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MODELING OF BUSINESS FORMS OF THE INDUSTRIAL ENTERPRISE IN THE CONDITIONS OF HIGH INSTABILITY OF THE EXTERNAL ENVIRONMENT

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МОДЕЛЮВАННЯ ФОРМ ОРГАНІЗАЦІЇ ДІЯЛЬНОСТІ ПРОМИСЛОВОГО ПІДПРИЄМСТВА В УМОВАХ ВИСОКОЇ НЕСТАБІЛЬНОСТІ ЗОВНІШНЬОГО СЕРЕДОВИЩА

Purpose. Development of the method of coordinating the interaction of the industrial enterprise with partners on the principles of marketing by analyzing the emergence and prevention of negative events.

Methodology. An approach to forming the models of the network organization of business which has a property of adaptation of all partnership participants to the external environment which is constantly changing is offered. The approach is based on the mathematical description of probabilistic processes in the economic system and allows describing formally the behavior of business partners without participation and with the participation of the coordinator for choosing an economically advantageous one in a specific situation.

Findings. Comparison models of marketing forms of organization of the relationships between industrial enterprises from the supplier and producer to the consumer, which have a property of evaluating the managing forms of the network structure under various conditions of the external and internal environment, are proposed. The developed mathematical models allow comparing various marketing forms of the organization of relationship on parameters of production activity of the enterprise at identical probability of the onset of a negative situation. It is shown that the most appropriate form of marketing activity of an enterprise producing expendable tools are flexible partnerships, which provide forming the partner network with the enterprise-integrator.

Originality. Development of the management theory of marketing activities by forming a model toolkit that facilitates a justified choice of the type of coordination of the interaction between an industrial enterprise and partners in the network organization of business in order to obtain equitable conditions for all participants. The advantage of the model is its adaptability to the external environment, which is changing dynamically, and taking into account the risks arising from the formation of consumer demand, which has a probabilistic character.

Practical value. The proposed probabilistic criteria for evaluating the marketing forms of interaction of enterprises within the framework of the network structure allow choosing new varieties of partnership that minimize the risks of fluctuating demand for products through the organization of activities of the enterprise-integrator.

Keywords: *marketing forms of business, industrial enterprise, network structures, partnership, consumable components, probabilistic models*

Introduction. The rates of development of Ukrainian industries over the last twenty years have changed very quickly in different directions. It is caused by a number of objective and subjective factors of the external environment, including political, economic, and social ones. As a result, the activities of industrial enterprises have

become differentiated, including those from the standpoint of the forms of business, speed of changes in the assortment, volumes of its production and sales. Historically, the most significant industries of Ukraine have been mining, metallurgical and machine building complexes. The enterprises of these branches became an example of the transformation processes of the business forms under the influence of changes in the commodity markets and globalization tendencies.

Enterprises of the mining industry and various subbranches of machine building (including mining engineering) are technologically connected among themselves and carry out operations which are predictably repeated. It causes low uncertainty of relationship which in the conditions of the stable markets allows using a bureaucratic form of the business organization. The organization of industrial enterprise production at the time of the USSR is a good example. So, in the machine-building industry more than 90 % of enterprises were vertically and horizontally integrated [1]. In the conditions of transformation of economy in the last two decades for adaptation of the enterprises to continuous changes of the external environment in the industry of Ukraine new forms of the organization of activity based on the western experience started to form. Thus, the enterprises of the machine-building industry pass from the bureaucratic form of activity organization to the specialized one, including those that unite into network structures. It allowed enterprises to stay in the market, focusing on servicing not only the technological cycles of one enterprise, but also other enterprises of various industries [2]. The specialized enterprises are able to provide industrial production of a wide and deep assortment, which is typical, but differentiated according to the qualimetric characteristics. With this approach, the subject-specialized enterprises are able to satisfy the individualized demand in the industrial market. However, these approaches determine the number of the company's connections and require the solution of the problem of the forming such organization of activities that will ensure the coherence of goals and the concentration of resources based on equitable benefits of all participants in the network, including consumers.

