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VISUALIZATION AND QUANTIFICATION OF BUSINESS PROCESSES IN SUPPLY NETWORK IN THE CURRENT CONDITIONS OF IT SPACE DEVELOPMENT

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Characteristic features of supply networks and three main types of business processes were described. From the organization's point of view, it is necessary to identify the person responsible for the process, which will observe the progress of the process and its implementation. One business process can be divided into subgroups of processes, which include activities that, in turn, can be divided into tasks. There are at least several «languages» that are used to simulate the process. Each of them has its own specificity, which determines that the graphic symbol itself means, as indicated by the combination of characters, and so on. Quantitative analysis of the business process determines numerical indicators (financial, technical, time). The financial indicators include the cost of the business process, the cost of raw materials and materials, labor costs, depreciation, and others. The disadvantage of the approach is the lack of a single coherent methodology for measuring business processes. Managers of enterprises should independently determine the necessary indicators for each, as well as the method of their calculation.

Keywords: logistics, business process, supply network, mathematical model, simulation model.

Introduction

In the current conditions of rapid development of digital technologies, all processes in the economy, including the organization of the work of logistics networks, acquires new dimensions. The supply networks represent a wide network of interconnected processes requiring a clear coordination of actions. Today, such coherent coordination of the flow of business processes in the supply chain is ensured by information technology.

Statement of the problem

The work of the enterprise should not only successfully manage the logistics network and evaluate the effectiveness of management. It is the complexity of process that determines the relevance of the article. The efficiency of logistics networks measured by various visualization and quantification methods that help monitor and evaluate the whole process of delivery.

Analysis of recent research and publications

The problem in determining the efficiency of logistics networks are imperfect toolkit assessment that may be applied in the present conditions in practice. Problems of business process supply networks covering E. Krykavsky [1], D.J. Davis [2], R. Handfield, [3], S. Mitchell [4] and others. However, the effectiveness of management models supply networks are under-represented.

Entire of article

The aim of the article is to assess the most used visualization and quantification models of supply network.

Many companies use the services of other companies or individuals to distribute some or all of their products to the end user. Large sales companies or large manufacturing concerns deliver their products to the consumer through the supply network also using software. To save on costs and ensure the convenience of deliveries to customers, companies sell their products in large quantities to other companies that can deliver products more efficiently than large companies could do directly.

Characteristic features of supply networks can be considered [1]:

– creation of trusting relations between the participants of the network, development of network corporate culture;

– the desire to coordinate the actions of the network participants;

– availability of a common network information space for operational data exchange;

– clear detail of business processes related to customer service, decision making, information processing, innovation implementation, etc.

There are three main types of business processes:

– management processes – control of the functioning of organizational processes, examples are

«strategic management» and «corporate governance»;

– operational processes – the main processes of formation of the organization's economic activity, which are involved in the creation of a value chain, such as «purchase», «production», «marketing», «sales»;

– supporting processes – auxiliary work processes, such as «accounting», «payroll calculation», «technical support».

These processes are presented in Fig. 1.

From the organization's point of view, it is necessary to identify the person responsible for the process, which will observe the progress of the process and its implementation. The responsible person should understand the essence of the whole process and have the appropriate competencies to determine the tasks of the various organizations of the organization involved in the whole process. This is important for the normal functioning of the process and its effectiveness. The criteria for assessing the business process can include: duration, flexibility, quality, cost, timeliness, importance for the organization, value for the consumer [2].

One business process can be divided into subgroups of processes, which include activities that, in turn, can be divided into tasks. The task is usually performed by one employee, and the same process can be carried out by several people from different companies with different competencies.

Before the start of the simulation process, the necessary information is collected. In order to clearly describe the processes, it is necessary to answer, among other things, the following questions:

– What is the purpose and desired results of the process?

– Where and when the «business» process starts («input») and ends («output»)?

– What measures are being taken to implement the business process?

– In what order do they occur?

