



IMPROVING THE FUNCTIONAL ASPECTS OF THE AUTOMATED INFORMATION SYSTEM OF ACCOUNTING AND CONTROL OF ELECTRICITY

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Abstract

This scientific article describes the functional aspects of automated information systems for accounting and control of electricity. The study of the introduction and effective use of automated information systems and the factors influencing it, automated information systems and administrative mechanisms. It also substantiates the economic efficiency of the introduction of information systems to control the collection and processing of information in power companies, the loss of electricity in the power grid and the accounting of electricity consumption.

Key words: Digitization, Communication technologies, Automated information technologies, Electricity and Power companies.

1. Introduction

In recent years, many companies in various sectors and industries of the national economy have faced a serious need for the introduction of corporate information systems. At present, these developments define the main directions of modernization and intensification of business processes of economic entities in all manufacturing and non-manufacturing sectors. Computer data processing, business process modeling is an important part of scientific and technological development in many areas of human activity. The increase in the volume of computer processing of data in the effective management of the economy means that information and communication technologies (ICT) are entering the economy at a rapid pace. It is this situation that provides the technical side of a radical restructuring of management and the transition from administrative to economic methods in a market economy.

Automated Information Systems (AIT) - provides a communication system for collecting, processing and transmitting data to employees to perform company management functions. AIT also includes modern hardware, high-performance computers, communications, software, and highly qualified personnel. The development and widespread implementation of such systems is very expensive, so their use must be economically justified. Also, the Decree of the President of the Republic of Uzbekistan dated June 18, 2020 PD-6010 "On additional measures to improve the mechanism of sale of natural gas and electricity" was adopted in our country. It instructed the relevant ministries and departments to improve the mechanism of sale of natural gas and electricity, and set a number of tasks (Decree of the President of the Republic of Uzbekistan, 2020).

All countries of the world are carrying out information processes at different levels. Improperly chosen informatization strategy or its inadequate activity can lead to significant and sometimes drastic dramatic changes in all spheres of life in the country. There are many advantages of the organization of settlements

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using the automated control system of electricity accounting (EEHNAT), which have been used for many years abroad and in our large companies. In addition to accounting, they control and manage energy consumption in these companies, the main economic effect of the widespread use of these systems for consumers is to reduce payments for energy consumed, and for energy companies to reduce maximum consumption and reduce investment in high energy production capacity.

Many developed countries argue that the backwardness and neglect of ICT development has a negative impact on the economic development of the country. Based on the above considerations, as well as the practical work carried out in our country on the development of ICT and the widespread introduction of automated information systems (AIS) in all sectors of the economy, the topic is relevant.

2. Literature Review

The problems of forming an information society, the use of ICT in various sectors of the national economy are the views of leading economists and experts, a number of economists in the field of economic informatics and automated management information systems. Well-known scientists in the field of economic informatics and automated control systems, in particular, S.S. Gulyamov, have focused on improving the efficiency of the use and introduction of ICT in various sectors of the national economy (Gulomov and Begalov, 2010). Begalov (2001) research is devoted to econometric modeling of the formation and development trends of the information and communication market, the widespread introduction of automated information systems. Aripov (2003) considers the market of information and communication technologies as a whole system and on their basis offers the concept of management at the macro level. Umarov (2018) approaches and proposals for the effective organization of the process of utility payments on the basis of information systems are given.

3. Research Methodology

During the research, the methods of remote control, data collection, and processing in the automated information system of electricity accounting and control using methods such as theoretical observation, monographic analysis, expert and system analysis, system approach, generalization, analysis and synthesis proposals for improving information processes were prepared.

4. Analysis and Results

The current tariffs and subsidies do not cover the costs in a timely manner. After the abolition of existing subsidies in our country and bringing tariffs for electricity among domestic consumers to the level of its production cost, their share in the revenues of energy companies will increase significantly. At the same time, the problem of non-payment and theft of electricity is exacerbated. The actual loss of electricity, is the difference between the electricity supplied to the grid and the electricity paid, consists of four parts:

- Technical losses of electric power, electric losses caused by physical processes caused by transmission through electric networks and heating of its parts in network elements.
- Power consumption required to ensure the operation of the substation's process equipment and maintenance personnel.
- Energy losses due to instrumental errors in electricity metering.
- Commercial theft caused by theft of electricity, making payments by household consumers without taking into account meter readings, delays in payments, non-payment of payments and other alloys of reasons. Their value is defined as the difference between the sum of the first three components, which is the actual loss and the technological loss.

