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DESIGNING OF MANAGEMENT SYSTEM OF INNOVATIVE-PRODUCTION SYSTEM

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Abstract: The paper discusses the problem of management of innovative production system and designing of its management system. The structure of the management system of innovative production system is suggested.

There is an urgent need to improve the quality of production while scientific enterprises are moving towards innovative strategy of development. It should meet the following requirements:

– to reduce time for R&D;

– to cut out non-production costs;

– to ensure the required level of reliability of technological system;

– to estimate the technological and innovative capabilities to produce new products;

– to have the ability to transform from its current state into a new order to meet existing or emerging needs [1].

The chemical-technological system (**CTS**) means a set of interrelated technological flows and act as a single unit of vehicles, which carry a certain sequence of operations, from raw material preparation prior to the release of the target products [2].

The production system (**PS**) is defined as the combination of CTS, inseparably connected with informational support. In the PS each technological flow has its own informational flow in the form of documents, reports, etc., intended for planning, accounting, management, etc. Thus, the PS includes not only the technological equipment, but also personnel, ensuring its proper functioning.

The innovative production system (**IPS**) means the PS, in which, together with technological and information flows circulate the intellectual flows that would provide the desired product of a new quality, which has competitive.

The flow describes a collection of resources related to a certain time interval, then the functioning of the IPS will consider as a sequence of changing status.

Output coordinates of the IPS as a control object, are the variables describing the status of the IPS, and the control inputs, the variables that characterize the technological, information and intellectual resources.

The general task of managing the IPS, as the control object, is to provide operational management of the allocation of resources for optimal functioning of the IPS, in accordance with the strategic goals of innovation development for getting competitive products.

Split this task.

1. Selecting CTS, satisfying the criteria of innovativeness.
2. Designing of status functioning graph of the IPS.

Fig. 1 shows a block diagram of control system that solves these problems.

Status vector of IPS $\mathbf{s} =< s_1, s_2, s_3 >, \mathbf{s} \in S$ defines in the functioning of the system at any time. Status of the system at any time depends on the technological s_1, economical s_2 and innovative s_3 parameters.

The technological parameters include rate the overall effectiveness of the equipment, the actual production capacity, the number of emergency repairs, availability of production capacity, wear coefficient, the coefficient of technical life, retirement rate, the coefficient of technical utilization, the percentage of critical equipment and etc.

The economic parameters characterize the volume of sales, the indicator of new sales, the indicator of cost savings, results from implementation, unit costs of R&D in total sales, which characterize the rate high technology products and etc.

The innovative parameters define as innovative strategy and objectives, the level of mobilization of innovative potential, the level of borrowed capital investment, speed of development and implement innovative strategies.

The vector $\mathrm{u} =< u^1, u^2, u^3 >$ is defined by technological, information and intelligence flows.

The vector of the strategic goals of innovation development $\mathrm{u}_0 =< u_0^1, u_0^2, u_0^3, u_0^4, u_0^5 >$. For innovative production system are identified the following objectives: to increase the investment attractiveness, the selection of new technologies, new products, and promoting innovation.

The vector of technological parameters $\mathrm{u}_0^1 =< u_{01}^1, u_{02}^1, u_{03}^1, ..., u_{0n}^1 >$, where n is the number of parameters, characterize the performance: reaction rate constants, the coefficients of heat and mass transfer, temperature, pressure and etc.

The vector of material parameters $\mathrm{u}_0^2 =< u_{01}^2, u_{02}^2, u_{03}^2, ..., u_{0m}^2 >$, where m is the number of parameters, characterize the material flows.

The vector of informational parameters $\mathrm{u}_0^3 =< u_{01}^3, u_{02}^3, u_{03}^3, ..., u_{0k}^3 >$, where k – number of parameters, characterize the information flow. Information resources are defined by the following information: technological calculations, technical and economic calculations, working documentation, process procedures, work schedule CTS, plot plan – preventive maintenance of equipment, consumables, standards and schedules for consumption of raw materials and energy use, waste production schedules and information on the number of chemical engineering systems, maintenance equipment passport plot plan – preventive maintenance of equipment, consumables, standards and schedules for consumption of raw materials and energy use, waste production schedules and information on the number of chemical engineering systems, maintenance equipment passport (**MEP**), performance reliability of the equipment (the failure rate and recovery options diagnosed).