– What measures can be taken in parallel, and which starts only after the closing of the previous event?

– What documents, data, and products are the result of each action?

– Who carries out concrete actions and what role of separate subdivisions / executors?

– What is the duration of each action in this process?

– What are the limitations in the process?

This information can be collected in a variety of ways. The most commonly used methods are: interviewing employees, analyzing documentation and processes operating in the company, collecting informal documents (for example, e-mail and protocol of meetings), monitoring the current work in the company.

Modeling of business processes is used in different cases:

– with further restructuring and organizational changes in the company;

– control of necessary for the company's current activities;

– introduction of new information systems that change the existing processes;

– the sale of new products or services;

– require these changes to tasks that are performed at the operating level.

Process modeling is not the ultimate goal of the process. Among the most common reasons, simulation of the process chart is:

– the desire to better understand all processes occurring in the enterprise and the connections between them;

– desire to improve communication between employees in the event of a problem;

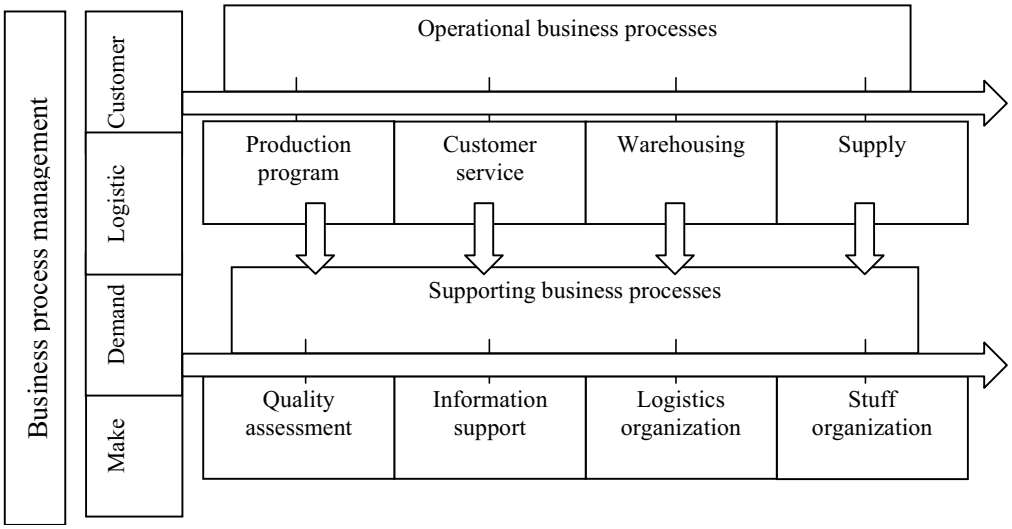

Fig. 1. The main types of business processes*

Note: * – the author's own work based on sources [3], [7]

– the ability to quickly identify ineffective areas in the process;

– increasing the efficiency of the company.

The simulation of business processes involves the need for a graphical representation of business processes for their optimization and archiving. Therefore, there is a need to know the structure of the organization, the goals of this process, its resources and making specific decisions in which the business process is modeled [4].

A business process model is a simplified representation of events that take place in the business process. And the process of ordered sequential actions is carried out with the help of certain units (divisions of the company or one specialist), whose actions are to achieve the goal.

The tools by which business process modeling is conducted can be divided into:

– diagramming tools used mainly for visualization and display of processes that include: Microsoft Visio, Flowchart (Micrografix);

– CASE tools for modeling processes, especially if they need to be integrated into an IT solution, such as Designer / 2000 (Oracle), Select Enterprise (Select Software);

– design and process improvement tools that allow advanced analysis and simulation, such as ARIS Toolset, Igrafix, Adonis, and process modeling tools with ERP.

There are at least several «languages» that are used to simulate the process. Each of them has its own specificity, which determines that the graphic symbol itself means, as indicated by the combination of characters, and so on.

