantage.
- Enabling "end-to-end process thinking" and automation, allowing workers to focus on innovation and creativity rather than repetitive tasks.

Most organizations recognize their need for digital transformation when they want to improve the customer experience and realize they need more accurate, real-time data.

In 2019, lockdowns and telecommuting forced business leaders to accelerate their digital transformation projects. Most of the leaders of large companies interviewed by McKinsey analysts admitted that nowadays technology is a critical business component, and not just a tool to increase the economic efficiency of an enterprise [4].

Considering the problems, a mathematical model has been investigated that increases the speed of the processes of building and calling triggers for managing enterprise business processes in ERP systems [5].

To evaluate the speed of the developed methods and algorithms, tests were carried out to build an ERP trigger graph in the GreenSight ERP enterprise resource planning system. The following were used as performance criteria:

1. Time spent on creating trigger links between objects: Time spent on creating trigger links between objects:

$$\mathrm{T(n)}=\sum_{i=1}^{n}\sum_{i=1}^{n} e(t_{ij})\mathrm{l}(v_j)$$

where $e(t_{ij})$ is time for creating triggering connection $(t_{ij})=(v_i\ ,\ v_j)$, $\mathrm{l}(v_j)$ is time for implementing trigger actions on object v_j.

2. Time spent on updating the updating the call graph of ERP triggers in case of data conflicts:

$$\mathrm{D(n)}=\sum_{i=1}^{n}\sum_{i=1}^{n} d(t_{ij})\mathrm{l}(v_j)$$

where $d(t_{ij})$ is the delay in the occurrence of a trigger connection that occurs when there is a conflict over data (RAW, WAR), $l(v_j)$ is the time for implementing trigger actions on object v_j [5]. Table 1 and 2 show the test results [5].

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Table 1. The speed of trigger construction operations before the application of the developed algorithms.

Number of objects	Number of requests	Time delay ms
10	15	13
100	31	85
1000	75	400
10000	130	7600
100000	738	15700

Table 2. The speed of trigger construction operations before the application of the developed algorithms.

Number of objects	Number of requests	Time delay ms
10	2	7
100	7	37
1000	19	250
10000	88	570
100000	170	3600

As part of this approach, triggers are stored in a serialized form in a database, which simultaneously ensures the portability of the created ERP triggers and the ability to specify any actions performed when the trigger is called. Tests were carried out to assess the speed of constructing and updating the graph of ERP triggers using the developed model, as a result of which a 52% reduction in the number of requests was obtained, and the time spent on building and updating ERP triggers – by 54%.

The structure of the phases of the life cycle of an ERP system consists of different concepts. The stages of implementing the ERP system are following:

1) formation of requirements for the system;
2) design;
3) implementation;
4) testing;
5) launching;
6) operation;
7) support.

A detailed classification of the phases of the implementation life cycle is offered by Oracle AIM (Application Implementation Method) methods of ready-made applications.

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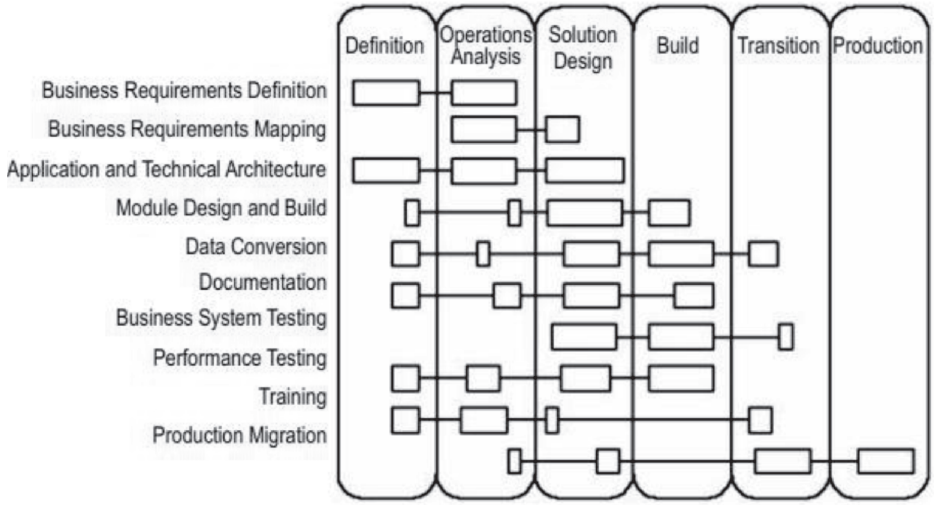

Figure 5. Processes and phases of implementation of finished applications according to Oracle methodology.

