

The results of the study and the development of an effective business process management information system (IS) made it possible to conduct an analysis in the experimental conditions of an information technology (IT) company using project management tools in the field of information technology in the sphere of telecommunications.

A wide analysis of the mechanisms, models and systems for processing distributed spatial information using information technologies has been carried out, and it has been determined that none of the presented tools can fully satisfy the requirements for processing heterogeneous data when creating information systems.

A model for processing and managing heterogeneous spatial information based on data access technologies is constructed, a diagram of information flows is presented, and a mechanism for effective data management is described. The algorithm of the data processing module is presented, which allows access to any sources of information necessary for making a management decision. The methodology for designing an information system has been improved using a model for processing heterogeneous spatial information, taking into account the requirements for a decision support system.

This is done so that in the digital age, people focus on the production and trade of products and services through digitized data, information and knowledge. This new infrastructure not only helps people to do better and faster than in previous eras, but opens up new ways of control, coordination, and cooperation in activities with lower costs, regulated by the law of decreasing costs. That is, due to the properties of digital goods, the cost of a unit of marginal or additional output is gradually decreasing, while the number of all other factors of production remains constant

Keywords: information system, project management, business process, information and communication technologies

PROJECT MANAGEMENT TECHNOLOGY IN CREATING A BUSINESS PROCESS MANAGEMENT INFORMATION SYSTEM AT THE PRESENT STAGE OF DEVELOPMENT OF THE TELECOMMUNICATIONS SECTOR OF KAZAKHSTAN

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1. Introduction

In the last 10–15 years, quite effective intelligent technologies have been created that allow using the knowledge, experience and intuition of human experts who are familiar with a particular area.

Today, management information systems are generally recognized as a promising area of scientific research, but their theoretical and applied foundations are far from complete, including in terms of control and management systems for complex business processes that operate in difficult conditions [1]. Difficult conditions mean a large dimension of the control object, its non-stationarity, long-term dynamic memory, distribution of parameters, nonlinearity, significant delays, a variety of situations, incomplete control of external influences, output actions and object states, the presence of fluctuation and gross interference, variability of goals, criteria and restrictions [2].

Modern information systems in telecommunications belong to the class of complex objects. A significant increase in the management efficiency of such objects can be achieved by using only intelligent systems. An important applied task is the development of methods and algorithms based on the joint integration of specific intelligent tools, such as dynamic expert systems, artificial neural networks, fuzzy logic and associative memory. As long-term experience has shown, traditional methods of mathematical modeling do not allow creating effective optimal control systems due to the low adequacy of models. Instead of creating mathematical models of technological processes, it is proposed to create intelligent models (algorithms) for managing them, based on the experience, knowledge and intuition of process operators. At the same time, instead of the generally accepted rules of production, it is proposed to form planning matrices for a full factorial experiment (FFE) [2].

As the analysis of works in the field of theory and practice of artificial intelligence has shown, quite effective artificial intelligence technologies have been created to date, which are used in various practical applications, including in management. We have not found any examples of using intelligent technologies to create optimal business process management systems.

Thus, the technology of creating an information system based on international standards of project management is an urgent task at the present stage of development of the telecommunications sector.

Based on the data obtained and taking into account the specifics of the infrastructure, a specific plan is being developed to build a more secure, manageable and dynamic system relative to its initial state. It should be said that in light of continuous progress in the development of information technology and peripheral industries with them, it is extremely important to have the most flexible, capable of fast, painless and low-cost adaptation optimized IT infrastructure.

The result of the study and the development of an effective business process management IS make it possible to conduct an analysis in the experimental conditions of an IT company using project management tools in the field of information technology in the field of telecommunications. Therefore, studies on the development of a decision support information system implemented in a particular organization are relevant [3].

As is known, the currently observed boom in the dissemination of information and the introduction of digital technologies has its origins. At the same time, we should not forget that information processes aimed at collecting, processing and transmitting information have always played an important role in science and technology. In the course of human evolution, there has been a steady trend towards automation of individual stages of these processes, although their internal content has essentially always remained unchanged.

Today, rapid decision-making, the degree of adequacy of analytical data to real processes, the possibility of using economic and mathematical methods and models for analyzing specific management decisions and managing business processes are relevant.

With the development of information technologies, the possibilities of modern science for conducting multifaceted research have expanded, including the use of project management technologies in the development and creation of information systems.

We must not forget that often the stumbling block for correct forecasts in various industries is the inaccessibility of the necessary information about the real state of affairs, in particular in the consumer market. In this regard, it became necessary to conduct research in the field of information technology and project management technologies.

2. Literature review and problem statement

The paper [3] presents the results of studies of theoretical and methodological problems of accounting for income and expenses for the production processes of telecommunications companies, but does not disclose the features of accounting for business processes. Therefore, in order to substantiate the accounting methodology for business processes in relation to

the activities of telecommunications companies, a comparative analysis of approaches to accounting for production processes and accounting for business processes was carried out.

One of the main differences between the compared accounting methods is that they are based on different approaches to management: operation-oriented and process-oriented approaches. In the first case, accounting focuses on individual operations carried out within the framework of the company's activities, and in the second case, the flow of activities passing through all structural divisions of a telecommunications company, which together represent the business processes of this company [4].

In the digital age, people are focusing on the production and trade of products and services through digitized data, information and knowledge. This era is based on an infrastructure consisting of information and communication technologies. This new infrastructure not only helps people do better and faster than in previous eras, but opens up new ways of controlling, coordinating, and collaborating on lower-cost activities governed by the law of diminishing costs. That is, due to the properties of digital goods, the cost of a unit of marginal or additional output gradually decreases, while the amount of all other factors of production remains constant. As digital resources become available, processed, transmitted and stored regardless of location or time, boundaries and geographic distances are no longer as important as they used to be, and entirely new, invisible electronic spaces are now available. Information systems are becoming more and more multimedia as well as networked. This evolution, as well as the increased rate of change, places new requirements on the methods and competencies needed to develop future information systems.

The paper [4] presents the results of a study related to an integrated information system (IS), which allows achieving high work efficiency in the management of innovative projects and supporting all areas of the company's activities related to the development and implementation of projects. The system provides all stages of planning and implementation of projects.