Often, the following models are used for business simulation:

– BPMN (Business Process Modeling Notation);

– EPC (Event-Driven Process Chain);

– ERM (Entity-Relationship Model);

– CMMN (Model Management Case and Notation);

– UML (Unified Modeling Language);

– DFD (Data Flow Diagram Notation).

The first three are used both as business department and informational, the last three are commonly used in the programming or IT systems.

In view of modeling the business process and its subsequent changes, it is necessary to use the corresponding notation, which represents the business process. The use of UML (Unified Modeling Language) as a modeling application for object-oriented business users is problematic as it requires programming knowledge that relates to the features of an object-oriented approach.

For this reason, in order to present business processes, formalisms are proposed, among which BPEL and BPMN play an important role [3].

BPEL (Business Process Execution Language) is a standard notation for describing the flow of work in accordance with the concepts of SOA (Service Oriented Architecture).

The BPMN note has a finite and well-defined character set to support business process modeling.

BPMN graphic elements can be divided into four main groups:

– objects that determine the progress of the process, which includes an event and objects for decision making;

– elements allowing for the combination of elements of the model in the form of flow control messages;

– grouping objects of other elements of the process in the form of reserves and tracks;

– expansion objects.

Below are the most commonly used symbols

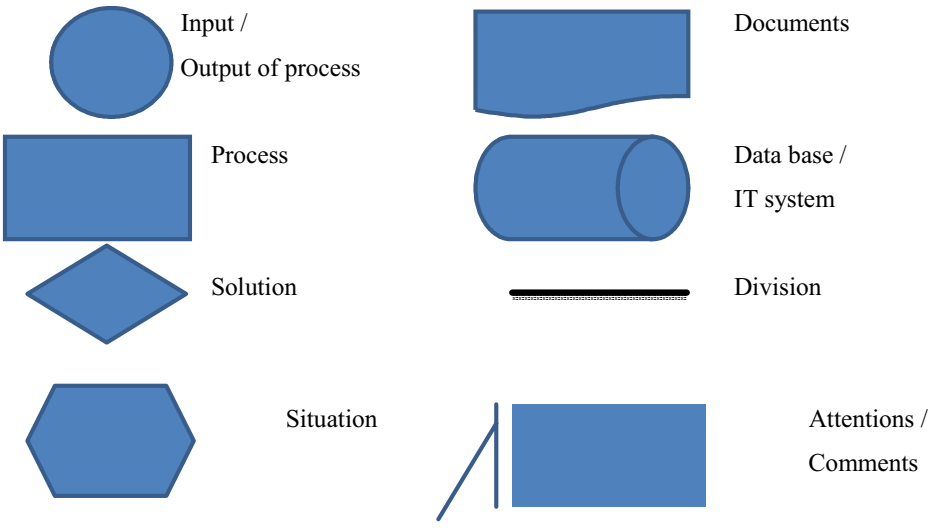

Fig. 2. The most commonly used characters in the business process modeling*

Note: * – the author's own work based on sources [1], [4]

and their meanings (notation) (Figure 2.).

Among the most commonly used diagrams for business process modeling, one can distinguish: a process diagram (workflow, including cross-functional diagrams), a cost chain diagram, a data flow diagram (DFD), a decision tree, a hierarchy diagram, a diagram goals, relationship diagrams.

The most common is the diagram of the flow of processes (Fig. 3).

As a result, the modern concept of network supply enables:

– expansion of the client base through multichannel network structures;

– reducing costs and improving management efficiency by transforming existing supply chains into the supply chain;

– reducing the duration of network flows due to close cooperation in the field of planning, motivation, organization and control throughout the supply chain;

– improvement of product quality and customer service level throughout the supply chain;

– increasing the social and environmental responsibility of the business.

Quantitative analysis of business processes allows to get numerical values of the business process that determine its status, due to the assessment of quality and technical specifications. This analysis allows to measure the level of business process efficiency, profitability and time rates. The results of quantitative analysis include the introduction of norms, forecasting further development of the enterprise and adjusting strategic goals.