Analysis of recent research and objectives of the article. Theoretical studies of the network organization of business were carried out mainly by foreign scientists. They convincingly proved that, firstly, this is one of the forms of marketing activities, and secondly, that organizational forms evolve along with transformations of the external environment [3, 4]. In general the dynamism of development of the modern industrial market, structure of production of technologically specialized enterprises, aimed at providing the individualized demand of consumers of technically complex products, induce the enterprises to focus in the organization of activities on network structures rather than on the intra-corporate organization of business. The selection of the most rational form of business within the network structures depends mainly on the degree of coherence of objectives and concentration of resources and the degree of uncertainty in the market situation [5]. Domestic scientists investigate the above problems primarily from the point of view of the theory of logistics [6, 7].

The modern approach to the classification of the organization of activity of the enterprises in network structures based on marketing allows dividing them into those that are formed on the basis of transactions and those that act on the basis of partnership relations. Today it is considered that the main focus of the organization of the company's activities on terms of transactions is aimed at the implementation of one-time operations (exchanges, sales) with other partners in case of necessity in order to achieve a competitive advantage and minimize operating costs [8]. Another approach to the organization of activities of the enterprise is based on the marketing of partnerships [9]. It considers interaction between the enterprises during certain time. This interaction is a complex combined process, which includes not only that part which is connected with transactional costs, but also social, business, information exchange; aspects of trust, reputation and responsibility.

The carried-out analysis has shown that analytical models which allow choosing the most rational form of interaction can be conditionally divided into two varieties.

The first kind of models describes the process of interaction from the position of coordination of the relations and the willingness to enter into interaction [10, 11]. However, such models are represented by general mathematical equations, which make their application practically impossible for justification of the rationality of the form of interaction taking into account the characteristics of consumption or consumers. The second approach is based on modeling of interaction taking into account the optimum size of the order, fixed interval between it and the established frequency of replenishment of the order to a certain level. Such models are actively developed by domestic scientists primarily for forming various approaches to logistics management [6, 7]. The research by a number of scientists convincingly proves that considering the interaction of enterprises only from the point of view of coordinating logistics processes makes it impossible to optimize the management of the interaction of enterprises in partnerships. These types of models do not take into account the specifics of those industrial goods, where the features of their consumption cannot be described by certain characteristics within each of the approaches. Such situation induces to development of a model of interaction between an industrial enterprise and others in partnership, including consumers.

Objectives of the article. The purpose of the article is substantiation of the method to coordinate the interaction of the industrial enterprise with partners in the network organization of business on the principles of marketing.

Presentation of the main research and results. The research is expedient to be done by the example of the enterprises whose production is characterized by a deep and wide assortment and is consumed by various branches of the industry. These include enterprises of mining engineering. One of the typical examples of subject-specialized mining engineering enterprises is those that pro-

duce consumable components and tools. The range of products of these enterprises is deep, wide and depends on the requests of a specific enterprise – the consumer, which makes each consignment of goods individual orders. In addition, the same goods can be consumed by different industries. This requires the formation of a coherent management system not only of production, but of partnership relations between enterprises as a single system, not as a certain number of individual elements of the logistics chain. Since producers, suppliers of material resources and end users are involved in the process; the structure of the channel becomes a complex branched system of direct and reverse interrelations based on subject specialization. Management of such network structure becomes not just the management of the integrated movement of materials, products and information, but the management of the needs of all business partners for achieving a common goal, taking into account the principle of the parity benefit of all participants.

Consumable components and tools are a rather specific type of goods that are widely used in engineering, mining, etc. The specificity of the goods is that the consumer estimates the total volume of demand in nomenclature units based on medium and long-term plans of the production volumes of the main products and expert estimates of the requirements for a unit of production. It is related to the fact that frequency of emergence of requirement depends on a number of factors of objective and subjective character: fluctuations of demand for these goods depending on fluctuations of demand for end products, rock strength, operating conditions of the main equipment, the duration of its planned and unplanned repairs, etc. So, the emergence of an event of the single requirement in nomenclature units of consumable components and tools is a random variable.