It is shown that the work consists in approaches to the development of business processes for the management of a telecommunications company as an interconnection of the sequence of certain phases [5], as well as in the development of a system that allows us to consider operational activities as separate projects, dividing it into stages, which makes it possible to improve the quality of project implementation.

But the issues related to the assessment of the state of IS according to the proposed generalized parameters do not exclude the possibility of skipping one of the specific control parameters. Therefore, it is difficult to assess the availability of IP, to determine the conditions for preventive measures, taking into account the approaches under consideration.

The reason for this may be that during the implementation of the project several times overruns were made, and the commissioning of the information system for supporting management decision-making was delayed, which makes the corresponding study inappropriate.

As an option to overcome the corresponding difficulties, it may be that at present the project approach is becoming larger and more and more of its penetration into management practice is observed. Quite a lot of organizations are beginning to view themselves through the prism of project-oriented activity. At the same time, there is a growing need for professional project managers, as all stakeholders

expect sufficiently high positive results from the project. It was the project approach that was used in [6], however, the application of the theory of sets and categories is considered as one of the ways to formalize these approaches.

All this allows us to assert the expediency of conducting research in the field of project management technologies when creating information systems.

This evolution, as well as the increased rate of change, places new requirements on the methods and competencies needed to develop future information systems. In this section, we give an overview of different types of information technologies and methods for the development of information systems, especially with regard to multimedia aspects. The development of multimedia information systems is discussed in particular with regard to the dual process of software and content development. Possible future directions are indicated in which the development of information systems seems to become even more of an interdisciplinary effort. These areas of research cover the following topics related to the development of information systems: project management, conceptual modeling, content maintenance, requirements processing, and development approaches.

It is shown that one of the significant differences between these methods is the multidirectionality of the goals and objectives of accounting for production processes and accounting for business processes. The main task of separate accounting of income and expenses is to meet the information needs of state bodies in order to regulate tariffs for communication services, and management accounting for business processes solves a wide range of management tasks.

Given the rapid development and growing dependence on technology, the question of how they change work and employment is very relevant for researchers. The current society has become involved in a general historical process called informatization. Unlike the industrial society, in which the main activity was the production of material goods, in the current, post-industrial society, the main activity is the production of information (by information we mean knowledge as information about persons, objects, facts, events, phenomena and processes, regardless of the form their representation, which can be recorded on a material medium), and this process is called informatization (hence the term – information society). Such a shift in emphasis is caused, firstly, by the fact that humanity is aware of the limited natural resources of its habitat, and secondly, the emergence of global problems (for example, energy, environmental), the solution of which is impossible by the same means [7]. Information becomes the main resource for the development of the world community and significantly affects the development of other industries and spheres of life: science, technology, social spheres (cultural communication between people, education).

An option to overcome the corresponding difficulties may be that the main number of data processing centers is concentrated in the corporate segment, but from 2030 the situation will begin to change dramatically in favor of commercial data centers. Now, this market is actually at the bottom starting point and will begin to change its structure. Today, only 20 % of the physical infrastructure is outside the perimeter. Moreover, in the Republic of Kazakhstan, there is low competition in almost all industries. Therefore, paradoxically as it may sound, digitalization and the introduction of new processes are not always considered as a factor of competitive advantage.

However, in order to move from basic to more detailed and in-depth studies of IS phenomena not only in developing countries, but also in the world as a whole in the era of globalization, a certain understanding of research in developing countries by a wider community of information system researchers is necessary [8]. As IS transcends organizational and national boundaries and supports global economic and political activities, knowledge of the conditions and processes of socio-technological change in developing countries becomes of general importance for IS research and practice.

The study [8] uses examples from the Information systems in Developing Countries (ISDC) literature on IS implementation and organizational change to clarify these trends. The work discusses the main issues raised in the research of some common topics of IS research, namely: IS failures, outsourcing and the strategic value of IS innovations.

But challenges remain to create an optimized space that connects people, computers, networks and objects, thereby overcoming the limitations of both the physical world and the electronic space. The administrative model is cooperation and entrepreneurship. Given that ubiquitous computing is paving the way for a new phase, we will now expand this phase and focus on understanding how it can change the way organizations work.

This may be due to the fact that in recent years, telecommunications services are in increasing demand from companies operating in various sectors of the economy. In turn, in the wake of forecasts about the expansion of such trends as the Internet of things and big data, players in the global telecommunications market are paying special attention to work in the corporate segment.

Despite a fairly significant amount of work on this topic, to date, the world has not created sufficiently effective information systems for optimal management of business processes in the field of telecommunications.

3. The aim and objectives of the study

The aim of the study is to develop and implement an information system for supporting management decision-making based on Project Management Institute (PMI) standards in the company's activities to improve the quality of development of design estimates (DED). This will improve the efficiency of data processing through the sharing of existing information resources with new enterprise information systems.

To achieve this aim, the following objectives were set and accomplished:

- to analyze existing solutions for automation and digitalization of the subject area;
- to conduct an analysis of the business processes of the enterprise in the “Service Factory “Mobile Telecom-Service” branch, Kazakhtelecom JSC;
- to conduct an analysis of methodologies and tools for modeling business processes of Kazakhtelecom JSC;
- to conduct a standardization analysis. National standards of Republic of Kazakhstan on IT project management;
- to explore the experimental installation in industrial conditions of the “Service factory “Mobile Telecom – Service” branch, Kazakhtelecom JSC.

4. Materials and research methods

In this work, the task was to develop a software product designed for the integration and analysis of specialized meteorological information.

To solve the problem, data integration by the method of consolidation was chosen. The PHP server programming language was used to extract, transform and load data. The fast retrieval of the required data was achieved using a multi-threading technique supported by the functions of the libcurl library.

A relational database was developed to store data using the Oracle MySQL Workbench environment. It consists of 9 relations, in which all the specialized meteorological information of interest to us is located. Data manipulation is carried out using the SQL query language.

For the operational analysis of specialized meteorological information, using the Jedox Palo BI Suite product, a multi-dimensional data warehouse was developed, presented in the form of a data cube containing information about the parameters of the convective cloud obtained using a series of numerical experiments. Data manipulations are carried out using the Multidimensional Expressions (MDX) query language.