Maintenance equipment passport combines information about the technical status of the object (journal entries for technological status) monitoring data, conducted the inspection, diagnosis, test, troubleshoot, transactions carried out over an object (operational, maintenance) data on the types of work, wasted resources and time, indicators of living conditions and quality of execution.

The vector of parameters $\mathrm{u}_0^4 =< u_{01}^4, u_{02}^4, u_{03}^4, ..., u_{0q}^4 >$, where q is the number of parameters, characterizes the intellectual flows. Intellectual resources are determined by the availability of models, algorithms, algorithms, programs, collection of industrial and human skills, knowledge, abilities and experience of employees, percentage of staff able to take part in various projects.

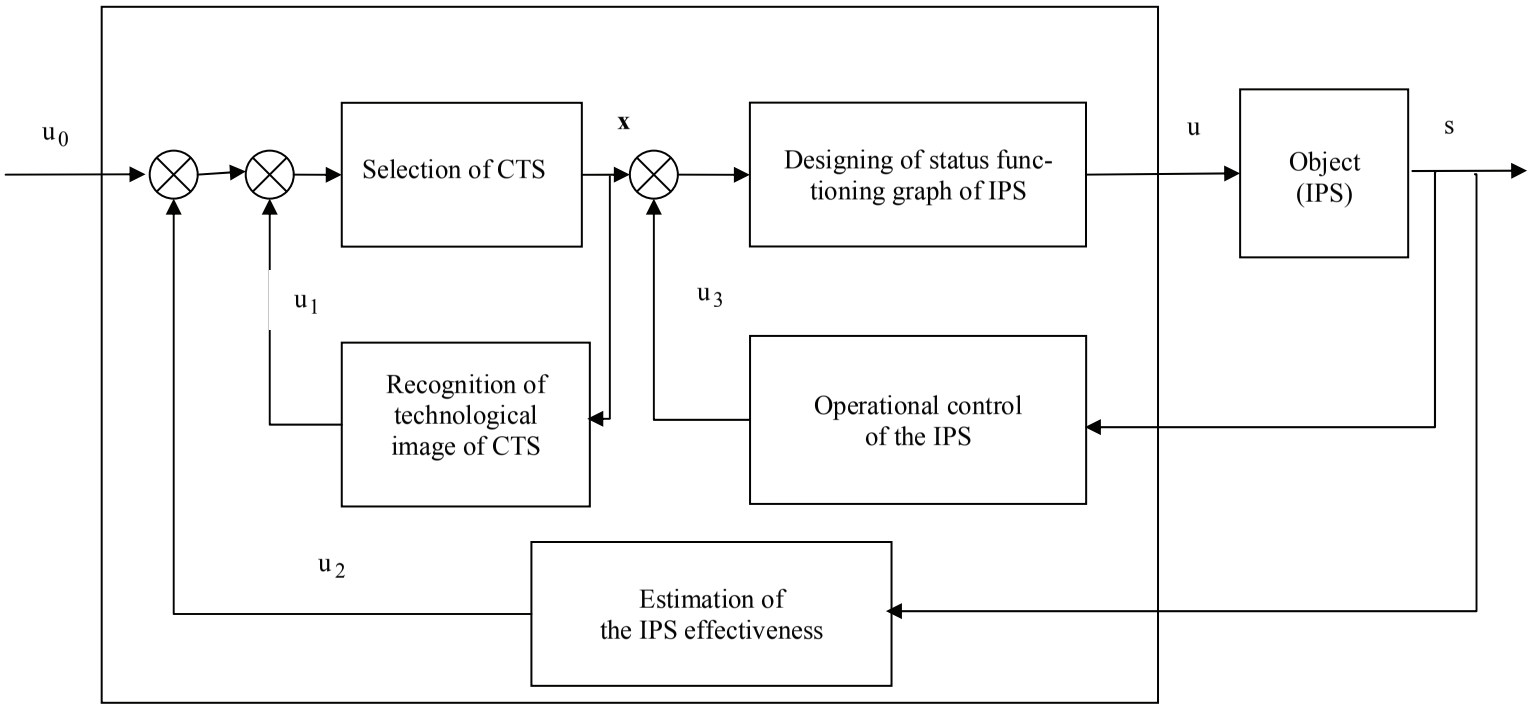

Fig. 1. Block diagram of control system IPS:

$s, u, x, u_0, u_1, u_2, u_3$ – status vectors of the IPS, technological, information and intellectual flows, topological and structural parameters, the strategic goals of innovation development; parameters that characterize the innovative and technological level of CTS and product; variables that characterize the implementation of the strategic objectives of the IPS card; variables describing the availability of resources

The vector of parameters $u_0^5 =< u_{01}^5, u_{02}^5, u_{03}^5, ..., u_{0r}^5 >$, where r is the number of parameters, determines the financial flows that are characterized by a set of sources and stocks of financial opportunities that are available and can be used to implement specific goals and objectives.

The vector of topological and structural parameters of the CTS $\mathbf{x} =< x_1, x_2 >$.

The vector of parameters $u_1 =< u_1^1, u_1^2 >$ characterizes by innovation – technological level of the CTS and the product: cost-benefit ratio of innovation, return on R & D, profitability index of innovation, the overall impact of innovation, reliability and duration of the process of developing a new product, the duration of pre-production of a new product, the duration of the production cycle of a new product.

Balanced Scorecard $u_2 =< u_2^1, u_2^2, ..., u_2^1 >$ characterizes the evaluation of the effectiveness of innovative production system, depends on the status of innovative production system.

Set of information, intellectual and technological flows determines the availability of resources at any given time.

IPS management system consists of modules:

1) the selection of CTS;
2) the recognition technological image of CTS;
3) the designing of status functioning graph of IPS;
4) the operational control of the IPS;
5) the estimation of effectiveness of the IPS.

The Module "Selection of CTS"

The module "Selection of CTS" means: you must select the best chemical technological systems to create a portfolio of CTS, compare dissimilar CTS among themselves on various performance indicators selected for the development and implementation fit into the allocated resources, CTS.

The selection of CTS goes on in two steps:

In the first phase the database is formed for each CTS. Next, the ranking by assigning each of CTS scores.

The CTS ranking algorithm

1. Entering $F(m)$ – financial resources required to perform all of CTS, have received an assessment; m, Q – allocated financial resources.

2. Comparing the values $F(m)$ and Q.

2.1 If $Q \geq F(m)$, then select those of CTS, estimates that equal or exceed the predetermined threshold score range of innovative project and are determined not expended funds if $Q > F(m)$.

2.2 If $Q < F(m)$, that there are insufficient funds and move to the next stage of the algorithm.

2.3 Define the funds F_t, required for CTS.

2.4 Produce a ranking of CTS, estimates that equal or exceed the predetermined threshold score, select them in ascending order and form a portfolio of CTS, which passed through the threshold barrier in the funds allocated to finance the portfolio of CTS.

Block diagram of ranking of CTS is shown on Fig. 2.