Thus, minimization of downtime of the main equipment because of depletion of stocks of tools and components in a warehouse has to become the purpose of activity of network structures. At the same time, it is necessary to prevent excessive storage volumes. Let us consider the organization of coordination of interaction of an industrial enterprise with partners at the network organization of business for providing with tools and components by an example of two industries: mining mechanical engineering and mining industry.

The emergence of the need for a consumable components or tool of a given nomenclature position can be considered as a flow of random events with a known mathematical expectation, which is determined by the annual needs of the enterprise, that is as a Poisson flow, [12], which is described by the distribution density $f_z(t)$

$$f_z(t) = z \cdot e^{-z \cdot t}, \quad (1)$$

where z is the parameter of the indicative law of distribution or the density of the demand flow in a given product.

At the known annual requirement of a certain nomenclature position Z and the deadline for performing work with the use of this product – T_z, the density of the flow of demand is defined as

$$z = \frac{Z}{T_Z}. \quad (2)$$

Proceeding from this and the purpose of the research, the task is to determine the rationality of various forms of organization of the enterprise for providing it with consumable components and tools. Due to the probabilistic nature of emergence of need for a certain nomenclature position, it is expedient to compare forms of the organization of activities with conditions under which the probability of absence in a warehouse of a nomenclature position in case of need does not exceed, for example, 0.001 or 0.1 %.

Today, two main forms of organizing marketing activities are possible. They provide interaction of enterprises in network structures under different conditions:

- based on transactions;
- based on partnership.

The form of the organization of marketing activity based on transactions, assumes the focus on providing only one single transaction. Therefore, it provides purchase of Δ_S products when their quantity in a warehouse reaches a certain "critical level" (s), that is, after receiving these products through the transactional period T_T (the period of preparation of the contract and delivery), at the enterprise there are u products, so, that $s \leqslant u \leqslant n$. The supplier is determined upon the emergence of each single requirement on a tender basis. Such form in modern Ukrainian supply conditions ensures the best price offers at a certain timepoint. But it is risky, as it does not provide the long-term relationships, that is, it does not ensure the necessity of repeated purchases under the same conditions, and also leads to additional transaction costs for each subsequent transaction. The form of the organization, which is based on transactions, is provided by two types of supply contracts. It assumes the existence of the following alternative restrictions of the supply contracts.

The first type of restriction is that suppliers provide supply time (T_T) as the time constraints

$$T_{T\_\min} \leq T_T \leq T_{T\_\max}. \quad (3)$$

The second restriction is in the form of the fixed supply time (T_T).

We will consider these conditions of restrictions within the transaction form of the organization of activities for identical mathematical expectation of supply to determine the most rational ones from the point of view of critical stock rate in a warehouse.

The procedure for calculating the probabilistic characteristics of the supply time and risks for the first type will be defined according to formula (3). The supply period (T_T) depends on many factors, such as the availability of a consumable tool in the producer's/supplier's

warehouse (in full from the need or partially, the condition of production of this type of components, etc.), that is, it is a random variable. As a rule, such a variable is a typical function of the time distribution of the occurrence of a random occurrence

$$f_h(t) = h \cdot e^{-h \cdot t};$$

$$\int_{t=0}^{\infty} f_h(t) \cdot dt = 1, \quad (4)$$

where h is a variable that is inverse of the average time of one transaction (the mathematical expectation (m.e.)) of the supply period – $M_T[T_T]$

$$h = \frac{1}{M_T[T_T]}. \quad (5)$$

In probability theory, a function of the form (4) is determined on a time interval t, so that $0 \le t \le \infty$.

We will accept a function $f_H(t)$ as a distribution option, such that

$$\left.\begin{aligned} \int_{t=0}^{T_{T\_\min}} f_H(t) = 0 \\ \int_{t=T_{T\_\min}}^{T_{T\_\max}} f_H(t) = 1 \\ \int_{t=T_{T\_\max}}^{\infty} f_H(t) = 0 \end{aligned}\right\}. \quad (6)$$

That is, the function $f_H(t)$ has on time periods $0 \le t < T_{T\_\min}$ and $T_{T\_\max} < t \le \infty$ a zero value.