As a result of our research, according to the analysis of the situation of manufacturers of meters installed in the country, the total number of delivered meters was 5,384,758, KAIFA



meters were 1,427,144, electronic meters were 2,337,709, and the number of meters supplied by

Tashelektroapparat was 1,619,905. The total number of faulty meters was 16,176 (Table - 1).

Table - 1: Analysis of the situation of manufacturers on the meters installed in the regions of the country

Counters	Total number	From this		
		KAIFA	Electronic counter	Tashelektro-apparatus
Delivered counters				
Total number	5 384 758	1 427 144	2 337 709	1 619 905
<i>Including :</i>				
Single phase	5 219 706	1 308 295	2 300 271	1 611 140
Three phase	165 052	118 849	37 438	8 765
Built-in counters				
Total number	5 290 837	1 381 257	2 303 195	1 606 385
<i>Including:</i>				
Single phase	5 161 259	1 289 183	2 272 058	1 600 018
Three phase	129 578	92 074	31 137	6 367
Balance (transformer)	16 138	13 855	1 239	1 044
Unrepaired	16 176	7 611	3 467	5 098

Based on our research, we propose to conditionally divide the commercial losses into four groups:

- Losses due to faults in the electricity metering system. Faults in electricity meters, faults in transformers and meters, and unspecified faults. Efforts are now being made to prevent miscalculations of electricity. Energy sales companies are developing and adopting programs to replace existing electricity meters with modern ones. Under these programs, energy companies allocate their own financial resources. It should be noted that this activity is usually carried out in isolation from other activities, in particular, not related to measures aimed at increasing the collection of electricity bills. As a result, energy companies are spending less money on replacing metering devices and not achieving the expected economic benefits. Apparently, the solution to this problem lies not only

in the mechanical replacement of some measuring instruments with others, but also in the performance of a number of functions that allow newly installed measuring instruments to be used as EEHNAT by automated systems for commercial accounting of electricity.

- Losses due to incorrect provision of information on contracts, special tariffs or benefits at the time of payment. Their share of trade losses is the smallest.
- Theft of electricity through unauthorized connection of consumers, fraud with measuring instruments, etc. Energy companies do not publish statistics on the component of these losses in the open press. In rural areas and individual housing estates, the rate of loss due to theft of electricity is usually higher than in urban high-rise buildings. Currently, the main measures aimed at detecting and eliminating electrical thefts include checking the integrity of the seals and



ensuring that the gauges of the measuring instruments are entered correctly. Practice shows that this is not enough. Additional technical and organizational measures will be required to quickly identify unauthorized access points to consumers' power lines. In solving this problem, it is necessary to implement measures for the widespread introduction of EEHNAT.

- Failure to make payments for electricity used on time and non-payment of debts for a long time and loss of payments through unpaid bills. The main role in the financial losses of the energy supply organization is played by losses due to non-payment of electricity and losses due to delays in payments. However, the situation with these components of business losses is not improving, and energy marketers are increasingly focusing on the introduction of automated energy metering and control systems and their rapid impact on energy supply processes, payment of the subscription fee.

As a result of our research, we analyzed the state of installation of meters in the districts of the Andijan region as of January 1, 2021. According to him, Andijan TETK 54677, Andijan TETK 61121, Asaka TETK 50400, Balikchin TETK 34642, Boz TETK 12752, Bulakboshi TETK 14234, Jalakuduk TETK 33382, Izboskan TETK at 11611 meters, Kurgh 25673 meters, 20552 meters in Altynkol, 13890 meters in Pakhtaabad, 11110 tons in Khanabad, 21761 meters in Khodjaabad and 48669 meters in Shakhrikhan.

The EEHNAT system has the following advantages:

- Collection of information on the amount of electricity consumed at the power supply site without external interference
- Control and dispatching
- Monitoring of energy consumption in individual units or whole facilities
- Evaluation of system performance

- Calculation of current and planned indicators
- External communication through EEHNAT
- Data processing from controlled sensors
- Implementation of accounting algorithms and programming
- Adjust the tariff
- Record of system operation
- Visualization of the received data
- Storage of data logs and emergency situations.

