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ҚР ЖОҒАРҒЫ ОҚУ ОРЫНДАРЫНДА ҚҰРЫЛЫС САЛАСЫНЫҢ МАМАНДАРЫН BIM-ДІ ҚОЛДАНУҒА БАЙЛАНЫСТЫ САПАЛЫ ӘРІ КЕШЕНДІ ДАЯРЛАУДЫ ҰЙЫМДАСТЫРУ МӘСЕЛЕЛЕРІ

Мақалада ҚР жоғарғы оқу орындарында құрылыс саласының мамандарын сапалы, кешенді даярлау мәселелері қарастырылған. Бұл – қазақстандық компанияларда ақпараттық моделдеудің (BIM) заманауи технологияларын енгізу жылдамдығына, мерзіміне және сапасына тікелей әсер ететін негізгі мәселелердің бірі. Бакалаврлар мен магистранттар үшін, сондай-ақ жоғарғы білімнен кейінгі кәсіби білім беруге арналып Ұлыбритания мен Ресейде қолданылатын тәсілдер мен бағдарламаларға қысқаша шолу жасалды. Қазақстанның жоғарғы оқу орындарында BIM-жобалау бағытында кадрларды даярлау жүйесіне жаңа, тәжірибеге бағдарланған тәсіл ұсынылды. Осы мақалада берілген ұсыныстар BIM-ді қолданып жүрген мамандардың пікірлерін ескеріп құрылған. Сәулет және құрылыс оқу орындары мен бейіндік факультеттерде оқытудың ұсынылған ұсынымдары мен әдістерін тәжірибеде қолдану нәтижесінде құрылыс саласы жаңа талаптарға дайын жоғары білікті мамандар мен басқарушыларға ие болады.

***Түйін сөздер**: ақпараттық моделдеу технологиялары, BIM бойынша кәсіби кадрларды дайындау, BIM-менеджері, BIM-үйлестірушісі.*

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CONSIDERATIONS ON THE ORGANIZATION OF HIGH-QUALITY AND COMPREHENSIVE TRAINING OF THE CONSTRUCTION INDUSTRY SPECIALISTS IN HIGHER EDUCATIONAL INSTITUTIONS OF THE REPUBLIC OF KAZAKHSTAN RELATED TO THE APPLICATION OF BIM

The article outlines the issues of high-quality and comprehensive education for specialists of the construction industry in the universities of the Republic of Kazakhstan. This is one of the key problems which directly affects the speed, timing and quality of implementation of Building Information Modeling (BIM) technologies for companies based in Kazakhstan. A brief overview of existing approaches and programs for bachelors, undergraduates, as well as post-professional education, used in the UK and in Russia, was carried out.

New practice-oriented approach to the Specialists Training System in the field of BIM in higher educational institutions of Kazakhstan is proposed. The suggestions presented in this article are formulated considering the opinions of practicing BIM specialists. As a result of the practical application of the proposed recommendations and teaching methods in architecture and construction universities and specialized faculties, the construction industry will receive highly qualified specialists and managers prepared for the new realities.

***Keywords**: Building Information Modeling (BIM) technologies, professional BIM training, BIM education, BIM manager, BIM coordinator.*

МРНТИ 28.23.17, 28.23.29, 20.53.19, 20.53.17
УДК 631.362.36:57.087.3
https://doi.org/10.47533/2020.1606-146X.105

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ENSURING OBSERVABILITY AND CONTROL OF BUSINESS PROCESSES IN THE EXISTING LOGISTICS SYSTEM IN KAZAKHSTAN

In all economic and production-technological areas (or processes), business processes are the main objects that unite everything that is related to the achievement of the goal. Designing business processes is an important step that reflects a subjective view of the actual processes in the organization.

The activity of a warehouse, like the activity of any enterprise, consists of a set of external (supply, work with customers and suppliers) and internal (marketing, technological process, etc.) processes.

The main warehouse processes are:

– Acceptance of cargo to the warehouse;

– Placement and storage of cargo;

– Complete set of cargo;

– Shipment of sets of cargo.

