Regarding information system for technological docflow: global challenge within the framework of the sixth technological basis

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Abstract—**The information system for technological docflow for enterprises has been considered. The analysis of the route of documents participating in bussiness, organizational and other activities was carried out and on the basis of analysis a classification of these documents was developed and a list of their main types was developed. The article is devoted to the issues of effective change management at enterprise. Within the framework of the sixth technological basis, general high-speed information networks will bear the dominant value. The development of information systems depends on benchmarking and adjustment of the required key technical and socio-economic indicators of the desired model of production and economic activity and the current state of affairs. The project is also aimed at implementation of a new Master's program "Conceptual design and engineering to improve energy efficiency".**

Keywords—***sixth technological basis, docflow, document, information system, structure, change management, indicators***

I. INTRODUCTION

Effective management is a necessary condition for the successful operation of an enterprise in an innovation economy. Nowadays, effective management is impossible without the creation of automated management systems that allow to optimally organize internal business processes in the enterprise.

Effective management means to make prompt and correct decisions. Recently, an increasing number of enterprises understand the need for complex automation, which is an indispensable condition for achieving process controllability, increasing labor productivity and the level of profitability in general.

For instance, there are three basic approaches to solving the tasks of enterprise automation:

- Ggradually closing the "narrow" parts of the production process, buying ready-made software products for solving individual problems.
- Developing an information system with the help of own specialists.
- Calling in consultants and ordering the development of an integrated information system from a system integrator that has the technology and experience of creating such systems.

Nowadays there is global challenge associated with transition to doing business in the next technological basis [1]. Before the enterprises in general and before its departments, there are a number of serious problems related to centralization, qualitative and timely consideration of various applications, requirements, documents [2]. In addition, the task arises of operative processing and management of data on the state of technological equipment, aggregates, their completeness, and so on [3].

Currently, there are many systems that solve the tasks of organizing the document flow of the enterprise. However, the approaches to the solution and the concept of building such systems have some differences. Among the determining factors are the scale of the enterprise, the existing document management structure, and enterprise requirements for the system.

The docflow information system should perform either implementation of production activities, tracking and periodic reporting for supervisory organizations as personnel management and training.

The research areas are:

- Examination of the existing system of document circulation and document forms;

- Forming the structure of the docflow;

- Development of requirements and descriptions for the main business processes (business logic layer);

- Accounting and planning the allocation of resources (materials, equipment, working hours, transportation costs, etc.), taking into account the norms for the consumption of materials and working time, tracking and periodic reporting, personnel management, i.e. account of admittances, duties, tracking of periodic briefings and inspections;

- Development the study case.

The key problem is understanding what changes will be done to implement enterprise's system.

II. THEORETICAL PART

Document Management Systems are rather complicated mechanisms and they can be analyzed according to the size of a company and its specific activity. There is no sense to take into account a separated software as a whole Document Management Systems. For example, Document Management Systems of a small trade company, a Legislative assembly or a project company are used for different companies' functions and based on different software. It means that Document Management Systems of these organizations have got only some common features.

When the company needs to improve its performance, it analyzes projects which require changes. Changes to processes and uses of new technology are most often needed.

Change management is the discipline that guides how we prepare, equip and support individuals to successfully adopt changes in order to drive organizational success and outcomes.

Currently, to improve the efficiency of the enterprise and its competitiveness, it is necessary to continuously improve and optimize business processes. In many companies there are activities involving optimization, efficiency and quality of its business processes.

Change management as an area of scientific knowledge is at the beginning of its formation and is just starting to evolve [4]. All changes are unique. Therefore one can distinguish three levels of change management such as [5]:

- Individual Change Management;
- Organizational/Initiative Change Management;
- Enterprise Change Management Capability.

Individual change management requires understanding how people experience change and what they need to change successfully. Individual change management draws on disciplines like psychology and neuroscience to apply actionable frameworks to individual change.