The user can use the information from the databases with the help of the web application developed by us. It is implemented in the PhpStorm environment using the following tools: PHP, JavaScript, CSS, HTML. The application has an intuitive interface and consists of six sections, the main of which are: "Data Extraction", "Database", "Multivariate Analysis" and "Verification" [7].

So, the main problem was solved as follows. A prototype of a software product was developed in the form of a web application that allows you to integrate data using consolidation technology, place them in a relational database, conduct a series of numerical experiments and classify hazardous convective phenomena by type, such as thunderstorms, hail, squalls and heavy precipitation.

Using the developed prototype from heterogeneous sources, data were integrated that served as input initial and boundary conditions for a non-stationary 1.5-dimensional model of a convective cloud. As a result of verification, it behaved correctly, which gives reason to believe that the

model is adequate, and this, in turn, means that the results of experiments with the model make it possible to obtain statistically valid data on the effectiveness of using the cloud model to predict dangerous convective phenomena.

An information system was developed to optimize business and IT processes through automation using project management tools and designed to integrate existing sub-systems.

5. Results of the study of data storage systems for business and government agencies

5.1. Analysis of existing solutions for automation and digitalization of the subject area

Today, global trends suggest that the major number of data centers is concentrated in the corporate segment, but from 2030 the situation will begin to change dramatically in favor of commercial data centers. Now, this market is actually at the lowest starting point and will begin to change its structure. Today, only 20 % of the physical infrastructure has been moved outside the perimeter. Moreover, Kazakhstan has low competition in almost all industries. Therefore, paradoxically, digitalization and the introduction of new processes are not always considered as a factor of competitive advantage.

As for the readiness of the Kazakh market to implement advanced solutions that are present in the global trend, I can say that business actively accepts innovations. Research has shown that the project of cash registers (CR), for example, Kazakhtelecom Joint-Stock Company (JSC) was the first to implement in the post-Soviet space, and today 83 thousand CR customers connect their cash registers to a common center, and these data are stored in data centers, as shown in Fig. 1.

Recently, there has been a growing demand from businesses and government agencies for video surveillance services for legal entities, as well as for data storage systems. These innovations make it possible to connect customer cameras to a secure communication channel and cloud data storage [8]. This solution is relevant for local authorities and for small and medium-sized businesses (MSBs) – owners of shops, offices, industrial premises.

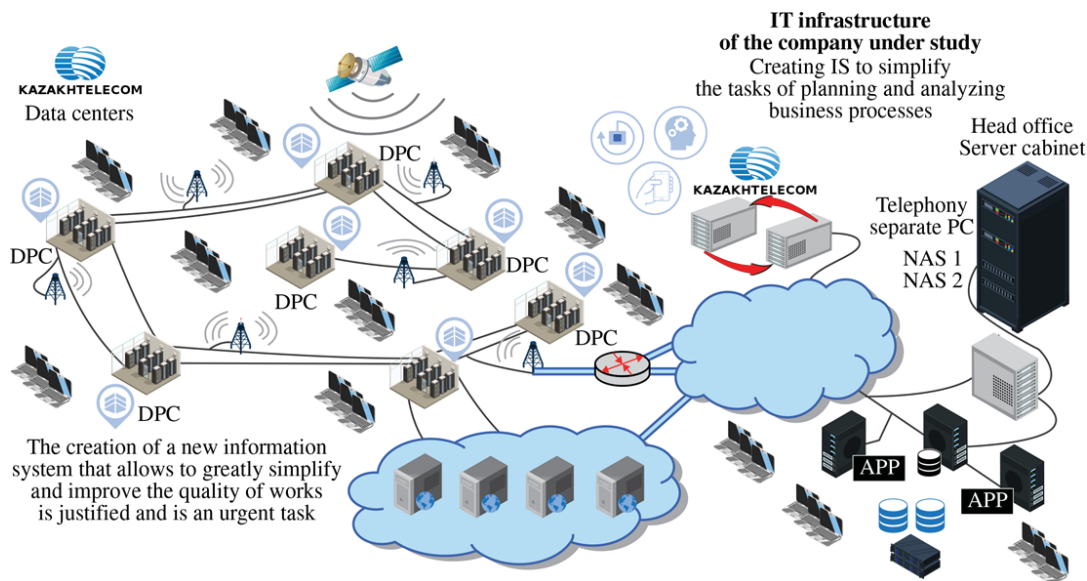


Fig. 1. Technical representation of the information system (regional part)

At the same time, constantly growing information flows, as well as the implementation of initiatives within the framework of the “Digital Kazakhstan” program, impose new requirements on data transmission, processing and storage systems. In the near future, industrial enterprises and the housing and communal services sector will have to come to the digitalization of processes, which in turn means the appearance of huge amounts of information that needs to be collected and processed. The same applies to video surveillance systems. Ideally, law enforcement agencies should store data obtained from cameras for at least 30 days, but today private companies often cannot provide data storage for more than a day.

5. 2. Analysis of the enterprise business processes in the branch of Kazakhtelecom Joint-Stock Company

The orientation of the telecommunications sector towards business processes is due to the indicated trends in the development of the industry and the peculiarities of their activities, namely, increased knowledge intensity, continuity of the service provision process and a short life cycle of communication services with a relatively low level of their material consumption, as well as the need to manage individual services and resources. Business processes are a structural component of process-oriented management (Business Process Management, BPM), which, in contrast to the functional approach to management based on the organizational structure of the company, allows you to take into account such important aspects of business as focusing on the final product and the interest of each specific contractor in improving its quality, more flexible response to external and internal changes, optimization of information exchange between functional units.

The process approach in accordance with the ISO 9001:2001 standard “Requirements for quality management systems” is a systematic identification and management of various processes of the organization and their interrelations. The basis of the process approach is the allocation of business processes, management of these processes, their improvement and development on the basis of a quality management system. A similar definition is given in the ISO 9001:2001 standard [9], where a business process is understood as a stable, purposeful set of interrelated activities that, according to a certain technology, transforms inputs into outputs of value to the consumer. However, in modern scientific literature, the concepts of “business process”, “type of activity”, “function”, “operation” are sometimes used as synonyms, which, in our opinion, is not correct from the standpoint of the economic essence of these concepts. The business process as a set of activities is fixed in the Regulations of Management Accounting (SMA) of the Institute of Management Accountants of the USA.