Quantitative analysis of the business process determines numerical indicators (financial, technical, time). The financial indicators include the cost of the business process, the cost of raw materials and materials, labor costs, depreciation, and others. Technical indicators are characterized by the number of functions of the business process, the number of staff, etc. Time rates are characterized by averages: the time of execution of the process, the time of idle

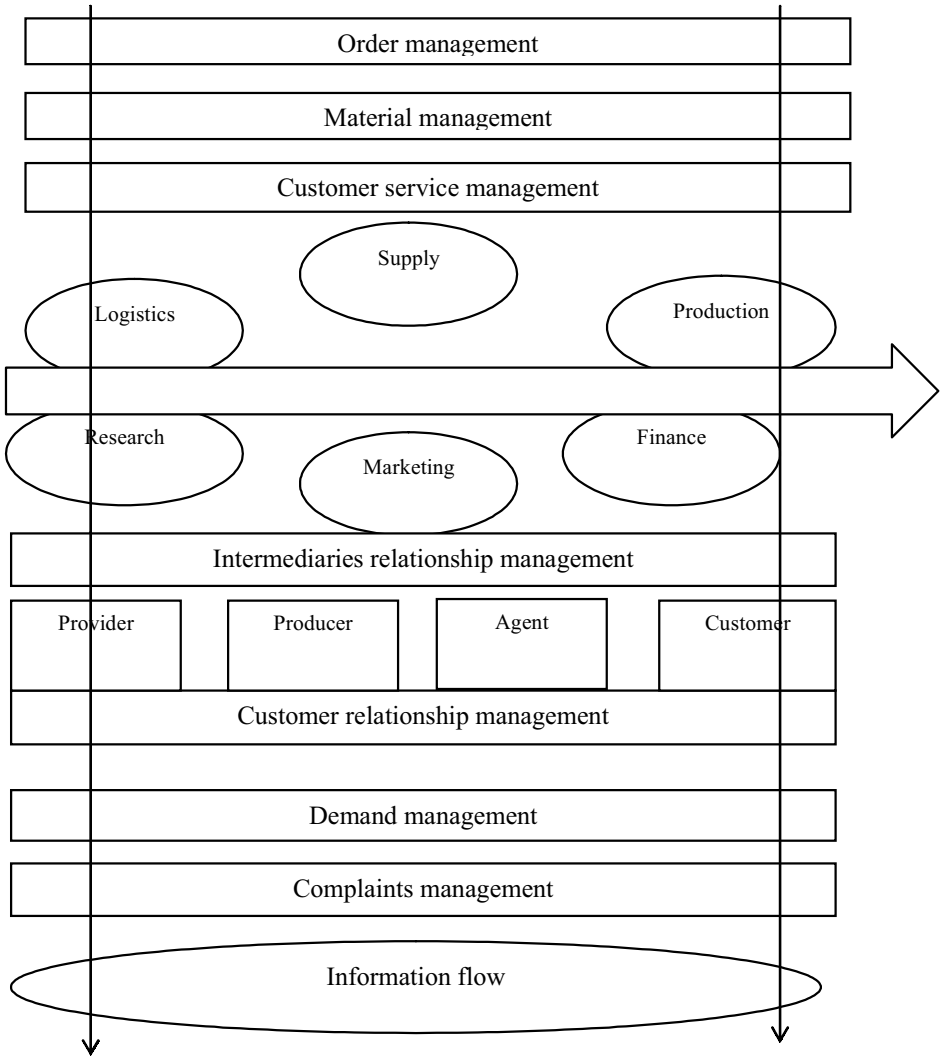

Fig. 3. Business process flow diagram in logistics chain *

Note: * – the author's own work based on sources [2], [4]

time, time of execution of individual functions of the business process.