While change happens at the individual level, it is often impossible for a project team to manage change on a person-by-person basis. Organizational change management involves first identifying the groups and people who will need to change as the result of the project, and in what ways they will need to change.

Enterprise change management is an organizational core competency that provides competitive differentiation and the ability to effectively adapt to the ever-changing world. An enterprise change management capability means effective change management is embedded into your organization's roles, structures, processes, projects and leadership competencies.

In terms of dynamism, the preservation of competitive advantages is vital for the organizations and the task is to make production move efficient. Since there is a direct relationship between the effective functioning of the organization and quality, there is a need to investigate the changes of the enterprise and its economic effect.

According to the client requirements the information system must provide of the departments and has got the following characteristics [6]: complex and constant support of the available technology; an opportunity for flexible changes of the technology; good scalability; simple maintenance.

The creation of any rather significant software demands the analysis of its objects to find out their main sides and the links between them [7]. Moreover, it's necessary to know about existing prototypes when creating a new system. Exactly the analysis of such systems which are successfully used helps us greatly shorten the interval between the own system analysis and its design.

Workflow, according to [7, 8], is the process of documents' transfer within the area of the document support of a department. In other words, workflow is the complex of operations which provides a document transfer from the stage of its creation or incoming to the stage of its execution or sending [9, 10].

A document is a semi-structured complex of blocks and objects of information which is clear for a person [11]. Life cycle of any document consists of three steps such as creation of a document, its confirmation (signature, agreement and etc.) and execution (closing).

A route is a path of a document from the step of its creation or incoming to the step of its execution or sending. Every step of this path is a phase of a document confirmation with some of officials according to the rules of the company. For example, official must have some particular rights to sign documents.

Obviously, all the Document Management Systems are based on the abstractions above. Moreover, it is also necessary to analyze the ways of these abstractions realization to design the own system [12].

There are some parallels between the Russian definition of "Document Management System" and non-Russian definition of analysis in literature and press. They are based on specific features and usage of the described software[13-17]:

- DMS (Document Management Systems). It has got rather full definition for its terminology in Russian literature as "Documents Archives";
- Doc Flow systems or Document Routing systems;
- WorkFlow systems which have got rather exact definition as "Automated Business Systems".

DMS consists of several subsystems and each system has got specific functions. Some of the subsystems are in the process of close interactivity.

Identification of the abstractions of DMS includes the abstractions of the workflow area. However, the definition of the terminology "automated" involves computing means in the workflow process. Completed or partial transfer of paper documents into electronic documents causes a user interface creation which can help to cooperate with the existing system. It leads to the idea that there are abstractions which help to organize user interface to work with documents (abstractions of documents and their entry, document archives and automated workflow) and routes (the abstractions of a route, an official, rules and routing systems). They can be found among the objects of workflow area and the objects of the subsystems mentioned above.

The first group of abstractions includes an interface of a document entry, its search and editing.

The other group provides administration of users, editing and creating of document routes. It is worth to understand that all of the objects can work together or separately according to the process of workflow realization [18]. However, in any case the system must follow all the rules which are included in the abstractions. Moreover, it's possible if the new abstractions appear within the particular system.

III. METHODOLOGICAL FRAMEWORK

Analysis Of Document Management Systems

The idea is that the definition of "Document Management Systems" can be identified completely within the context of an executed task. A document can have different forms according to the executed tasks. Moreover, it's been found out that DMS can perform a lot of functions to provide the workflow process. Also two abstractions have been added to the list of workflow system abstractions. They are responsible for organization of user interface within the area of a document, a route, an official and a rule abstraction.

On the one hand we have found out about the opportunities and functions of Document Management Systems. However, the information is not enough for the chosen company department because we need to take into account the specific of its workflow structure [4].

It means that we need to analyze the structure of the department workflow. To do this we need to identify the list of documents, structure them and identify their routes.

Identification And Analysis Of The Whole List Of The Documents Of The Department Units

The Identification of the list of the documents and its analysis help us divide the list into two independent subsets: "Documents which provide fast department work" and "Documents which provide the department organization activity".