Benefits of developing your own ERP:

- no need to change the existing management structure and business processes;
- the absence of unnecessary functions, interface elements and the ability to add (or remove) new tools as needed;
- focus only on the necessary business processes (all tasks, functions, analyzes, roles in the system);
- cheaper in the long run

Cheaper in the long run, this advantage may seem doubtful, but given the cost of the license and the hidden costs of ready-made solutions (installation, staff training, technical support, etc.). It turns out that you will pay 20-30% of the total cost of developing the software you use. And the development of ERP from scratch will pay off in a few years, and you will use it for 7-10 years [6].

The leading driver of financial economic recovery is the competitiveness of the economy. Investing in ICT has every potential to contribute to productivity, efficiency and competitiveness in any sector of economic activity. According to world experts, up to 50% of productivity growth in the European Union has been influenced by information and communication technologies.

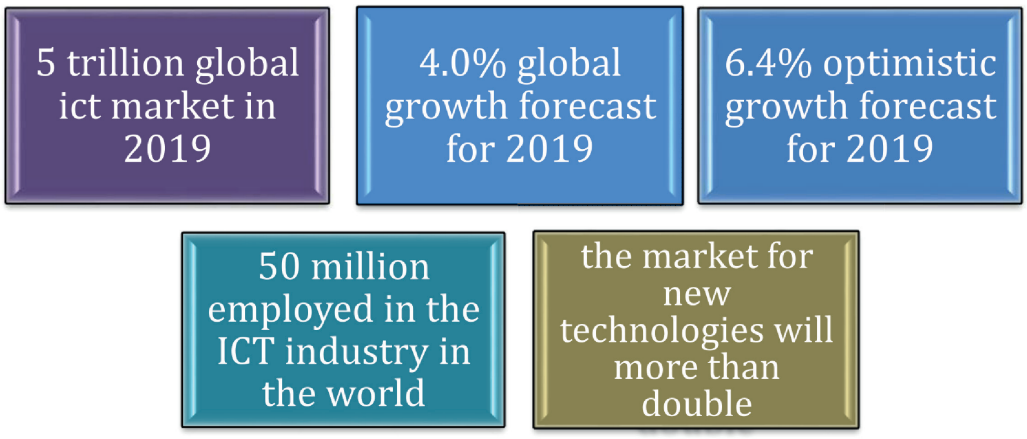

Figure 6. Global ICT market, 2020 [29]

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According to research agency IDC, in 2017, the global IT industry annually exceeds $4.5 trillion. IDC predicts that global ICT spending will grow by 4% and will reach $5 trillion in 2020. From a geographical point of view, the United States will make the most significant contribution to the development of information and communication technologies.

Today, the sphere of information and communication technologies remains one of the most active developing sectors of the economy of Kazakhstan.

During the period from 2014 to 2018, the volume of production and sales of goods (services) in the ICT sector has been steadily growing. Thus, at the end of 2018, the volume amounted to 2,053.1 billion tenge, which is 9% more than in 2017. Despite the annual growth in volumes, the share of the sector in the country's GDP is negative.

In 2019, the ICT sector of Kazakhstan continues its development in all directions. So, at the end of 2019, the volume of the ICT industry in the Republic of Kazakhstan amounted to 2 382 707 million tenge Figure 9, which is 16% more than in the same period in 2018. Due to the fact that the total gross domestic product of the country showed a similar growth 13%, the share of production and sales of goods (services) in the ICT industry in the total volume of the country's GDP remained at 3.4% [7].