Each of these processes can be investigated and solved as a separate problem.

In this paper, we will investigate and find ways to automate the business tasks of the business processes for fulfilling applications, the processes of receiving, placing, picking and shipping goods to customers.

This paper discusses the principles of the theory of automatic control in relation to the business processes of logistics, allowing to ensure observability and control of the business process without human participation. To create such a system, it is necessary that the control object functions effectively. Therefore, it is necessary first to design a business process that meets the requirements of efficiency and then it must be automated, so that the controllability and observability of the system is even higher.

Keywords: *digitalization of processes, observability, controllability, business-process.*

Introduction. Each of the enterprise systems requires the organization of interaction with the warehouse system at the main points of cargo movement. In practice, the number of points of contact between systems and the complexity of integration largely depends on the specifics of the industry of the enterprise, the organization of its business processes and the principles of working with cargo in the system.

Let's say a warehouse has a cargo picking area where the goods are assembled. Various integration options are possible, depending on how the system takes into account the loads and whether it takes them into account in principle. For example, the system reflects the fact that the cargo was assembled. In this case, the integration of systems will have to reflect the movement of components and kits at all stages of the warehouse technological process.

When designing an integration between systems, it is also important to know how the unit of measure is taken into account in the system. Often in the system, all work is carried out in terms of minimum units - for example, pieces. At the same time, for a warehouse system, you need to know the remainder of the cargo exactly in the context of all available units - boxes, boxes, packages, etc. This allows you to significantly optimize warehouse operations. Despite the possible discrepancy in the principles of cargo accounting, the interests of both systems should be taken into account in the process of developing integration.

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Despite the diversity of companies and their specifics, there are several main points of contact between systems that should be present in any integration scheme. These include acceptance of cargo, selection and shipment of cargo, inventory (or arbitrary reconciliation of balances).

The system can transfer all of its functionality via web services. Web service definitions are defined in the configuration tree and made available to other systems by publishing them to the server.

Any system can access the service, just as the proposed system can access the web services of other manufacturers.

The SOA architecture is based on a service manager that performs the following functions:

– Management of connections with infobases;

– Support for WSDL service;

– Implementation of the SOAP protocol, serialization of messages, calling the corresponding service.

The integration of a warehouse management system and an enterprise system can be done in different ways.

The following integration mechanisms exist [1]:

• Integration through the OLE mechanism, which allows the corporate database and the warehouse management system to embed or link data created in one of the databases into a document and / or reference created by another database.

• Integration through the use of SQL capabilities.

• Integration on the principle of "one window", when the functionality of the corporate system and the system of accounting and warehouse management are combined into a common information base.

• Integration on the basis of file exchange between the office of the enterprise and the warehouse.

The decision on the choice of one or another method of integrating the accounting and warehouse management automation system should be made based on the specifics of the enterprise information system, the territorial location of the integrated objects, the characteristics of the enterprise's business processes, the stored cargo, and warehouse personnel.

Research methodology. There are two ways to automate business operations of business processes, one with human participation, the second without human participation. Moreover, it is clear that in the first case, it is sufficient to provide a human-machine interface, then in the second case it is necessary to provide:

• observability by supplying or installing the sensor or sensors;

• controllability by means of supply or installation of the executive body (s) (a working control body).

To make it controllable, it is required for this operation to develop control systems or regulators according to a certain law, for example, P, D, I, PD, PI, PID, which can (these control laws) be implemented.

To ensure observability and controllability of the business process, we will use the concept derived from management theory, i.e. control circuit. It defines and describes the boundaries of regulation of the operation of the control object.

The platform implements these control loops and contains the necessary components for this: a controlled system (control object), control actions, etc.

Feedback is the impact of control results on the process of this control, or, in other words, the use of information coming from a controlled object (Figure 1).