Within the number of the subsets some lists of types of documents were identified. Each of the documents is a document of one type only when all the types of documents organize a hierarchy. At the top of the hierarchy is the abstraction "document". The second level is the main types of documents which include different protocols and acts. Next levels include documents which clarify the documents of the higher levels for each particular situation. Moreover, they inherit the attributes of the documents of the higher levels [11]. It refers to object – oriented design and programming terminology. According to the analysis above the result of this section is identification of the abstraction "Types of documents" [12].

Identification Of Department Structure

This stage of analysis is a process of cooperation of a designer of the system and a specialist of the particular sphere who presents the department. It's important to note that this stage is not independent and interacts with both the previous and the next stages. The data of the department structure is necessary to make the stage of the document routes analysis easier.

E.g., Chief power engineering department (CPED) structurally consists of the following units (Figure 1):

The main power engineer manages the maintenance and repair of power equipment of the enterprise, and resolves organizational issues.

Planning and economic department manages the preparation of production plans and purchase requisitions, maintenance of reporting on planned preventive service of the main power equipment.

Chief Engineer is responsible for questions of operation, carrying out planned preventive service.

Chief Heat Engineer carries out an organization of operation, supervision of heat and power systems.

Department for repair and operation of power equipment carries out the repair of power equipment.

Steam and heat supply department carries out the operation and repair of heat and technical equipment and heating networks of the enterprise.

Communication department is responsible for operation of telephone and network lines.

Electrical department is responsible for electric power supply of installation and facilities of the enterprise.

Electrical repair department is responsible for repair of engines, transformers, etc for the enterprise.
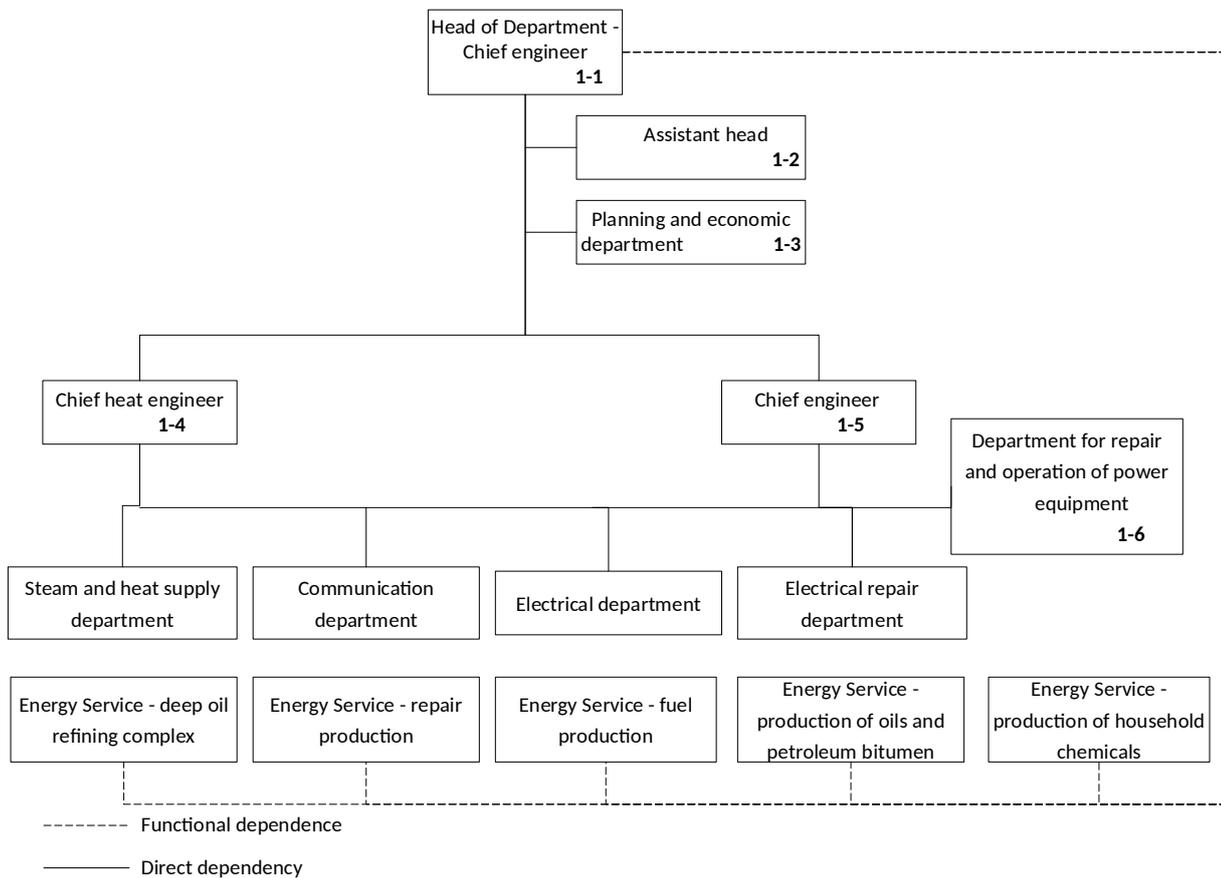
Fig. 1. Organizational structure of Chief power engineering department