One of the most well-known methods of quantitative approach to business process evaluation is Activity-Based Costing. The essence of the ABC method is to identify the main business processes associated with the production of a particular product; determining costs and their carriers for each business process and applying each carrier cost to products [5]. The analysis is based on the Pareto principle.

Relative to the ABC analysis, the Pareto rule looks like this: reliable 20% control allows you to control 80% of the system. Frequently, ABC analysis and the Pareto principle are used in logistics for inventory management. Very often, ABC analysis is conducted in conjunction with the XYZ analysis, allowing more precise groups to be identified, with respect to their properties.

ABC analysis gives the accuracy of calculated parameters, the visibility of the analyzed parameters and the ability to automate the analysis. The complexity of the analysis for many enterprises is that the cost accounting system needs a restructuring because there is no cost accounting system.

Another method of quantifying – simulation modeling as an instrument for the experimental study of complex systems. This method consists in creating models of systems, methods of algorithms and means of program implementations of simulators with the help of information systems and analysis of the results [7].

The method is based on four blocks: the results processing block provides information about the object under study; the block of mathematical models of an object contains the necessary information about it; the block of simulation of external actions imitates the influence of the external environment on the object; the model control unit implements a method for studying this model.

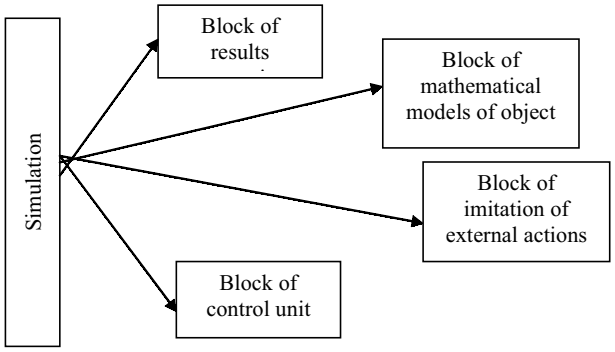

Fig. 4. Blocks of simulation*

Note: * – the author's own work based on sources [1], [5]

This method is most often used to solve problems that cannot be applied to analytical methods; when a real experiment cannot be performed; to find optimal, project-based solutions in terms of efficiency.

The simulation model allows you to improve the quality and accuracy of managerial decisions and their implications and consider a large number of alternatives. Unfortunately, this method is rather complicated and requires large funds for its implementation.

Another method categorizes the business process indicators with the allocation of four main groups of indicators: performance, efficiency, performance and quality. Also, auxiliary groups of indicators are selected: artist activity, resource costs and profits. The performance indicator is a measure of the outcome of a useful process for the client. Efficiency characterizes the ratio of the achieved result and the resources used. Productivity – the ratio of the achieved result and used human resources. The Quality Score reflects the degree of customer satisfaction resulting from the business process.

The disadvantage of the approach is the lack of a single coherent methodology for measuring business processes. Managers of enterprises should independently determine the necessary indicators for each, as well as the method of their calculation.

For the quantitative characteristics of the business process model, the following indicators should be taken into account:

– the structure of the logistics system of the business process, which shows the actual transport links between elements of the logistics system;

– characteristics of the structural elements of the business process, reflecting the actual properties of the system elements and related to the use of different types of transport;

– task of determining the size of the logistics system due to the size of loading of cargo of aircraft at the time of filing – receiving;

– organization of a business process that shows how to adapt the infrastructure and equipment for the tasks [6].

Formally, the model of the business process (MLS^K) in the aspect of the joint mechanism of the logistics system can be written in the form of ordering of four forms:

$$MLS^K=(S^{LS}, F^{LS}, Q^{LS}, O^{LS})$$

where: MLS^K is a model of the logistics system of the business process; S^{LS} – the structure of the logistics system; F^{LS} – a set of characteristics of elements of a structure; Q^{LS} is the logistic task size of the system; O^{LS} is an organization, way of implementing logistic tasks.