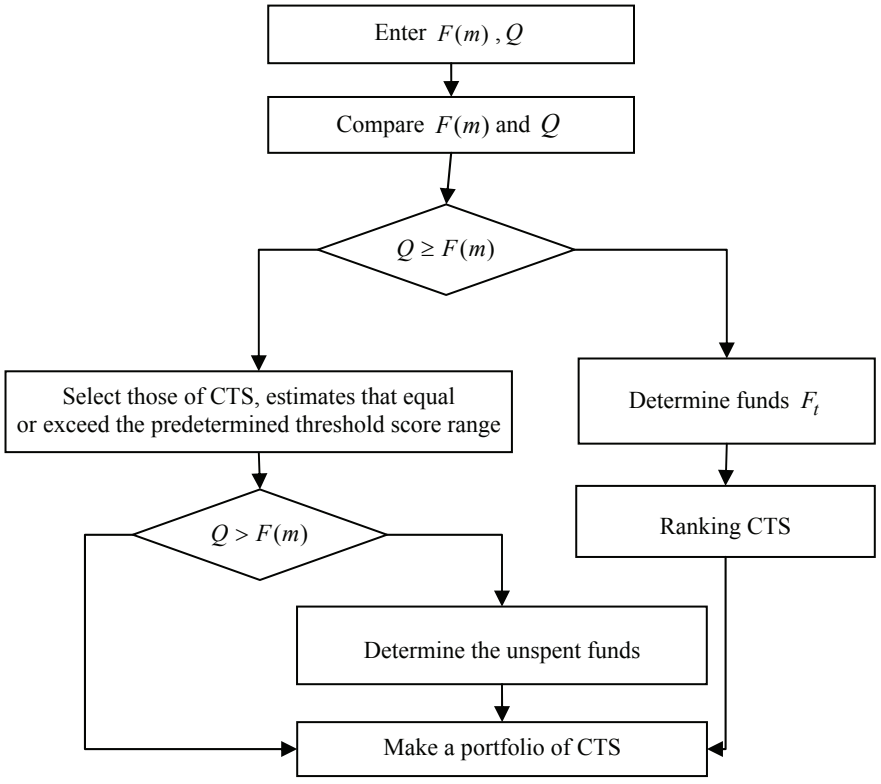

Fig. 2. Block diagram of the ranking algorithm CTS

Module "The recognition of technological image of CTS"

In the module "The recognition of technological image of CTS" solves the problem of estimating the scientific and economic levels of CTS, the capacity of its execution, the development of recommendations on the feasibility and scope of its funding. The purpose of recognition of the technological image of CTS is to reasonably determine the nature of innovation implemented in the CTS and prospective competitive products.

To determine the competitiveness of a specific product it is necessary to combine the technological level of performance of all production units of its manufacturing into a single network technology of production of all its constituent elements. It is characterized by a set of technological level of production of the final product.

The recognition of technological image of CTS must ensure comparability of different CTS between itself and reliable assessment of the technological level of the innovation component of CTS. When choosing CTS it is advisable to use CTS, which provides the implementation of innovation, combined into a technological network.

The recognition of technological image of CTS includes the following steps.

1. The estimation of innovative and technological level of development of innovation on the basis of data on scientific and technical characteristics of the CTS (CTS STC).

2. The estimation of technical and techno-economic level of product innovation on the basis of data on scientific and technical level (STL) and the cost of product innovation.

3. The determination of the market share and potential sales by means of economic-mathematical modeling.

4. The identification of the expected economic benefits and the cost of the CTS implementation using data from step 3.

Module "Designing of status functioning graph of IPS"

In the module "Designing of status function graph of IPS" takes into account the major technological limitations: the schedules of work units (including types of devices, the phase of its launch, the number of manufacturing operations performed, the time of conversion devices, preventive maintenance, the frequency shift range of manufactured products), operating capacity of the lines, the nature of the relationship between operations, while technological transitions, priorities for selection of devices in the planning, the availability of intellectual resources required qualifications and their work schedules, and information resources. While solving this problem must take into account all the features of the production environment (name of the commodity list, delays in delivery of raw materials from suppliers, etc.). It must also run synchronously planning of all components of the design of the product, taking into account the need for material resources and restriction on the shelf life of semi-finished products.

For making decision in the module "Designing of status functioning graph of the IPS", let us divide it into the following tasks:

1) the task of building of the original (initial) status functioning graph of the IPS.

For different input data: the number of vehicles, information and intellectual resources to build a status graph and the IPS to choose a procedure for distribution of inputs according to the constructed graph, which would lead to a minimum since the end of processes;

2) the task of building of status functioning graph of the IPS with taking into account the changeovers and resource deficiency.

Rebuild a status functioning graph of the IPS within the constraints imposed by the schedule of planned preventive maintenance and defect of the resource, as well as emergency repairs. Gathering information about the number, frequency and nature of repairs, the unit starts from the beginning of its operation and taking into account this information there is adjustment of the schedule preventative maintenance;

3) the task of status functioning graph of the IPS with taking into account the restrictions on the use of continuous resources.