IV. THE TECHNICAL AND ECONOMIC INDICATORS

The analysis of the list of CPED documents has been provided.

In the "Document Route" column the path of the document formation, its route is shown. Positions "1.1", …, "1.6" are as shown on Figure 1, "1" is the chief of the electrical department, "2" is his deputy, "3", …, "7" – sections of departments.

Analisys shown that there are 58 documents related to technological docflow in CPED. And 16 of them are deal with not only technical indicators (Table I).

TABLE I.   LIST OF CPED DOCUMENTS WITH COMPLEX ACTYIVITY INDICATORS

No.	Title of the document	Document route
1.	List of activities that increase the safety of work.	1-1 to all
2.	Assigning electrical installations to the personnel.	1-5 to 3,4,5,6,7
7.	Schedule of operational personnel.	1 to 4,6
13.	List of works performed in the order of current operation.	I to 4,6
14.	List of operating personnel who have the right to give orders for the execution of works.	1-5 to 6
21.	Business trip documents.	1-5 to 1,2 to 6
25.	Acts of acceptance in operation of	1,2 to 1-6 to 1-5 to

No.	Title of the document	Document route
	electrical installations. Project documentation. Technical documentation.	1,2 to 6
36.	List of measures to improve reliability, economy and safety of power supply of the enterprise.	1,2 to 1-5 to 1-6
37.	Provisions and instructions on the relationship of personnel at different levels of dispatching management.	1-1 to 1,2 to 6
43.	The procedure for acceptance of equipment after repair or testing in electrical installations without constant watch (local instructions).	1,2 to 1-5 to 1,2 to 6
47.	Responsibilities of structural units for maintenance of a complex of technical facilities, software.	7 ->1,2 ->1-6 ->1-5 ->1,2
49.	Schedule of repair and maintenance works on the technical means of automated control systems.	7 to 1,2 to 1-6 to 1-5 to 1,2
50.	Annual schedule of planning and economic department.	1-6 to 1,2 to 1-6 to 1-5 to 1,2 to 3..7
55.	Acts about major repairs of the main equipment.	3..7 to 1,2 to 1-6
56.	Repair journal.	3..7 to 2 to 3..7
58.	List of measures for the prevention of accidents.	1,2 to 1-5 to 1,2

To calculate economic efficiency, we make use of the following economic indicators [19]:

- Net present value (*NPV*)

$$NPV = \sum_{t=1}^{n}(CF_t / (1+i)^t) - \sum_{t=1}^{n}(I_t /(1 + i)^t), \quad (1)$$

where *CF* – cash flow, rub; *I* – investment, rub; *i* – the discount rate, %; *n* – duration of the project, year; *t* – the current year valuation period n, year;