5. 3. Analysis of methodologies and tools for modeling business processes of Kazakhtelecom Joint-Stock Company (JSC)

This paper mainly presents the results of research on theoretical and methodological problems of accounting for income and expenses in the production processes of telecommunications companies, but does not disclose the specifics of accounting for business processes. Therefore, to substantiate the methodology of accounting for business processes in relation to the activities of telecommunications companies, a comparative analysis of approaches to accounting for pro-

duction processes and accounting for business processes has been carried out.

One of the main differences between the compared accounting methods is that they are based on different approaches to management: operation-oriented and process-oriented approaches. In the first case, the accounting focuses on individual operations carried out within the framework of the company’s activities, and in the second case, the flows of activities passing through all structural divisions of a telecommunications company, which together represent the business processes of this company.

As the study showed, one of the significant differences between these methods is the divergence of goals and objectives of accounting for production processes and accounting for business processes. The main task of separate accounting of income and expenses is to meet the information needs of government agencies in order to regulate tariffs for communication services, and management accounting for business processes solves a wide range of management tasks.

The improvement of the activities of telecommunications companies is largely due to the optimization of business processes in accordance with international standards. Issues of development and optimization of telecom operators’ business, as well as standardization of communication network management, are under the jurisdiction of the International Non-profit Organization TeleManagement Forum (TM Forum), whose developed documents have been adopted as industry standards [9] by the International Telecommunication Union.

The purpose of experimental research is to develop and implement an information system to support management decision-making in the field of information technology in the field of telecommunications in the company’s activities. The experimental research program provides for the collection of the necessary statistical information to solve the optimization problem, substantiate the optimal parameters of the technical means.

The most modern and effective way to describe the company’s activities is graphical diagrams of business processes (Fig. 2, *a, b*). Our program supports two of the simplest and most visual notations for process modeling: Fox Manager FlowChart and Cross Functional FlowChart.

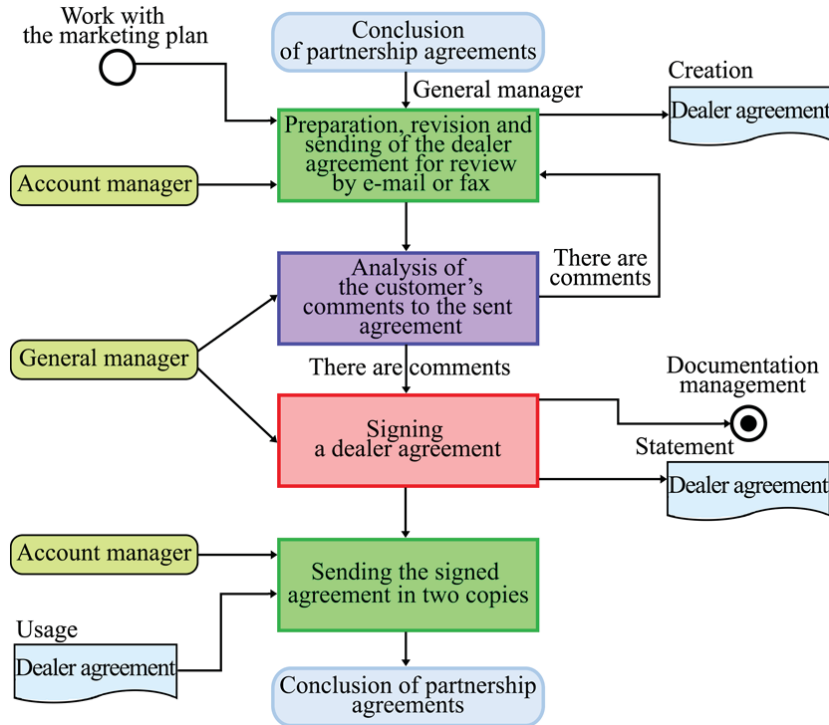
For business analysts and professionals who prefer to use Business Process Model and Notation (BPMN) as a core (Fig. 3).

With the help of graphical diagrams (Fig. 4, *a–c*), you can visually display the sequence of work performed, responsibility for them, as well as make links to the necessary documents, software and resources used during the process.

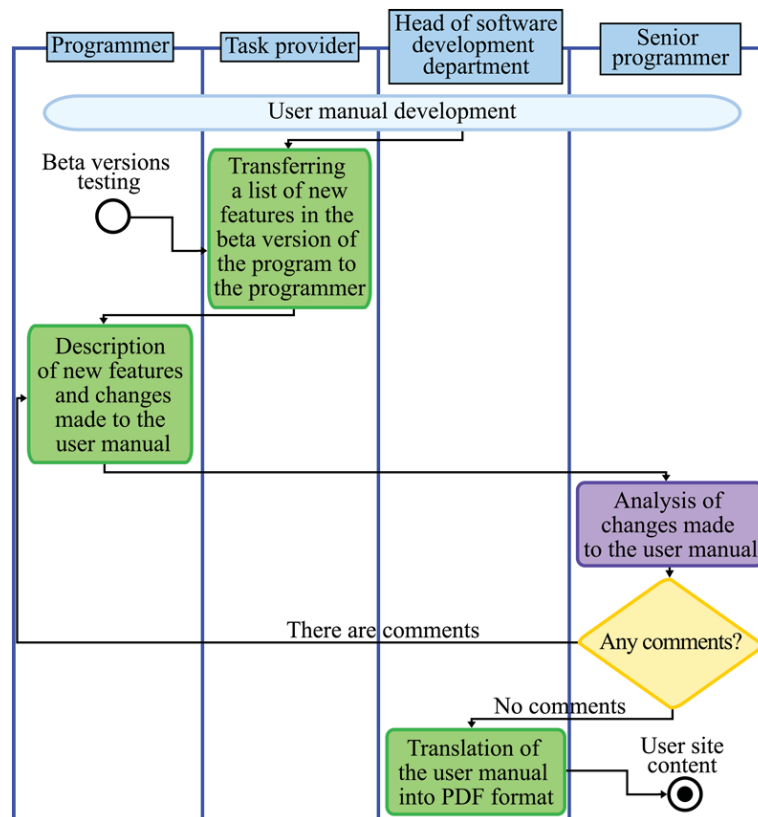
The information contained in the graphical diagrams will then be used to calculate the cost and time of the process, as well as the formation of such regulatory documents as job descriptions, regulations on the division, process regulations, work instructions, etc. At the same time, all business process diagrams are interconnected and form a single integral model of the enterprise. All routine user actions are automated as much as possible, when deleting or changing any element in the database, information about it is updated throughout the business model. Fox Manager BPA is the only program on the market that can generate top-level process diagrams automatically, without requiring multi-level modeling skills and knowledge of complex model decomposition rules. You can decide for yourself how much detail and how deeply you want to describe your model. The

program allows you to set a planned and boundary execution time for each process function, the frequency with which the function is performed, and a brief and detailed description of

it. You can also specify the requirements for the competencies, professions and personal qualities of the performers who are responsible for performing this function in the process.