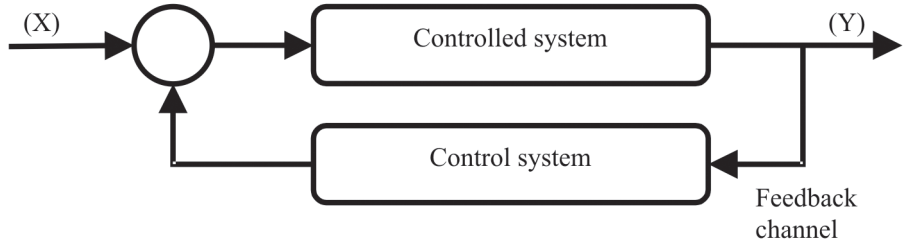

Figure 1 **–** A feedback control loop

In this regard, an approach based on the implementation of self-organization procedures in the system is being updated, which provides automatic adjustment of the structure and parameters of the system in conditions of a changing internal and external environment of functioning. The possibility of synthesizing organizational, technical, and technological objects by the example of the functioning of living organisms at the level of scientifically grounded knowledge was described by N. Wiener [2]. The idea of self-organization was very fruitfully developed by J. Saridis for the sphere of technical sciences, who introduced the concept of structurally and parametrically self-organizing systems [3]. In the first case, self-organization arose because of managing the combined structure of the object and the control system, in the second it was a consequence of the optimal combination of system parameters.

The attempt was made transfer this conceptual apparatus into management theory by Slyusar Yu.B [4]. He showed that in the process of functioning of a complex economic system (CES), the effects of structural and parametric self-organization can be distinguished in the same way.

By creating systems with negative feedback (Figure 1), under certain conditions, we can obtain such a new quality of the system as stability of functioning, which consists in stabilizing (adjusting) the values of the studied indicators within the level set by the decision maker. The fundamental point in the use of positive and negative feedbacks is the fact that only their joint application and interaction can create the effect of self-organization.

Thus, the controllability of the business process is achieved by introducing a control loop. Moreover, first, the strategic process of the control loop, which is the beginning of the control process. Therefore, to give the BP a managerial property, we will introduce the concept of a strategic process.

The strategic model constitutes the strategic level of business process management, which is designed to design, before completing the task by business processes, the content and structure of the business process based on the current situations that have arisen in the production environment, i.e. in a business process environment.

In all local problem areas of logistics, the strategic business process model determines the option of joint execution of specialized processes based on the current situations in production before the business process. The variant of joint execution of operations of specialized processes can be different, for example:

– first, the administrative operation (or decisions) in the current situation St(1) must carry out a set of personnel for the execution of all operations of the business process, and then organizational operations (for example, the distribution of functions between personnel for the entire BP) for all technological operations will determine the operations of organizations, and management operations is appointed and leads management based on the organizational structure and composition;

– and in a different current situation, St(2) must carry out a set of personnel for each operation before its execution, these actions are performed for each operation separately, and then organizational operations (for example, the distribution of functions between personnel for the entire BP) for the current technological operations will determine the operations of organizations and lead management based on the organizational structure and composition.

Each local or global business process is a set of operations, given the initial situations of the problem area, the execution of which, in a certain sequence, leads to the goal. At the same time, operations are heterogeneous, diverse: strategic, administrative, organizational, managerial, technological, providing resources, etc. Another important feature of the business process is that diverse operations such as administrative, organizational, technological, depending on situations in the problem area, can be performed in different sequences. It defines the operations of business process strategies [5-6].

If these operations are grouped according to their nature, which can be performed in parallel with the coordinated operations of different groups, then it is possible to organize separate processes from separate groups of operations. And then their coordinated execution of operations of different groups gives the same result as with the mixed execution of these operations as part of a business process.

Research results and discussion. Any BP is a set of operations, given the initial situations of the problem area, the execution of which, in a certain sequence, leads to the goal, i.e. any business process runs linearly.

But a linear process cannot be resistant to external factors and influences, since the impact of the administrative process (management, process owner) must be taken into account, i.e. there must be a process correction in manual mode [7-8].