The structure defines the relationship between the logistics system of the business process and the environment. Logistics is a system of services for other sectors of the economy, which performs tasks

for various spheres of the economy.

In terms of the formal structure, the logistics system of the business process can be represented as:

$$G=<W, L>$$

where: W is a set of nodes that form the source of the flows of goods and intermediate nodes, including various objects of logistics; L is a set of transport nodes between elements W.

For the purposes of the logistics system of the business process, system elements are indexed:

$$W=\{1,...,i,...,i',...,W^n\},$$

in which W^n are capacities of the set W.

In the set W, it is possible to distinguish between three types of subsets: the set of sources, product streams (delivery points), that is, $N=\{i=n_{pn}: pn=1,...,PN\}$, the set of flows of goods (points of receipt) $O=\{i=o_{op}: op=1,...,OP\}$and the set of logistic objects used to convert the product flows $P=\{i=p_p: p=1,...,P\}$.

The symbol W^n denotes the number of elements of the model of the logistics system of the business process, that is, the set of sources and outputs of the intermediate points that are involved in the flow of goods, in which:

$$W=N\cup O\cup P$$

The set of supply points for goods N is the sum of the following sets:

– the set of raw sources defined as a set of $N1=\{n1_k: k=1,...,K\}$;

– the set of industrial objects defined as a set $N2=\{n2_m: m=1,...,M\}$;

– the set of processing points defined as a set of $N3=\{n3_r: r=1,.,R\}$.

Thus, the set N is the sum of the sets N1, N2, N3, that is, $N=N1\cup N2\cup N3$. Mentioned in the set K, M, R, respectively, denote the number of individual elements.

In the set O the output streams of cargoes were allocated:

– the set of border crossing points $O1=\{p1_g: g=1,...,G\}$, determined depending on the type of transport;

– the set of industrial objects $O2=\{p2_h: h=1,...,H\}$ are determined depending on the industry;

– the set of logistic objects $O3=\{p3_{pl}: pl=1,...,PL\}$ are defined depending on the type.

The set O is the sum of the sets O1, O2, O3, i.e. $O=O1\cup O2\cup O3$. Mentioned in the plural G, H, PL denote the number of individual elements.

Similarly, the set of logistic objects used to transform the flows of goods of P. is determined in the following cases:

– the set of overload points $P1=\{p1_L: L=1,...,L\}$, determined depending on the number of used modes of transport;

– the plurality of terminals $P2=\{p2_m: m=1,...,M\}$ determined depending on the number of used modes of transport;

– set of logistic centers $P3=\{p3_c: c=1,...,C\}$ determined depending on the possibility of realized tasks.

The set P is the sum of P1, P2, and P3 sets, that is,. $P=P1\cup P2\cup P3$. Listed in a plural L, M, C denote the number of individual elements.

The model is developed taking into account various types of transport, including road, rail, inland water and air transport. Thus, many transport connections are defined as sets of sets:

$$T=\{t_a: a=1,...,A\}$$

At the initial stage of the study, it is assumed that A=6. The types of transport involved in the carriage of goods may be rail transport (t_1), car (t_2), internal water (t_3); air transport (t_4). sea (t_5); pipeline (t_6).

The latter element is important in terms of the developed model of the logistics system of the business process. They have a plurality of databases created for the purpose of research and necessary for the proper development of the rationalization of traffic flows of the transport network. Accordingly, one can distinguish:

– number of databases relating to the transport infrastructure point: $B1=\{b1_z: z=n_{pn}, p_{pl}, O_{op}\}$;

– multiple databases associated with the linear transport infrastructure: B2={b2t: t=1,2,3,4,5,6};

– a plurality of communication channels between databases: $B3=\{b3_{bd}: bd=1,...,BD\}$;

– central database of B4.