a



b

Fig. 2. Graphical diagrams of business processes: a – Fox Manager FlowChart; b – Cross Functional FlowChart

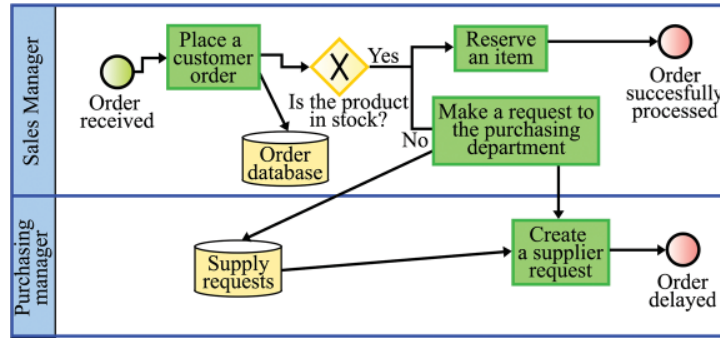


Fig. 3. Business process model and notation

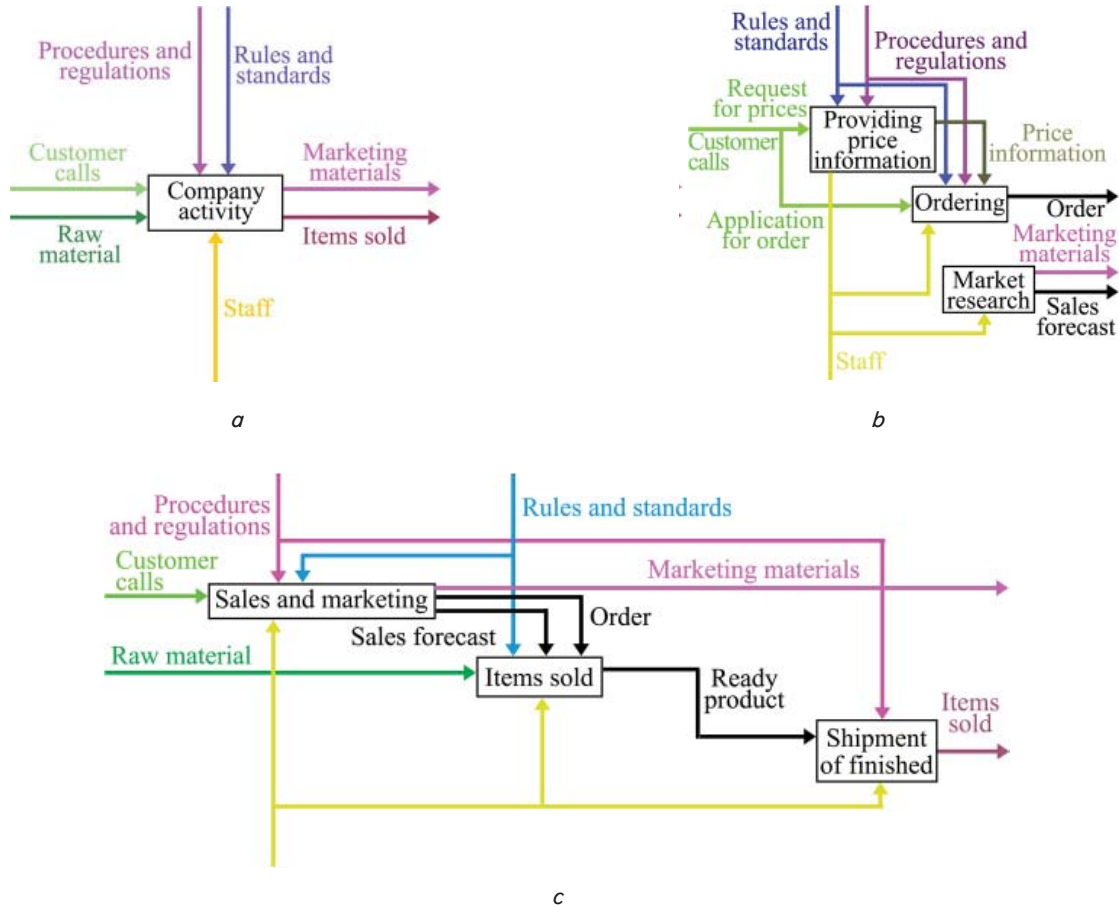


Fig. 4. Decomposition diagrams: a – company activity; b – ordering; c – product manufacturing

5. 4. National standards of Kazakhstan on IT project management

The results of IS modeling confirmed the efficiency of the developed model. The obtained model of extreme process control allows improving performance by maintaining the optimal efficiency value (Fig. 5).

The diagram can show both the desired and possible alternative measurement strategies (Fig. 5). Now, in order to be able to compare alternative options not only qualitatively, but also quantitatively, it remains only to develop metrics for each of the axes. And then the strategy can be evaluated, for example, by the area of the corresponding triangle.

The total set of possible processes can be represented in the form of a three-dimensional space, shown in Fig. 6, a, b.

The coordinate axes are postponed by those measurements that are mentioned in the framework standards, and

other, for example, control levels, calendar periods, can be proposed. Each point of this space represents an elementary control process. For example, “risk planning at the stage of system implementation”.

The selected elementary processes form project management procedures that can be built according to the “axial” principle (here we mean the abscissa, ordinate and application, indicated in Fig. 7, a, b).

Actually, the description of these procedures is the main volume of the standard. And to be more precise, by the enterprise standard we mean a set of documents explaining or prescribing how, in what sequence, in what time frame, using which templates it is necessary to perform certain actions in the project management process. The number of these documents depends on the level of detail of the standard and can be quite large (from dozens to hundreds of documents) [9].