The lack of such flexibility of an automated information system for electricity metering and metering significantly reduces its importance as an effective tool for combating commercial electricity losses and managing power supply modes for remote subscribers. An automated system for monitoring and metering energy resources is a local data collection tool associated with an interface by its structure, which allows you to process the received data on electricity consumption on site, and also creates all the necessary grounds for operational reporting for government agencies and private use. Its peculiarity is that the user cannot influence the readings by falsifying them, because the data is automatically transmitted to the regulatory authorities in a certain way in the form received by the user (Figure - 1).

EEHNAT allows us to organize individual control over the terms and amount of payment for subscribers of any system. Subscribers will be able to work in multi-definition schemes. At the same time, the energy sales manager, if necessary, can remotely change the load of each subscriber and set a limit on the amount of power consumed. The original structure and work algorithm of EEHNAT makes it equally easy to carry out the task assigned to it for example, the detection of cases of unauthorized connection to power lines, using a wide range of new patented methods. EEHNAT technical devices prevent power outages in the mains and household appliances in the event of a mode change.



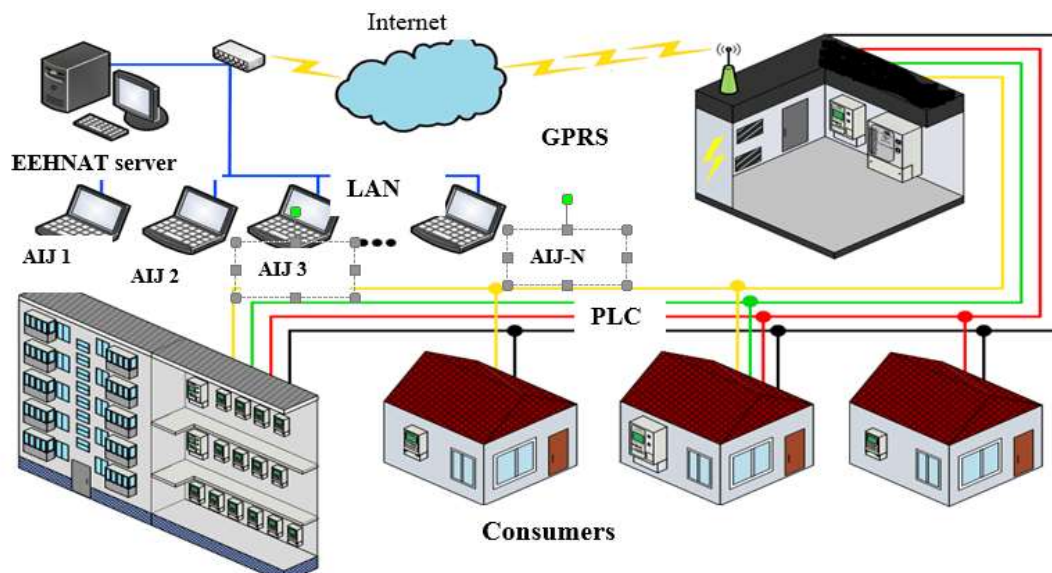


Figure – 1: Data transmission system in EEHNAT using PLC technology

The specialized program EEHNAT allows subscribers to make payments both at the checkout and through the bank, as well as widely use single-use payment cards to create additional convenience and speed up the process of entering and processing payments. Subscribers of the system will be able to view and replenish their personal account card online. The EEHNAT software runs on a local network and consists of a back-end database management system, a subscriber department, a dispatch department, as well as a central transmitter control software and a workstation for the technology department. Processing of incoming information on subscribers' payments (cash, bank, payment cards), printing of documents (receipts, statements, reports) of the Subscriber's Department with the central database in case of interconnection, the payments provide for the accounting of active energy generated using electronic meters (single-phase and three-phase).