Before applying the theory of automation to logistics business processes, let's define what is the object of control, the control system, etc.

Control object (CO) - an object is both a business process and its components. In this case, CO means special technological BP (operations), which include actions performed on the material flow (loading, unloading, transportation, storage, reloading with replacement of transport, acceptance, and release of cargo, etc.)

Since the process of accumulating operations is the accumulation of goods and information, the transfer function of the CO is an integrating link, that is, considering the presented data, we can accept the CO in the form of an integrator.

Under the subjects of control, we consider the rest of the special processes that determine where and why the process is moving. Moreover, the subjects of control must have the initial information to carry out a control effect on the control object:

– Regulator - a link that monitors the state of the CO and generates control signals. Since the role of control and monitoring of the process in the BP is performed by the owner of the process, as well as by administrative workers, it is proposed to use organizational special processes as a regulator.

– The executive mechanism (EM) is a link that directly affects the CO while changing the material and information flows that go to the CO.

Here we will consider special processes: management of technological operations, procurement processes and recruitment processes.

In addition to these links of the contour, information on the actual state of the object must be considered without fail. In this case, feedback is applied, which allows you to correct the behavior of the CO.

Since the blocks: CO, EM and sensors are links with unchangeable coefficients, we can regulate the parameters of the system only with the help of the regulator block, which must be assigned a regulation law [9-10].

A business process is satisfactorily completed if it was completed in a fairly short time frame and with a slight overshoot. To calculate the coefficients of blocks in MATLAB using the Simulink package, a feedback loop was built, and constant coefficients were selected experimentally. Also, an experiment was carried out on the regulator block using P, PI, PID regulation laws to identify the most suitable regulation law. As a result of the experiment, the simulation graphs shown in Figures 2-4 were obtained.

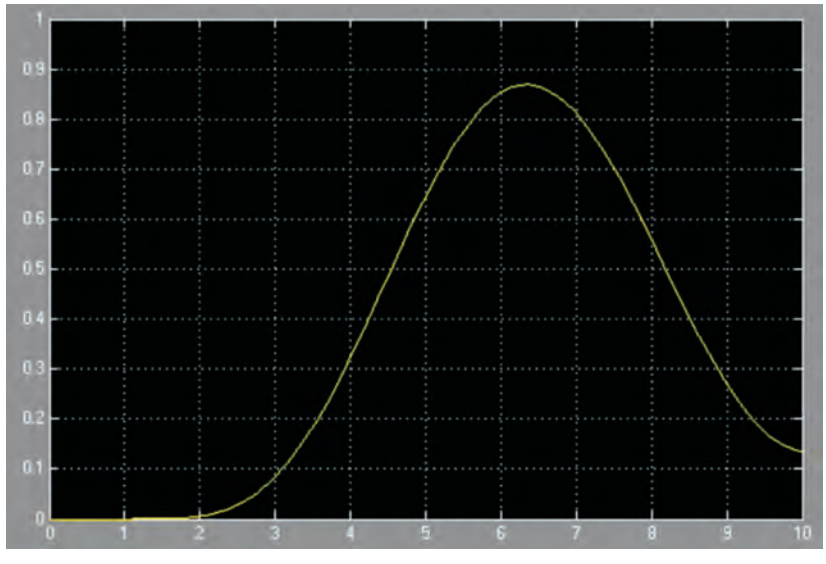

Figure 2 **–** Simulation graph of the AS in MATLAB, with a controller (proportional control law)