Rebuild a status functioning graph of the IPS subject to the restrictions on the use of continuous resources at any time, integral constraints for the entire period of the plan and solve the problem of quality management, which consists of the following tasks:

– the quality control and verification of its requirements;

– the control for building of status functioning graph of the IPS and verification of compliance with or violations;

– the establishment correlations between status functioning graph of the IPS quality of CTS;

– the definition of status functioning graph of the IPS, providing quality performance CTS;

– the control of the status functioning graph of the IPS in the implementation of CTS with a view to possibly improving the quality of performance of CTS or reduce the cost of technology in relation to their average values.

The quality of a concrete set of indicators of CTS Balanced Scorecard [3]. The possibility of objective ordering of CTS in quality has principle value to be compared, the appointment of the cost analysis of weaknesses and finding ways to improve the functioning of the status functioning graph of the IPS.

Module "Operational control of the IPS functioning"

In real-time in module "Operational control of the functioning of the IPS" needs to see where this or that kind of resources is and how it will be placed in a specific working shift. In the course of solving this problem is the description of process automation and accounting equipment, scheduling repairs, implementation and analysis, identifying and providing material and technical resources [4].

In order to find the solution to the task "Operational control of the functioning of the IPS", let us divide it into the following subtasks:

1) the management of outages, forced and scheduled repairs, failures in the supply of spare parts, consumables:

– monitoring of the facility (equipment/apparatus component of CTS) for operation (increasing complexity of technological equipment leads to an increase in the number of state parameters for the control and the amount of information about the values of these parameters that require processing and analysis);

– planning, accounting, monitoring, analysis and management of routine (scheduled preventive) maintenance work and/or repairs as objects (to eliminate the inconsistency between geographically distant warehouses, to coordinate the flow of parts from multiple vendors);

– configuration management facilities equipment, location, operating conditions;

2) the streamlining accounting of equipment and maintenance history of equipment;

3) the cutting costs of maintaining equipment in working condition without reducing the quality of its operation;

4) the estimation the setting parameters of the equipment has performed with it and over it operations, the quality of their performance, the costs incurred;

5) the increase competitiveness by reducing costs for maintenance and repair;

6) the management of costs of maintenance and repair:

– cost accounting for all types of work in relation to a particular item on which they are made;

– planning, monitoring, analysis and traffic control major resources (logistical values, personnel, finance, they must also be provided with information communication between the application for the parts and the specific work that is procurement on the basis of objective data in relation to a particular object);

7) decision making support for planning, forecasting, preparation and execution of maintenance and repair, modernization of production lines;

8) security operation providing and compliance with technical requirements:

– compiling the repair job with a list of operations and assigned to each operation of necessary materials, parts, spare parts;

– the appointment in the job qualifications required of staff or individual staff members for each operation;

– the determination of the parameters of quality control of the assignment and automatic acceptance of control actions in the event of the benchmarks for the established boundaries.

For visualization of the production process, various options of graphs and tables are used.

Module "The estimation of effectiveness of the IPS functioning"

After performing CTS in the module "The estimation of effectiveness of functioning the IPS" evaluates the impact of innovations on the effectiveness of research production cycle, provides the possibility of returning to the stage of development of CTS after production begins.

The algorithms and software of appraisal status system and decision making of the IPS management are developed.

The developed control system allows the IPS to improve the effectiveness and safety of the IPS by timely management decisions, improve the efficiency of technical diagnosing IPS in established modes of operation.

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Проектирование системы управления инновационно-производственной системой

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Ключевые слова и фразы: граф состояний функционирования; инновационно-производственная система; управление инновационно-производственной системой.

Аннотация: Рассмотрена задача управления инновационно-производственной системой и проектирование системы управления ею. Предложена структура системы управления инновационно-производственной системой.

Projertierung des Systems der Steuerung vom Innovationsproduktionssystem

Zusammenfassung: Es ist die Aufgabe der Steuerung vom Innovationsproduktionssystem und die Projektierung des Systems seiner Steuerung betrachtet. Es ist die Struktur des Systems der Steuerung vom Innovationsproduktionssystem vorgeschlagen.

Conception du système de la commande du système d'innovation et de production

Résumé: Est examiné le problème de la commande du système d'innovation et de production et de la conception du système de sa commande. Est proposée la structure du système de la commande du système d'innovation et de production.

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