Work stations of dispatchers provide additional control in the technological mode, when direct intervention of the dispatcher in the management of the automated energy sales management system is required. Workstations of the technical department provide EEHNAT equipment and technical aspects of its operation, delivery and programming of its metrological

and internal meters. Our research revealed the following existing problems:

- Lack of a modern and modern processing center
- Untimely transfer of electricity to the subscriber's personal account
- Lack of accurate accounting of the widespread use of public resources
- Complex processes of energy resources monitoring
- With non-specific personal accounts
- Consumers believe that paying for utilities is not a primary responsibility and that paying for them is not important.

In connection with the reorganization of the state joint-stock company Uzbekenergo, the liberalization of the electricity market and the creation of many regional electric grids and energy distribution companies, it will be necessary to organize electricity metering up to their newly established boundaries. From power grid companies to energy distribution companies, it is a very difficult task to set up electronic electricity metering for subsequent sale to consumers. This is due to the fact that, in accordance with the current design standards, electricity meters have never been installed on 10 / 0.4 kV low-voltage transformers or 0.4 kV input devices in residential buildings. To determine how much electricity is supplied to household consumers today, we add up the



readings of all individual electricity meters installed at the entrance of a residential building or country house to each city apartment, and then add 0 to the amount of electricity in the power grid. network., it is necessary to add losses of 4 kV.

By arranging such measurements, the distribution company will have to study the electricity supplied to consumers from its network from the electricity supply company, which will determine the amount of payments for domestic consumers and the specific method defines it as a "reverse account" based on the average sales tariff calculated on. The main problems in organizing the collection of electricity bills for residential consumers are:

- The transition to periodic (monthly or quarterly) mass shutdown of meter readings by the heads of energy companies makes it difficult to study the meters on the spot, without increasing the number of controllers. At the same time, the organization of remote meter reading remains relevant.
- When organizing mass metering of meter readings, it is necessary to minimize errors or minimize meter failure as a result of deliberate actions. It is also necessary to take into account the possibility of transferring meter readings to memory devices (flash drives), as well as the possibility of equipping the controllers themselves with portable electronic panels for organizing such readings. As a result, the controls become "remote control means" and the ability to change the meter readings is lost.
- Tariffs will be increased in connection with the termination of mutual subsidies for electricity and bringing the level of electricity tariffs to the real cost of its production, transmission and distribution, and new types of tariffs will inevitably be introduced to mitigate unforeseen social consequences for the population.

Every time a customer wants to change his tariff system, he must dismantle the old meter and install a new one. To overcome the difficulties that arise, it is necessary to make appropriate changes and additions to the project standards and other regulatory and technical documents, namely:

- Errors in the issuance of many receipts to the population are inevitable, and to prevent them, of course, it is necessary to automate this work.
- Markets in Western Europe have been liberalized in a very short time, and the role of metering and data collection systems in competitive energy supply processes has become particularly important.

The production, transmission, supply, metering and processing of electricity are now carried out within a single business structure. There is a need to standardize general rules for transferring information flows, satisfying requests and requirements for transferring data in the desired format. New goals and increased volumes of data have prompted energy companies to create their own information systems, which require the use of automated systems for collecting data from databases and meters. Also, in Picture 2, we have developed a technology for using EEHNAT for Uzbekenergo. In the course of the research, we proposed the following solutions to the above problems:

- Continue active implementation of an automated information system for accounting and registration of extensive use of communal resources in housing and communal services.
- Development and implementation of a subscriber debt information system.
- Organization of a high level of service
- Regularly explain to the population the importance of utility bills for human life
- Improvement of the payment procedure for used services, development and convenience.



When designing and automating technological cycles, a number of parameters are taken into account to achieve optimal results. At each stage of production, it is necessary to monitor the correctness of the process, monitor its condition and ensure the efficient use of funds. Modern technologies for measuring and controlling various parameters make it possible to organize accurate, technological and, most importantly, safe production, focused on product quality, while reducing the cost of electricity and production.

Based on the aforementioned EEHNAT concept, when modern and centralized computing is available, the following can be done:

- Disconnection from the system in the presence of arrears for electricity.
- Strengthening integration with payment acceptance systems, payment terminals or electronic systems.
- Prompt connection to utility networks with debt repayment
- Ability to view utility debt information in real time.