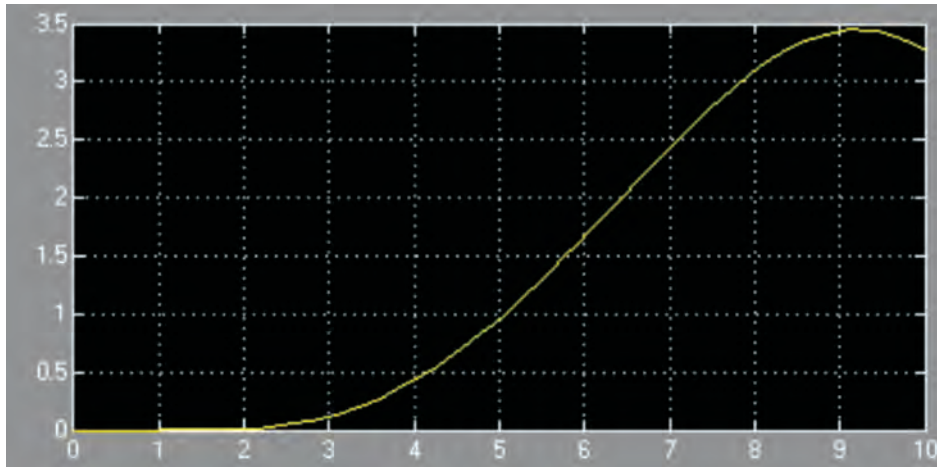

Figure 3 – Graph of AS simulation in MATLAB, with a controller (proportional-integral control law)

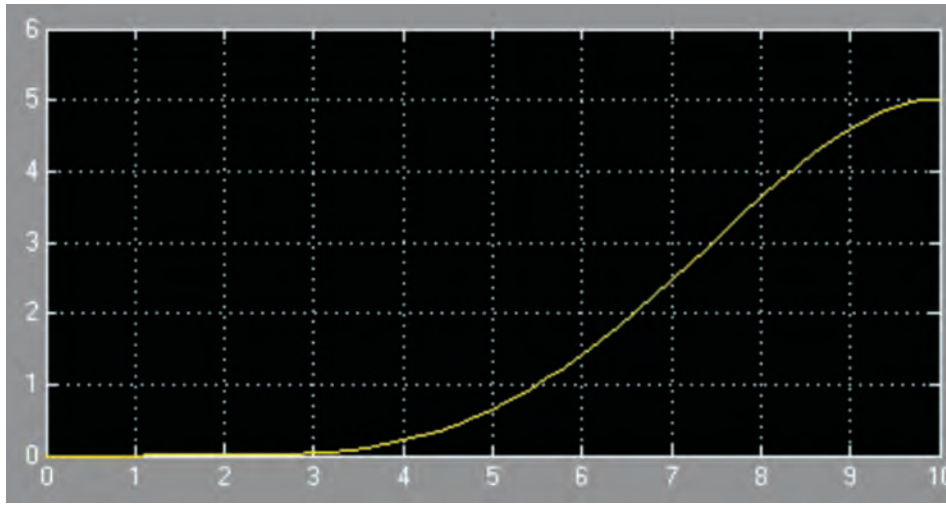

Figure 4 – Graph of AS simulation in MATLAB, with a controller (proportional-integral- differential control law)

As can be seen from the graphs with P-regulation, the process takes less time (in the P-controller, the maximum amplitude is reached at the time tmax = 6.2s, in the PI-controller, the maximum amplitude is reached at the time tmax = 9.1s, in the PID-controller, the maximum amplitude is reached at time tmax = 10 s), but this is compensated by the large process fluctuations. The smallest oscillation is with a PID controller, therefore, depending on the flow of applications, a change in the regulation law from PID to P and vice versa should be ensured. The hybrid system has the advantage of being able to cope with disturbances in the power supply unit in a dynamic mode, with continuous execution of the process under the influence of external factors, in a short time and with minimal overshoot.

Conclusions. As a result of the research done, a description of the logistics processes (in particular, warehouse processes) was carried out and a computer simulation of the process was carried out. As a result of the work, data were obtained on experiments with different types of regulators. During the experiment, it was revealed that when automating business processes, it is better to use a combined system with a regulator switch. Moreover, with a large queue of applications, the process should be executed with less time, respectively, by the P-controller, and when the queue of applications is not full, then the PID controller can be used.