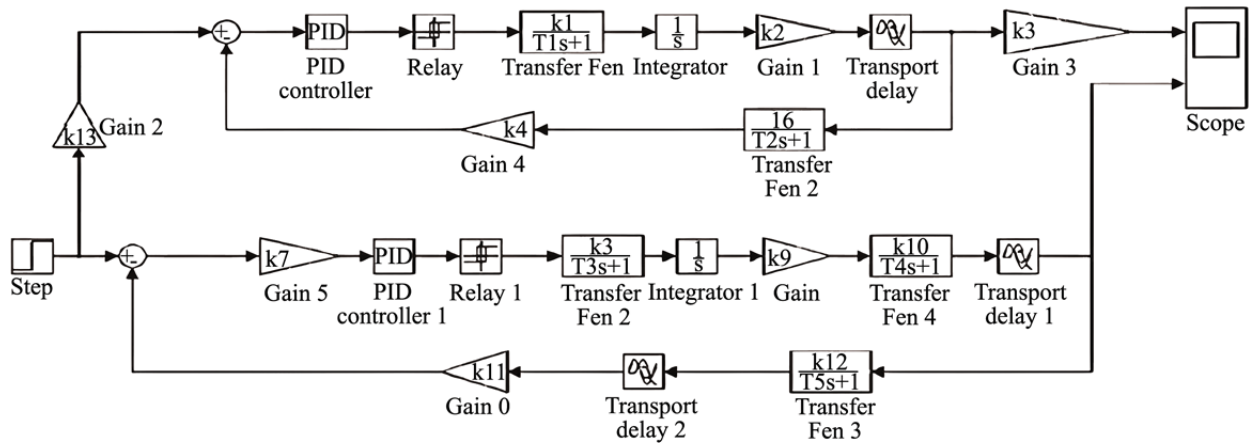
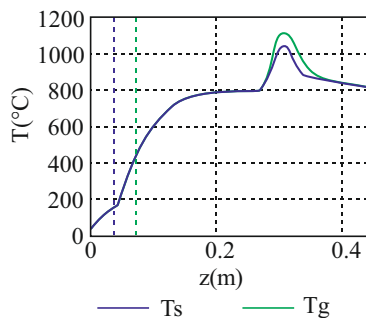
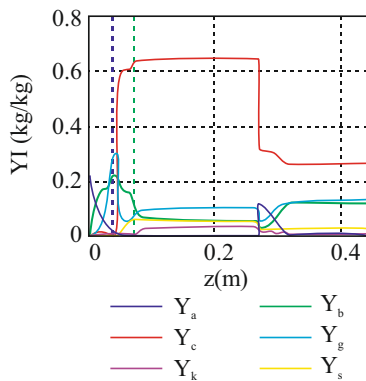


Fig. 5. Scheme of information flows and description of the mechanism for effective data management



a



b

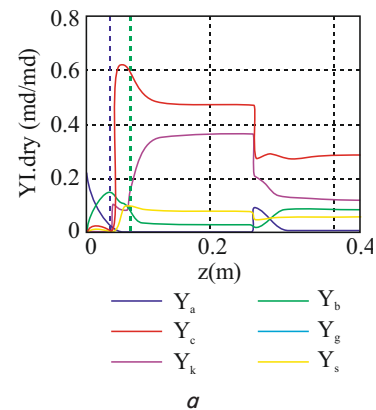
Fig. 6. Calculated curves characterizing the steady state of the process: a – profiles; b – composition (% vol.)

For each project, initially (let us say approximately), the degree of influence of certain changes on the amount of probable losses arising from the implementation of these changes can be determined. In Fig. 2, this information is presented as a diagram in which changes are associated with loss areas. Of course, the types of possible changes and their location by area are the properties of specific projects, or rather, types of projects. Therefore, such diagrams can be included in the enterprise standard as a characteristic of the types of projects defined in the project classification.

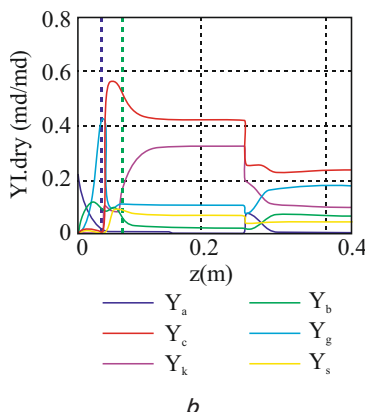
Restrictions on changes in resources, time, and products can be severe to varying degrees, and depending on this,

fairly typical situations arise in projects that can also be described in advance. Let us consider some such situations.

Often, the strategy of changes is determined by the fact that, at least along one of the axes, changes should not lead to an exit from the area of planned losses. And this means the need for displacement in one or two other dimensions at once. So, if it is known that the client is focused primarily on compliance with the planned level of product quality, then options for changes related to the manipulation of resources and/or deadlines should be provided (the “Stubborn Client” strategy).



a



b

Fig. 7. Calculated curves characterizing the steady state of the process: a – degree of conversion; b – heat sources (in % of the calorific value of biogas) (on the abscissa – the distance from the tuyeres)

In other cases, other strategies may be required, for example, “Tight deadlines” or “Limited budget”, when changes in terms of deadlines and resources should be recorded, respectively, in the area of planned losses.

It should also be noted that working with changes at the strategic level must necessarily be supported by formal procedures describing the main processes of change management – registration and execution of applications for changes, consideration and approval of applications, implementation of changes. In addition, change management processes should be monitored, which ensures control over their implementation.

The total set of possible processes is represented in the form of a three-dimensional space shown in Fig. 6. The measurements mentioned in the framework standards are postponed along the coordinate axes, and others, for example, management levels, calendar periods, can be proposed. Each point of this space represents an elementary control process. For example, “risk planning at the stage of system implementation”.

The enterprise project management standard is, first of all, a set of documents explaining or prescribing how, in what sequence, in what time frame, using which templates it is necessary to perform certain actions in the project management process. These documents do not belong to any one project and form the normative and methodological support of the project management system as a whole, and their number can be quite large.

Because of this, one of the promising approaches is the organization of the standard as a knowledge base, which provides all the necessary services for updating and searching documents, for organizing relationships between documents, cross-references. Although there are examples of another approach, when a specialized information environment (Andersen Consulting) is created to maintain the standard.