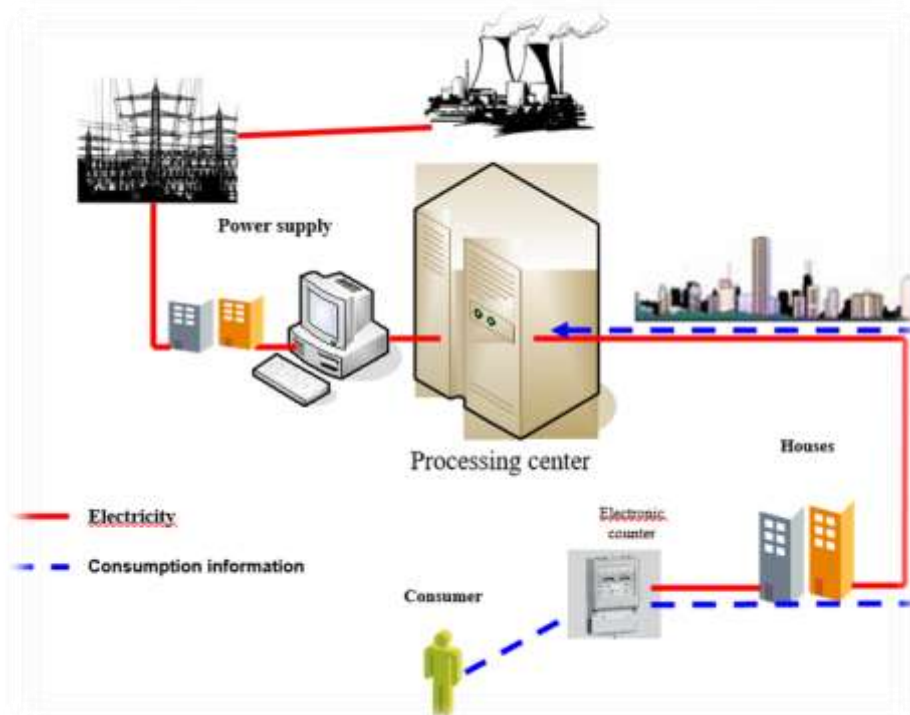


Figure – 2: Technology of application of EEHNAT by Uzbekenergo SJSC

The introduction of automated process control systems is explained by the growing dynamics of modern business. The struggle for a competitive advantage often turns into a search for modern ICTs. This includes the introduction of an effective and modern management system on the part of the company's management, reducing transaction costs, organizing logistics and accelerating business processes. The difference between workflow systems and other types of systems is that other systems mainly automate only a certain set of functions. On the contrary, workflow is a comprehensive

automation of a company's business processes. The process approach forces company leaders to focus on relationships between business participants. This is important because the process leads to economic and financial losses in the company due to the loss of time due to uncertainty in the relationship between the participants. If the sequence of actions of employees and their interaction during functional management is determined by instructions, the management of interaction processes is carried out correctly. When business process logic is misunderstood, process control is lost. As a result of the introduction of



information systems into the organization of the above work, the company's management:

- Prevents data loss and reduces the likelihood of errors when performing work in the framework of business processes.
- In the course of the development of any processes in the company.
- Ability to reduce the time for making and implementing management decisions, make management decisions in a timely manner and change processes.
- Improve performance discipline and reduce the impact of personal qualities of employees in the implementation of business processes.
- Timely receipt of statistical and analytical data necessary for the analysis and rescheduling of business processes.
- New high-level detailing of processes and scenarios for their implementation and their maximum possible implementation.
- Provides each employee with a clear list of tasks, which, in turn, allows you to organize your work as efficiently and conveniently as possible.

Automation of technological processes is a set of methods, equipment and tools that combine rational and competent management of objects and processes in accordance with the assigned tasks. Automation tools provided to our companies fully comply with the modern requirements of automation and process control systems. The scheme of automation of technological processes using the Sigma USB module was shown in Figure - 3.

Information system users will have the following capabilities:

- Goal management - the tree of business processes is structured in accordance with the tree of the company's goals.
- Reducing internal costs by establishing effective communications between company divisions and automating the flow of information flows along the chain from performer to performer.

- Strengthening management through monitoring - processes become more transparent and changes can be made at any time, which reduces the time spent by managers on organizing work and increases productivity.
- The flexibility of the company due to the manager's ability to easily make adjustments to processes or his divisions and to perform tasks in the executor.
- Dynamic, stable and fast response to the needs of the market and customers.