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ҚАЗАҚСТАНДАҒЫ БАР ЛОГИСТИКА ЖҮЙЕСІНДЕГІ БИЗНЕС ПРОЦЕССТЕРІНДЕ БАҚЫЛАУШЫЛЫҚТЫ ЖӘНЕ БАСҚАРУДЫ ҚАМТАМАСЫЗ ЕТУ

Барлық экономикалық және өндірістік-технологиялық салаларында (немесе процестерде) бизнес-процестер - мақсатқа жету үшін барлық нәрсені біріктіретін негізгі объектілер болып табылады. Бизнес-процесті жобалау - бұл ұйымдағы нақты процестердің субъективті көрінісін көрсететін маңызды қадам.

Қойма қызметі кез-келген кәсіпорынның қызметі сияқты сыртқы (жабдықтау, тапсырыс берушілермен және жеткізушілермен жұмыс жүргізу) және ішкі (маркетингтік, технологиялық процесс және т.б.) процестер жиынтығынан тұрады.

Қойманың негізгі процестері:

– жүкті қоймаға қабылдау;

– жүкті орналастыру және сақтау;

– жүктерді жинау;

– жүк жиынтығын жөнелту.

Осы процестердің әрқайсысын жеке-жеке зерттеп және шешуге болады.

Бұл жұмыста біз өтінімдерді орындау үшін бизнес-процестердің бизнес тапсырмаларын, тауарларды қабылдау, орналастыру, жинау және тұтынушыларға жөнелту процедураларын зерттеп, автоматтандырамыз.

Бұл жұмыста логистиканың бизнес-процестеріне қатысты автоматты басқару теориясының принциптері талқыланады, бұл адамның қатысуынсыз бизнес-процестің бақылауы мен басқаруын қамтамасыз етуге мүмкіндік береді. Мұндай жүйені құру үшін басқару объектісі тиімді жұмыс істеуі қажет. Сондықтан автоматтандырыуды бастамастан, алдымен тиімділік талаптарына сәйкес келетін бизнес-процесті жобалау қажет, сонда жүйенің бақылануы мен басқаруы одан да жоғары дәрежеде жүреді.

Түйін сөздер*: процестерді цифрландыру, бақыланатындық, басқарылатындық, бизнес-процесс*

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ОБЕСПЕЧЕНИЕ НАБЛЮДАЕМОСТИ И УПРАВЛЯЕМОСТИ БИЗНЕС-ПРОЦЕССОВ В ДЕЙСТВУЮЩЕЙ СИСТЕМЕ ЛОГИСТИКИ В КАЗАХСТАНЕ

Во всех экономических и производственно-технологических сферах (или процессах) бизнес-процессы является основными объектами, объединяющими все, что имеет отношение к достижению цели. Проектирование бизнес-процессов является важным шагом, отображающим субъективное видение реально существующих процессов в организации.

Деятельность складского хозяйства, как и деятельность любого предприятия, состоит из совокупности внешних (снабжение, работа с клиентами и поставщиками) и внутренних (маркетинг, технологический процесс и т.д.) процессов.

Основными процессами склада являются:

– Прием груза на склад;

– Размещение и хранение груза;

– Комплектация груза;

– Отгрузка комплектов груза.

Каждый из этих процессов может быть исследован и решен как отдельная задача.

В данной работе будут исследованы и найдены пути автоматизации бизнес-задач, бизнес-процессов выполнения заявок, процессов приема, размещения, комплектации и отгрузки грузов клиентам. В данной работе рассматриваются принципы теории автоматического управления применительно к бизнес-процессам логистики, позволяющие обеспечить наблюдаемость и управляемость бизнес-процессом без участия человека. Для создания такой системы необходимо, чтобы объект управления функционировал эффективно. Поэтому необходимо сначала спроектировать бизнес-процесс, удовлетворяющий требованиям эффективности и затем его надо автоматизировать так , чтобы управляемость и наблюдаемость системы была еще выше.

***Ключевые слова**: цифровизация процессов, наблюдаемость, управляемость, бизнес-процесс.*