Project management procedures usually demonstrate vivid examples of the need for teamwork, which involves not only the project team, but also permanent divisions of the enterprise (resource, functional, specialized). In this regard, the idea of using business process management technologies (workflow) to maintain the procedural part of the standard seems natural, although difficult in terms of implementation.

The methodology for designing an information system has been improved using a model for processing heterogeneous spatial information, taking into account the requirements for a decision support system. We have proposed requirements for the created data management system [9, 10].

It should be noted that the technological maturity of the organization, standardization and formalization of the processes of development and implementation of new technological solutions related to the ICT sphere requires special attention.

These issues are relevant for the Republic of Kazakhstan as a whole. The introduction of any kind of information and communication technologies should be linked to the state of the company’s technological maturity and management processes. Very often, enterprises spend quite a lot of resources on the introduction of information and communication

technologies, which later, firstly, do not fully perform their intended functions or sometimes simply turn out to be not in demand on the market.

Therefore, today there is an urgent need to create structures that will advise on project management, assess the level of technological maturity and assist in the implementation of information and communication technologies in accordance with the achieved level of managerial maturity of the company.

5. 5. Industrial plant in the branch of Kazakhtelecom Joint-Stock Company

The operability of the developed simulation model of extreme regulation with a change in the task signal, that is, maintaining the boiler efficiency at the same level with a given accuracy, has been proved. The modern technology of urban wastewater treatment is associated with the consumption of significant amounts of electrical and thermal energy. In the conditions of an acute energy crisis, the problem of reducing these energy costs through the use of non-traditional energy sources available at the treatment facilities themselves and constantly renewable is acutely relevant.

A methodology for modeling processes using modern design and engineering analysis packages (CAD/CAE technologies) has been developed and verified. The solution of this problem is one of the most important engineering tasks in the field of camera calculations. The purpose of modeling thermal processes is a visual representation of the principle of operation of the combustion chamber through its three-dimensional model (Fig. 8).

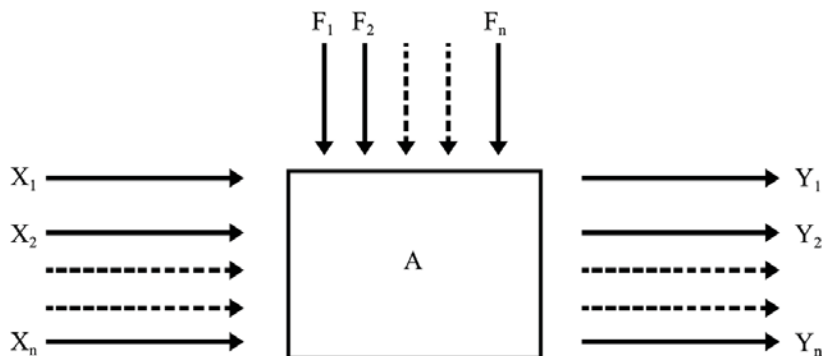


Fig. 8. Information system functioning model

The simulation of the flow of thermal processes inside is carried out using the ANSYS Fluent program. Efficiency depends on the totality of complex processes. The research provided by simulation in the early stages of design helps to optimize each of these processes. The complexity of the modeling process is associated with the construction of a computational grid model, which must move in full accordance with the movement that takes place inside the combustion chamber. This technique can be used to obtain the distribution fields of the main thermodynamic parameters in a cylindrical group using the ANSYS Fluent program, and also allows you to gain skills in working with moving computational grids.

In the work, the installation was considered as a control object. A mathematical model and method are proposed that allow determining the composition in the process and ensuring the optimal process parameters [10]. Mathematical models of the process have been developed.

6. Discussion of experimental results of the model for processing and managing heterogeneous spatial information

In this study, a part of the information system (Fig. 8) that corresponds to the consolidation technology and meets all its requirements and principles was designed and implemented. It consists of 9 relations, the names of which are entities, i.e. objects of the real world. The format of the information stored in the database does not require further decoding, which allows it to be used directly for verification and modeling of the characteristics of a convective cloud using a one-and-a-half-dimensional numerical model without additional manipulations (Fig. 1).

As a result of the analysis, it was decided to use the Jedox Palo BI Suite software, since it is provided free of charge and allows processing complex data models for statistics and decision-making, as well as the way to implement a multidimensional data warehouse in it is MOLAP, which is quite an important reason for choosing it (Fig. 8).

A multidimensional data warehouse was designed and implemented, presented in the form of a three-dimensional cube, the axes of which are the following dimensions. The data contained in it is in an aggregated state, which allows for their operational analysis, quick search and selection according to specified conditions and the execution of complex unregulated queries, as well as the use of the MDX language simplifies interaction with data stored in a multidimensional storage.

A software environment was developed that meets the goals necessary for verification, modeling of characteristics using a one-and-a-half dimensional numerical model and type classification. The software environment was tested using the software-oriented testing system “PHPUnit” and the errors and shortcomings found were corrected.

On the example of a one-and-a-half dimensional model, a number of test numerical experiments were carried out aimed at verifying this model. As a result, it behaved correctly, which means the adequacy of the model.

Using the developed complex information system, a range of characteristic parameters was identified, as well as their average values [11]. Based on the results obtained, recommendations were given on the prediction using a numerical model (Fig. 3).

A wide analysis of the mechanisms, models and systems for processing distributed spatial information using information technologies has been carried out, and it has been determined that none of the presented tools can fully satisfy the requirements for processing heterogeneous data when creating information systems.

A model (Fig. 6) for processing and managing heterogeneous spatial information based on data access technologies is constructed, a diagram of information flows is presented, and a mechanism for effective data management is described (Fig. 5).

The algorithm of the data processing module is presented, which allows access to any sources of information necessary for making a management decision.

These research results provide the following opportunities:

- leading organizations are steadily adopting project management as a way to control costs and improve project outcomes;
- strategies to reduce risks and costs against the backdrop of an increase in the number of successful projects – success factors during the economic crisis;

- dissemination and use of information in order to make effective decisions;

- to carry out a reasonable choice of specific methods, tools and software products for solving various analytical, design problems.