The data from the primary converters are transferred to the measuring and input channels of the Sigma USB modules. The operator controls the parameters in real time, that is, all measured parameters are displayed on the AIS screen. The remote terminal consists of a personal computer that can be installed in a control room or control room located far enough from the technological room. Real-time data from the workplace is transmitted to a remote terminal, which allows you to remotely control processes.

The business model is a meaningful result that allows you to set maximum goals for the implementation of EEHNAT and determine the following parameters:

- a) List of realizable places and the sequence of their automation.
- b) The presence of an actual need for the purchased software and hardware.
- c) Actual start time of EEHNAT.
- d) A specific list of startups and key users.
- e) The degree of compliance of the selected software with the specifics of the company's business.



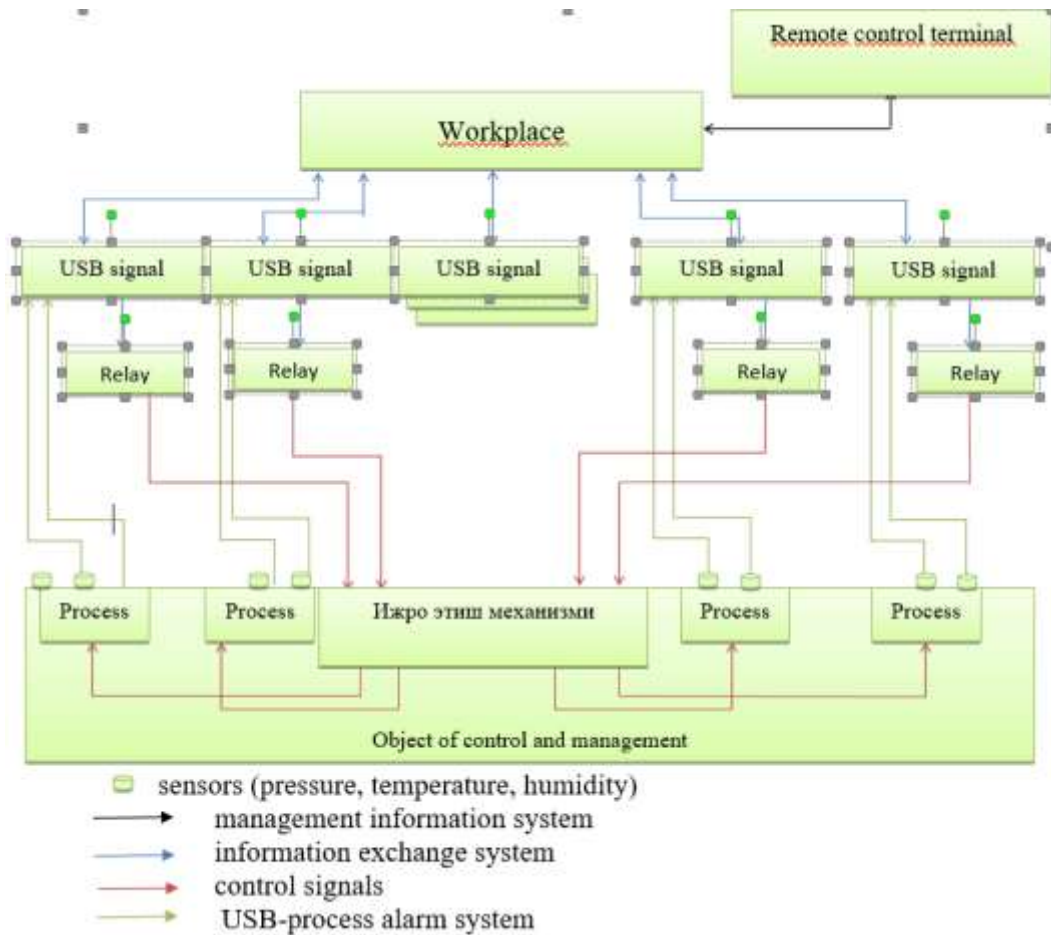


Figure – 3: The scheme of automation of technological processes using the module Sigma USB

In practice, creating a business model is not a quick process that takes 4 to 6 months to create. The main thing is to be patient and get answers to long-standing questions. Naturally, when it comes to automating local accounting, the result is achieved quickly. However, with large-scale automation, mistakes in company planning can be costly. What do you really need to focus on in the company's actual business model? How can creating a business model bring practical benefits to all project participants? The business model of a company is a model that allows management to understand graphics and text and describes the processes of company management using electronic dynamic modeling tools (Automated Information Technologies in the Economy, 2000).