The value of the function $f_H(t)$ on the time interval $T_{T\_\min} \le t \le T_{T\_\max}$ will be sought in the form of an exponential function similar to (4) in form

$$f_H\left(T_{T\_\min} \le t \le T_{T\_\max}\right) = H \cdot e^{-h \cdot t}. \quad (7)$$

Then we have

$$\int_{t=T_{T\_\min}}^{T_{T\_\max}} H \cdot e^{-h \cdot t} \cdot dt = H \cdot \int_{t=T_{T\_\min}}^{T_{T\_\max}} e^{-h \cdot t} dt =$$

$$= \frac{H}{h} \cdot \left(e^{-h \cdot T_{T\_\min}} - e^{-h \cdot T_{T\_\max}}\right) = 1.$$

From here we have

$$H = \frac{h}{e^{-h \cdot T_{T\_min}} - e^{-h \cdot T_{T\_max}}}. \quad (8)$$

Let us find the mathematical expectation for a random variable, which is described by the probability density function (6), taking into account (7, 8)

$$M_{T\_H|h}[T_T] = \int_{t=0}^{\infty} t \cdot f_H(t) \cdot dt = \int_{t=T_{T\_\min}}^{T_{T\_\max}} t \cdot f_H(t) dt =$$

$$= \frac{1}{h} + \frac{T_{T\_\min}}{1 - e^{-h \cdot (T_{T\_\max} - T_{T\_\min})}} +$$

$$+ \frac{T_{T\_\max}}{1 - e^{h \cdot (T_{T\_\max} - T_{T\_\min})}}. \quad (9)$$

Obviously, when $T_{T\_\min} \Rightarrow 0$, $T_{T\_\max} \Rightarrow \infty$ we have $M_{T\_H|h}[T_T] \Rightarrow M_T[T_T]$.

We will define under what conditions $M_{T\_H|h}[T_T] = M_T[T_T]$ takes place for given $T_{T\_\min}$, $T_{T\_\max}$ for the same h.

Proceeding from the equations (5, 9), we have

$$M_{T\_H|h}[T_T] - M_T[T_T] =$$

$$= \frac{T_{T\_\min}}{1 - e^{-h \cdot (T_{T\_\max} - T_{T\_\min})}} + \frac{T_{T\_\max}}{1 - e^{h \cdot (T_{T\_\max} - T_{T\_\min})}}, \quad (10)$$

from here we get

$$h = \frac{\ln\left(0.5 \cdot \left(\frac{T_{T\_\max}}{T_{T\_\min}} + 1\right) + \sqrt{\left(\frac{T_{T\_\max}}{T_{T\_\min}} + 1\right)^2 - 4}\right)}{T_{T\_\max} - T_{T\_\min}}. \quad (11)$$

Let us consider the probability of an event "the equipment stands idle" $P_{\ge m|T}$, where m is the "critical" expense of tools during the transaction period T_T, equal to the tool number in a warehouse at the time of the beginning of the period of transaction plus one unit, that is $m = s + 1$. It can be determined through the sum of the multiplication of the probability of the completion time of the transaction and the probability that during this time m or more tools will fail.

The probability that for a period τ m events will occur is determined by Poisson's law as

$$P_m(\tau) = \frac{(z \cdot \tau)^m}{m!} \cdot e^{-z \cdot \tau}.$$

Then the probability that over a period of time τ m and more units of tools will fail – $P_{\ge m}(\tau)$ will be

$$P_{\ge m}(\tau) = \sum_{i=m}^{\infty} \frac{(z \cdot \tau)^i}{i!} \cdot e^{-z \cdot \tau} =$$

$$= 1 - P_{<m}(\tau) = 1 - \sum_{i=0}^{m-1} \frac{(z \cdot \tau)^j}{j!} \cdot e^{-z \cdot \tau}, \quad (12)$$

where $P_{<m}(\tau)$ is the probability that within a period of time τ fewer than m units of tools will fail; z is the pa-

rameter of the indicative law of distribution or density of the flow of failure of the tool (1, 2).