One of the shortcomings of this study is the solution of the problem of assessing the quality of data in terms of their suitability for processing using various analytical algorithms and methods. If during the quality assessment process, factors are identified that do not allow one or another method to be correctly applied to the data, it is necessary to perform appropriate data cleaning.

In order to eliminate this shortcoming, in the future we want to provide customers with the opportunity to interact with the company on all services in the Full Digital self-service format. In the near future, the division will ensure the transformation of the company's infrastructure in order to meet the needs of customers in accordance with market demands. Currently, the IT division faces an ambitious, but extremely time-critical task: modernization of the entire infrastructure of the company with an emphasis on the development of digital and online services.

Without a built business model, we cannot make informed decisions and lose control over our business. In order to solve problems systematically, and not intuitively, it is necessary to design the business architecture, prescribe the rules and standards of work, distribute responsibility for functions among personnel and monitor their implementation.

When solving this problem, we may encounter the following difficulties:

- an information system acquired as a ready-made solution without taking into account technological maturity is difficult to adapt to the needs of top management in providing management;
- data in the sources are usually too detailed;
- the initial data, as a rule, are “dirty”, that is, they contain various factors that interfere with their correct analysis.

7. Conclusions

1. In IT, we talk about solutions in terms of their usefulness and convenience for the user. Accordingly, such solutions carry the embodiment of any goals and objectives into reality. It is not so important to talk about the fundamental difference between a tool and a solution, because in any case, their focus on managing the intellectual potential of employees is obvious. Creating an IP using a project management tool is not just a solution, we expect that it will help optimize business processes. Kazakhtelecom JSC has moved to a new concept of customer orientation, aimed at anticipating the wishes of the client. This approach will optimize the processes of introducing new services for business [12].

To date, the average workload of the operator's data centers is 80 %, but due to the interest in cloud storage among both large and small businesses, there is a tendency for consumers to grow.

The market of data processing centers in the Republic of Kazakhstan is approximately 6 billion tenge (\$18.1 million). The dynamics are quite good – double-digit rates (in 2016, the market volume grew by 21 %, and in 2017 – by 16 %). Changes in its structure are also noticeable. Back in 2016, the share of “colocation” and “dedicated server” business models accounted for 48%, and cloud – 29 %, then in 2017,

respectively, 43 % and 33 %. Utilization of capacities in data processing centers in the Republic of Kazakhstan is 67 % (in total, about 1000 racks are installed in commercial data centers of the country).

The current situation at enterprises in the Republic of Kazakhstan is as follows: about 67 % of respondents in the study use cloudless infrastructure on their own site, 13 % have deployed clouds on their own site, 11 % use cloudless structure in commercial data centers, and finally, only 4 % use private clouds in commercial data centers. The data show that the situation is evolving: if in 2015 companies in 28 % of cases did not have an attitude to the clouds, in 2016 there were significantly fewer of them – 15 %. Good dynamics is also noticeable in the samples “rather attractive” (+3 %) and “very attractive” (+4 %).

As stimulating factors of demand for commercial data center services, experts call digitalization and the growth of the volume of generated data; awareness of the advantages that cloud technologies bring; improvement of service sales systems by commercial data centers, for example, the creation of self-service portals; growing confidence in commercial data centers.

2. A decision support information system using heterogeneous spatial data is presented to optimize the company management process. The methodology proposed for IS verification is used for the first time in the systems under study.

Modeling and analysis of enterprise business processes are effective tools for optimizing activities, increasing profits and successful development [13]. But all these goals will be achieved under the condition of a competent description and consistent implementation.

As a result of the analysis, the problematic field of research is determined – outdated technical tools, models and methods for organizing the integration of programs and software systems, as well as tools for their presentation (the sequence of applying a number of metalanguages: natural language, metalanguage of set theory and set categories). Thus, the application of the theory of sets and categories is considered as one of the ways to formalize these approaches.

3. Existing methods of modeling business processes allow you to focus on certain aspects, determine the properties and relationships of components and present them both graphically and textually. A methodology for modeling processes using modern design and engineering analysis packages (CAD/CAE technologies) was developed and verified. The solution of this problem is one of the most important engineering tasks in the field of camera calculations. The purpose of modeling thermal processes is a visual representation of the principle of operation of the combustion chamber through its three-dimensional model. The simulation of the flow of thermal processes inside is carried out using the ANSYS Fluent program.

In the work, the installation was considered as a control object. A mathematical model and method are proposed that allow determining the composition in the process and ensuring the optimal process parameters. Mathematical models of the process have been developed.

The technique is applied in a new capacity, its result can become a new type of information product that takes into account the uncertainty of the implementation of the forecast text and allows you to optimize resource management.

Modeling and analysis of enterprise business processes are effective tools for optimizing activities, increasing profits and successful development [13]. But all these goals will be achieved under the condition of a competent description and consistent implementation.

Thus, the application of the theory of sets and categories is considered as one of the ways to formalize these approaches.

4. It should be noted that the technological maturity of the organization, standardization and formalization of the processes of development and implementation of new technological solutions related to the information and communication technologies (ICT) sphere requires special attention.

These issues are relevant for Kazakhstan as a whole. The introduction of any kind of information and communication technologies (ICT) should be linked to the state of technological maturity of the company and management processes. Very often, enterprises spend quite large resources on the introduction of information and communication technologies (ICT), which later, firstly, do not fully perform the intended functions or sometimes simply turn out to be not in demand on the market.

Therefore, today there is an urgent need to create structures that will advise on project management, assess the level of technological maturity and assist in the implementation of information and communication technologies (ICT) in accordance with the achieved level of managerial maturity of the company [14, 15].

Thus, the main conclusion is that today the requirements for the level and classes of implemented information systems, first of all, should be determined by the level of technological maturity of the company, as well as by how regularized the main, supporting processes and management processes are. It is necessary to instill a culture of project, portfolio and program management at all levels of company management in order to obtain the most effective solutions in the field of development and implementation of modern information and communication technologies (ICT).

5. The results of IS modeling confirmed the efficiency of the developed model. The obtained model of extreme process control allows improving performance by maintaining the optimal value of the coefficient of performance (COP). The working capacity of the developed simulation model of extreme regulation has been proved.

Conflict of interest

The authors declare that they have no conflict of interest in relation to this research, whether financial, personal, authorship or otherwise, that could affect the research and its results presented in this paper.

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