Typically, the management model is designed to improve management processes with the understanding that the company needs to move to a new stage of development, for example, to improve the quality of services

provided. A good way to improve the quality of a company is to move to a new integrated information management system. Ideally, a company should include the following dynamic modeling tools:

- Visualization of the company's activities, which allows to accurately assess management shortcomings and find potential sources and areas for improvement.
- Shortening the stage of EEHNAT creation for the specifics of the company.
- Demonstrate and install EEHNAT implementation options that are ready for future deployment, each of which can be selected as the company moves to the next stage of development.

In other words, a business model is a reflection of the company and its information management system. Without a business model, it is impossible to build a truly integrated and comprehensive EEHNAT. The IDEF0, based on



the well-known SADT (Structural Analysis and Project Methodology), is not available in the descriptions of business processes and functions, as well as in cases where the model is not built by a coordinated team. good results even with a group of employees. This ensures that the majority of team members are familiar with the widely recognized IDEF0 standard. Thus, you can quickly start working on the model, "dividing" the business functions of the company. In our opinion, it is a mistake to think that a business model is a set of documents that describe a company's business processes. In fact, business models are always based on the business objectives of the company, which fully define all the key components of the business model.

Classic EEHNAT uses a classic approach to create two business models: initial ("as is") and target ("so be it"). The description of the initial model is necessary to identify the existing shortcomings in the company's management system. The defect identification model starts from the "same" description stage. The fact is that dynamic modeling tools are based in one way or another on the construction of large knowledge about the object. One of the most important criteria for choosing a modeling tool is to support several stages and even options for the development of a company. When the target model is complete, it shows how many more changes need to be made to the company to make the model a reality (Dresher Yu, 2005). Thus, the conducted research allows us to draw the following conclusions.

At the heart of CAT control is an information model, which consists of a set of economic and mathematical models and algorithms that describe the mechanisms of information flows in the control system and all functional systems of the control object;

- Can be considered as a special logical-probabilistic task, which can include blocks for optimizing the formation of the information content of the enterprise management system.
- The functional planning system, as one of the main blocks of the control system,

should be based on the standard principles of MRP II - the most advanced methodology.

- Before design and implementation, it is necessary to analyze the feasibility of EEHNAT.
- The presence of economic risks associated with the process of organizing the management of EEHNAT requires a financial and economic analysis of the effectiveness of investments in its implementation.
- EEHNAT implementation processes - should be carried out in accordance with a predetermined schedule, taking into account the maximum number of factors affecting the time and cost of the project.

5. Conclusions

In our opinion, data collection processes include operations for the transfer of electronic and digital data. Most of the underlying data, especially information about business transactions in the economy, is also initially recorded on paper. To use them in computer systems, additional data entry operations are required, which are essentially information processes and processes that convert data into digital form. Intermediate data exchange is a potential source of error, so one way to improve these processes is to develop recording devices that bypass these intermediate stages and allow immediate digital retrieval of data. When choosing measures to reduce technical losses, it is necessary to formulate new approaches and assess their comparative efficiency in the context of the accumulation of energy resources, where investment decisions are aimed not at achieving maximum economic efficiency, but at increasing the profitability of this joint-stock company. To increase the efficiency of electricity distribution to the planned level. Thus, even in the event of a failure in the communication equipment, the energy measurement data archive contains accurate data for all periods. Based on the raw data, calculation parameters are generated, such as total substation consumption, power and energy balance, calculations of transmission losses and much more. Based on the above, it



should be noted that the maximum level of information achieved by companies in the industry is a certain natural template for informing any other company in the industry. This conclusion is based on the fact that an existing company cannot improve all aspects of its activities in a short period of time, which does not impede its success in certain aspects of its activities.

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