For models that are described by equations (6–8, 11), the probability that the delivery period, that is, before the arrival of the consignment of consumable tools, *m* or more units of the tool will be spent – $P_{\geq m|T}$ is equal to

$$P_{\geq m|T} = \int_{t=T_{T\_\min}}^{T_{T\_\max}} H \cdot e^{-h\cdot t} \cdot \left(1 - \sum_{j=0}^{m-1} \frac{\left(z\cdot t\right)^j}{j!} \cdot e^{-z\cdot t}\right) \cdot dt =$$

$$= \frac{H}{h} - H \cdot \sum_{j=0}^{m-1} \cdot \frac{z^j}{j!} \cdot \int_{t=T_{T\_\min}}^{T_{T\_\max}} t^j \cdot e^{-(z+h)\cdot t} dt\,.$$

At the second type of the transaction relations when supply time T_T is fixed, the probability that for a period of time τ *m* and more units of tools will fail can be calculated directly by a formula (12), assuming $\tau = T_T$.

The evaluation of two marketing transaction forms of organization of activities will be carried out for the conditions $M_{T\_\mathrm{H}|h}\left[T_T\right] = T_T$, $P_{m|T} = 0.001$. We will accept "the critical level" of a stock of products in the warehouse (*s*) as evaluation criterion as well as the annual planned demand will be taken as such that corresponds to the average requirement of the company. The calculations will be carried out for a fixed mathematical expectation of the supply time, which, according to the practice of mining enterprises, equals from thirty to sixty days. For the case when the supply time is given due to restrictions, we assume that the difference between the maximum and minimum supply time is equal to four weeks. Such conditions and terms of supply are quite typical in Ukraine for the supply of consumables or tools.

The results of calculations of the dependence of the critical stock of products in a warehouse (*s*) on the transaction period ($M_{T\_\mathrm{H}|h}\left[T_T\right]$) are shown in Fig. 1.

Results of calculations for providing mining industry with consumables show that at the form of the organization of the activities based on transactions, the first version has an advantage, providing for a strictly fixed period of the transaction. At equal terms of transaction it

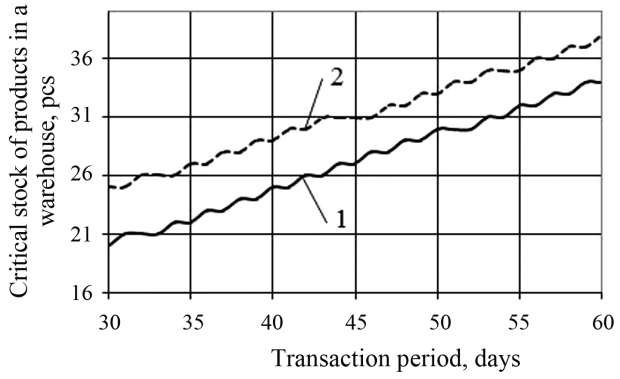

Fig. 1. Dynamics of dependence of a critical stock of products in a warehouse from the transaction period: 1 – at the given transaction interval; 2 – at the fixed transaction time

demands by 15–20 % less critical stock of products in a warehouse that reduces costs of storing products. Equivalent transaction forms become at $M_{T\_\mathrm{H}|h}\left[T_T\right] = T_T$, when $T_{T\_\min} \Rightarrow M_{T\_\mathrm{H}|h}\left[T_T\right]$ and $T_{T\_\max} \Rightarrow M_{T\_\mathrm{H}|h}\left[T_T\right]$.

Results of calculations allow drawing conclusions that at any types of contracts within a transaction form of the organization of marketing activity of the enterprise, the strong relation between the critical level of a stock and the period of transaction is observed. Therefore, providing activities of the enterprises of mining industry with consumable tools in the conditions of unstable demand is inexpedient to carry out because of the high degree of riskiness of the stability of work. Moreover, all forms of organization based on transactions require a significant critical level of stock in the warehouse.