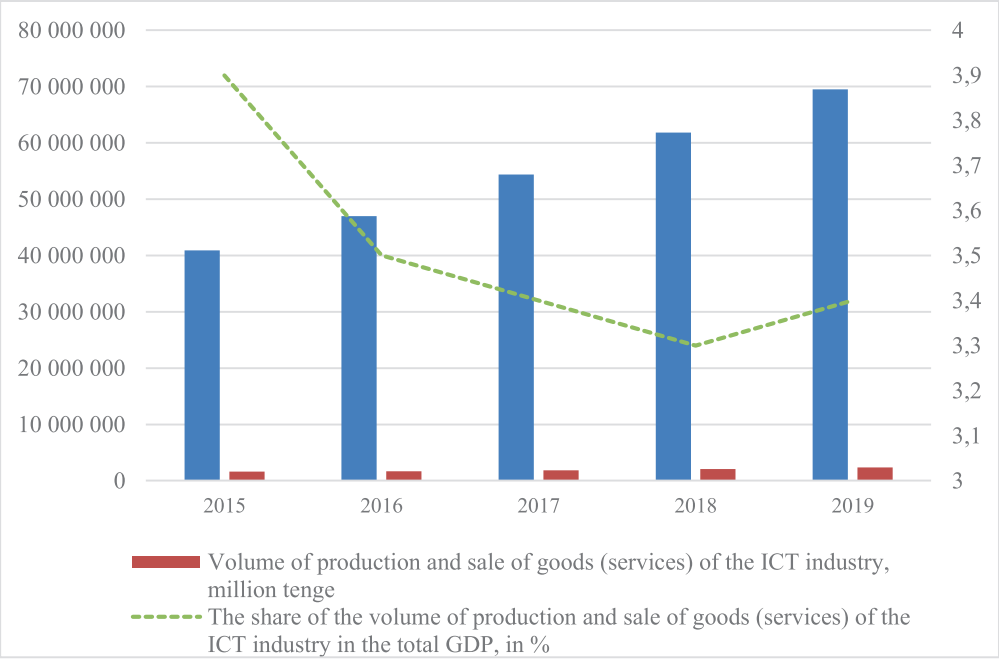

Figure 7. The volume of production and sales of goods (services) of the ICT industry and the share in the total GDP of Kazakhstan.

The market of information and communication technologies in Kazakhstan has been growing steadily in recent years; and leading analytical agencies forecast its growth to be even more stable. There is development of IT and Internet projects in the public, financial and other sectors [8-24].

JSC National Company KazMunayGas (hereinafter referred to as KMG, the Company) is a leading vertically integrated oil and gas company in Kazakhstan. KMG manages assets throughout the entire production cycle, from exploration and production of hydrocarbons to transportation, processing and provision of services. The company was founded in 2002 and it represents the interests of the Republic of Kazakhstan in the country's oil and gas industry [9].

In 2020, ten projects and activities were completed or transferred to operational activities: the implementation of an ERP system, IT cost optimization, the implementation of an

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information security management system, a new procurement model, data management, Lean 6 Sigma in processing and marketing, an intellectual field. For all of them, certain results were achieved during the reporting period. Thus, as part of the project to introduce an information security management system in the KMG group of companies (ISMS), the information security management processes in the KMG Corporate Center were updated and a methodological base was prepared for the functioning of the ISMS in KMG and subsidiaries. In the course of the event «Development of a methodology for managing the Company's procurement activities and conducting diagnostics», the Rules for managing KMG's procurement activities were developed and approved.

In accordance with the new approach, a new project is included in the portfolio of digital transformation projects which is «Development of IS ABAI» («Advanced base of artificial intelligence») [9].

The ABAI system will integrate all production data of KMG's oil exploration and production unit with the ability to analyze this data using artificial intelligence and its instant visualization, as well as continuous remote production control. In 2020, a large-scale project to create a KMG Multifunctional Shared Service Center was resumed. It provides for the transfer of a number of supporting functions (personnel management, accounting and tax accounting, procurement, administrative and economic support, etc.) to a single service center. This will significantly relieve the corporate center and subsidiaries and focus on core production activities.

When developing a new approach, this approach can be applied based on the results of a general analysis of ERP systems and of a specific example of implementation carried out in the work, the following stages of recommendations can be formulated: [10]

- recommendations for preliminary evaluation of the project;
- recommendations on the preparatory stage of implementation;
- recommendations on the functions of the ERP system;
- recommendations for changes within the company.

Recommendations for the preliminary assessment of the project:

1. When evaluating the profitability of the implementation of ERP systems, it is recommended to advise the expected reduction in personnel costs for the implementation of business processes in the company, as well as a reduction in the number of employees. Specific examples of the implementation of the ERP system show that to support this process, an additional number of employees is required to train and to support users, as well as for further work in the system. Reducing labor costs is possible if input and output forms are translated into ERP, which are completely identical to those, which were previously used outside the system. As it is known, the development of new forms, reports and input of new data was not carried out outside the system - this will inevitably lead to an increase in labor costs in the company. In addition, a permanent staff in the implementation of an ERP system is one of the factors for the successful implementation of the project as a whole [11].

2. While proceeding with the project plan, the implementation period should not be shorter than recommended by other projects or the general contractor. In addition, it is necessary to be prepared for an increase in the implementation time, and therefore it is recommended not to tie its completion to the deadlines that are critical for the company. The period of data collection and system commissioning (from the test version to the production environment) must be planned for the period of the least turnover of financial and economic activity [12].

Recommendations for the preparatory stage of implementation:

1. It is important to conduct a long phase of full testing of all functionality of the ERP system. It is highly desirable that the tests are not conducted on real financial and business transactions, but on virtual departments, materials and contracts. The more different variants

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of business processes are tested, the fewer improvements need to be made to the system for normal functioning in the future [13].