- Internal rate of return (*IRR*)

$$NPV_{(IRR)} = \sum_{t=0}^{n}(CF_t / (1+IRR)^t) - \sum_{t=0}^{n}(I_t /(1 + IRR)^t) = 0; \quad (2)$$

- The payback period (*PB*)

$$PB = I / CF; \quad (3)$$

- Profitability index (*PI*)

$$PI = (\sum_{t=1}^{n}(CF_t / (1+i)^t)) / (\sum_{t=1}^{n}(I_t /(1 + i)^t)); \quad (4)$$

- Average annual net arrive;
- The average economic efficiency of investments;
- Productivity (*P*)

$$P = Q / t, \quad (5)$$

where *Q* – actual production.

V. RESULTS AND RECOMMENDATIONS

A characteristic feature of above indicators (1)–(5) is that they consider the effectiveness of the investment project at all stages of the life cycle.

When calculating the effectiveness of the project, attention should be given to the external environment of entrepreneurship. When calculating the economic efficiency it is important to understand the influence of the political, social and technological factor on indicator.

The high-tech products have a number of indicators that significantly affect the integral assessment of its quality: safety, standardization, reliability, relevance and innovation of research compared to competitors, entry into key world clusters, and others.

Table II presents indicators that affect the quality of projects implemented in cooperation according to Decree of the Government of the Russian Federation [20].

TABLE II. LIST OF COMPLEX ACTYIVITY INDICATORS

No.	Name of indicator	Measure
1.	The volume of new and improved high-tech products (services) produced using the results of the research, development and technological works (R & D) performed	Mio rub
2.	The volume of own funds allocated for the project	Mio rub
3.	The number of persons involved in the implementation of R & D in the framework of the project, in total, including: - Young scientists, - Students, - PhD students	persons
4.	The number of scientific publications in Russian and foreign journals on the subject of R & D	pcs
5.	Number of patent applications	pcs

VI. CONCLUSION

At present, for all the importance of system performance, its quality often depends on how simple and understandable its structure is [21].

In turn, it is impossible to build a satisfactory structure without knowledge of the subject area of the system being developed. The analysis phase is intended to develop the designers' most complete understanding of the task at hand, to familiarize themselves with the main entities of the problem area of the product being created [22].

Therefore, the first step was the stage of analysis. In the analysis section, it was shown the need to create a workflow system that takes into account both the technical and economic indicators. The analysis of the subject area in the course of which the functions of the document management systems were established, the list of the main documents and business processes was identified.

Within the framework of the sixth technological basis, general high-speed information networks will bear the dominant value.

Technological docflow will not be a thing "in itself", it will completely go into virtual reality, it will "overgrow" with useful feedback properties from the performer, blockchain elements and verification on digital counterparts of enterpsises.

Therefore, the next steps to be taken now are the development of decision support systems based on benchmarking and adjustment of the required technical and socio-economic indicators of the desired model of production and economic activity (based on best practices) and the current state of affairs.

The project is also aimed at implementation of a new Master's program "Conceptual design and engineering to improve energy efficiency" for preparing of engineering and administrative skills for new generation's master's students [23].

VII. DISCUSSIONS

At the design stage, the general structure and information model of the system data will be constructed.

Each indicator from Table II is defined in two dimensions: at the current moment and in the future for 5 years after the end of the project. Thus, it is possible to identify the following criteria that affect the quality of the developed project:

- competitiveness of the functional consumer characteristics of the innovative product at the moment and within 5 years after the product is released to the market;
- relevance of the results of the project for the payback period of the project;
- completion of the project life cycle stages;
- legal sustainability of the project results;
- provision of the project life cycle stages with resources;
- economic efficiency of the project.

This solution gives the system stability and greatly simplifies data management. The information model of the data (database structure) of the system constructed at the same stage has the necessary flexibility to meet the current needs of the customer [15, 24].

This also requires the unification of the "typical" docflow of the "typical" department (based on modern management and information standards).

Acknowledgment

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