Knowing the specific properties of individual roads or sections of roads in terms of cost, time, and also taking into account the possibility of congestion, we can make a decision in terms of operational and strategic distribution of traffic on a specific road network. For each pair (n,o)OE, where n is the number of flows of goods, o is the number of receipt of the flow of goods, and E represents a set of relations of provision – receipt. The symbol P denotes the set of transport roads, which links the beginning of the carriage with its end.

Quantification of business processes requires compliance with the general recommendations:

– each of indicators should be measurable;

– the number of indicators should be minimal necessary for a complete business process management;

– it is necessary to develop indicators for the assessment of all aspects of the business process

(financial, technical, timing, quality);

– you need to create an integral indicator that gives a comprehensive assessment of the business process;

– the cost of measuring the indicator should not exceed the managerial effect of using this indicator;

– a generalized system of indicators should be carefully structured.

Summary

The emphasis on process excellence has become an integral part of management thinking and planning in successful organizations. A good vision statement enables an organization to have a consistent view of what it wants the future to look like. It is impossible to reach the desired future state if the management in not complete without visualization and quantification of the process. Visualization and quantification methods can provide an excellent communication vehicle to illustrate which processes are most important in organization, as well as the customer and financial results that improving these processes are expected to drive.

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ВІЗУАЛІЗАЦІЯ ТА КВАНТИФІКАЦІЯ БІЗНЕС-ПРОЦЕСІВ У МЕРЕЖІ ПОСТАВОК В УМОВАХ РОЗВИТКУ ІНФОРМАЦІЙНИХ ТЕХНОЛОГІЙ

Петрик І.В.

В статті охарактеризовано особливості мереж постачання та три основних типи бізнес-процесів. З точки зору організації, необхідно визначити особу, відповідальну за процес, який буде спостерігати за ходом процесу та його виконанням. Один бізнес-процес можна розділити на підгрупи процесів, які включають діяльність, яку, у свою чергу, можна розділити на завдання. Є принаймні кілька «мов», які використовуються для імітації процесу. Кожна з них має свою специфіку, яка визначає, що сам графічний символ означає, як це вказується комбінацією символів і так далі. Кількісний аналіз бізнес-процесу визначає числові показники (фінансовий, технічний, час). Фінансові показники включають вартість бізнес-процесу, вартість сировини та матеріалів, витрати на робочу силу, амортизацію та інші. Недоліком цього підходу є відсутність єдиної послідовної методології для вимірювання бізнес-процесів. Менеджери підприємств повинні самостійно визначати необхідні показники для кожного, а також метод їх обчислення.

Ключові слова: логістика, бізнес процес, мережа поставок, математична модель, симуляційна модель.

ВИЗУАЛИЗАЦИЯ И КВАНТИФИКАЦИЯ БИЗНЕС-ПРОЦЕССОВ В СЕТИ ПОСТАВОК В УСЛОВИЯХ РАЗВИТИЯ ИНФОРМАЦИОННЫХ ТЕХНОЛОГИЙ

Петрык И.В.

В статье были описаны характерные особенности сетей поставок и три основных типа бизнес-процессов. С точки зрения организации необходимо определить ответственного за процесс, который будет следить за ходом процесса и его осуществлением. Один бизнес-процесс можно разделить на подгруппы процессов, которые включают в себя действия, которые, в свою очередь, можно разделить на задачи. Существует не менее нескольких «языков», которые используются для имитации процесса. Каждая из них имеет свою специфику, которая определяет, что сам графический символ означает, как указано комбинацией символов, и так далее. Количественный анализ бизнес-процесса определяет числовые показатели (финансовые, технические, временные). Финансовые показатели включают стоимость бизнес-процесса, стоимость сырья и материалов, затраты на рабочую силу, амортизацию и другие. Недостатком подхода является отсутствие единой согласованной методологии для измерения бизнес-процессов. Руководители предприятий должны самостоятельно определять необходимые индикаторы для каждого, а также метод их расчета.

Ключевые слова: логистика, бизнес процесс, сеть поставок, математическая модель, симуляционная модель.