2. It is extremely important to provide for the complete training of employees to work in the system. It is important to provide complete training of employees to work in the system. It is recommended to use all modern approaches to teaching. A flexible set of courses (basic, advanced, optional functional modules), video training, multimedia and interactive training programs help to significantly increase the effectiveness of training [14].

Recommendations for the functions of the ERP system:

1. The practice of implementing and using ERP systems shows that most of them (due to their flexibility and adaptability to any production) have redundant functions. It is recommended to study the screen masks for ease of use and to exclude all screen elements that do not participate in the required operations. Notes for filling or a note about the order of filling in fields and forms can greatly facilitate the work of employees in the system.

2. When implementing an ERP system in one of the organizations of a large company, it is necessary to immediately take into account the requirements to avoid duplication of work outside the system and inside the system. It is recommended that at the stage of implementing the system functionality, to immediately enter reporting forms into the organization in accordance with applicable regulatory requirements and strictly adhere to this rule, especially in a large organization with many branches.

The functionality of an ERP system should be discussed with as many people as possible. Even if the decision is ultimately made by the top management of the company, the opinion of ordinary employees can also be taken into account at least at the initial stage. In addition, employees' simple previous experience with the functions of the future system helps to prepare staff for further training. Consider the recommendations for changes in the company: [15]

1. The introduction of an ERP system in a company is associated with high monetary costs, most of which are payments for contractors. These are companies whose competence includes knowledge in the field of IT and enterprise economics. Such companies rarely speak business language and understand the specifics of a particular production. In such conditions, the risks of unsuccessful project implementation increase significantly. To minimize this factor, it is recommended to create a separate structural unit in the company responsible for interaction with companies implementing ERP. Employees of such a department should be proficient in ERP terminology and the specifics of production. This approach saves both the time spent on training ordinary employees of the company in the functions of ERP systems, and the risks of implementing and paying for redundant functions.

In case of implementing a non-standard ERP solution and the need to pre-configure the system, it is also recommended to provide additional employees in key structural divisions for ERP work. Designing business processes in an ERP system is an extremely important task, the quality of which determines the quality of a business operation after implementation. In accomplishing this task, additional labor costs are required [15].

Some final recommendations:

1. Make sure managers are on your side. Administrative staff need to understand the importance of change management and what actions are required to achieve it.

2. Form a project team. When it comes to a large scale project, building a project team is vital. Part of this team should be responsible for managing change, ensuring employee readiness, and developing a change plan.

3. Conduct a readiness assessment. An organization cannot bring about change without understanding its people. An online survey and a series of focus groups can provide useful information about the strengths and weaknesses of a company's organizational culture.

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4. Assess the impact of the change on businesses. The management of the organization can simply notify employees about the change in their work or explain in detail how it will change. To communicate effectively with subordinates, management needs to understand the scope and nature of the change.

5. Start learning as early as possible. Most project managers agree that training should begin about two weeks before the changes go into effect. Regular training sessions will help employees to remember the information firmly and confidently use new skills in the future.

6. Customize training. Most companies have training materials for their employees. However, training will be much more effective if all training materials and the learning process itself are adapted to the needs of a particular enterprise, its business processes.

7. Listen to the words of employees. Communication is very important as the performers may have a vision that the leaders do not understand. In addition to ideas, performers have concerns. This need is not be neglected, as performers are much more responsive to change if they feel they are being listened to.

Conclusion

As part of the study, an analysis was made of the digital information technology market, including ERP systems, their selection and implementation. The results obtained showed that for oil and gas companies, the introduction of a unified enterprise management system, such as an ERP system, is the most interesting and most advanced innovative technology.

As a result of the analysis, a general tendency was found to underestimate the amount of change management needed to update ERP. Organizations expect to recoup the costs of their ERP projects and many organizations have actually achieved low ROI. The focus of change management was not strong enough to facilitate the realization of significant benefits. Recommendations were made to introduce organizational changes and developments of domestic ERP systems using a mathematical model, implementation concepts and development models of ERP systems that are given in this article.

The analysis of the technique – economic activity of KazMunayGas JSC showed that it is possible to give a positive assessment of the financial condition of the analyzed enterprise. KazMunayGas JSC has reserves and opportunities to further improve its financial condition through the introduction of innovative digital processes as an ERP system, given the data on the cost of developing an ERP system, this is one of the most expensive implementations for any company.

In today's digital age, the need for new technologies is urgent; organizations realize that they need to focus first and foremost on aligning strategy and business management so they can engage employees and drive innovation.

This review suggests future research on ERP development in large organizations such as oil and gas or mining industry.

This may also be helpful for future researchers who intend to investigate the development of innovative digital technologies for enterprise management.

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