An alternative marketing form of organization of relationships between enterprises is a long-term partnership. The steady nature of cooperation as well as establishment of terms, specifications and the prices of supplies before the production leads to interaction cost cutting. At the same time, the autonomy of the participants in the partnership makes it possible to distribute resources across several key competencies of the enterprise and flexibly adapt to changes in the market conditions, distributing the corresponding risks between the areas of activities. It allows the enterprise to enter different partnership for achievement of aggregate maximum effect at the same time.

We will consider the possibility of using the partnership for the enterprises that produce consumable tools for mining enterprises. The organization of partnership as a form of business consists in establishment of the long-term relations to supply a specified number of consumable components or instruments of a certain nomenclature position. This form provides arrival of a fixed amount of the instrument Δ_s, such that compensates its planned consumption at the warehouse at regular intervals (supply periods T_s)

$$\Delta_s = z \cdot T_s\,. \tag{13}$$

That is, the instrument replenishment to the warehouse can be described by the function

$$r(\tau) = \left]\frac{\tau}{T_s}\right[\Delta_s\,, \tag{14}$$

where] [is the rounding operation to the smaller integer.

As the interaction in partnership takes place on a regular basis, that is quantity of units of products in the order and frequency of supply are established on long-term conditions, it leads to minimization of interaction costs. However, in practice there quite often occurs a situation when expenses of tools exceed its planned arrival. For the analysis of this situation we will put the function of expenses of tools $m(\tau) = s + r(t) + 1$ in compliance to the function of tools receipt on a warehouse, at which the equipment begins to stand idle when the actual expenses of the tool are equal or exceed $m(\tau)$, and

the probability of this event in time can be determined by a formula (12).

The calculations show that the probability of emergence of this situation is rather high as the strong dependence on the fixed frequency of supply and the availability of constant quantity of a stock in a warehouse is observed. The solution of this problem is rather a difficult task connected with complexity of management of partnership that is a natural consequence of interorganizational structures. This leads to the need for constant adjustment of operational and current activities and, accordingly, for adjusting the coordination of the partnership with the corresponding work evaluation.

For elimination of these shortcomings and stabilization of network structure it is expedient to offer the modified form of the organization of activities: partnership with allocation of the enterprise-coordinator (integrator) from among the participants. It will allow carrying out long term flexible interaction of the enterprises of network from the supplier to the consumer on several nomenclature positions. It is proposed to carry out constant coordination of the activities of network participants based on market situation analysis through descriptive marketing research by the coordinator. It will allow tracking changes in market size, purchasing power and changing customer profiles. The analysis of sales by geography of regions, product lines and their sizes will allow determining the perception by each consumer of the type of product and its producer. Thus, the study of distribution that determines the model of trade flows, the number and location of suppliers, the level and the establishment of a possible reaction of consumers to price changes will allow optimizing the processes of production and sale of consumable components throughout the partnership network.

It is especially important when single needs of partners in consumable components and tools are difficult to predict, and the supply lines are formed from several product items, taking into account the volume of the minimum delivery lot. That is, deliveries, in fact, satisfy the individualized demand, random in time, but having a regular character for the enterprises of the whole network.

One of the possible realization of partnership with flexible interaction of the supplier and consumer is the provision for each nomenclature unit of the component supply period – T_{s_p} and the volume of the lot delivered – Δ_{s_p} with no specific date of supply being established. That is, the delivery can be made at any time during the supply period.

This model of the form of the activity organization corresponds to the form of marketing activity of partnership through inequalities

$$1 \le \Delta_{s\_p} \le \Delta_s ;$$

$$T_{s\_p} \le T_s .$$

It is clear that equations (13, 10) must also be satisfied in this case.

At the same time arrival of components at the warehouse is described by a slightly different dependence. For discrete moments of time, it is found by the formula

$$\tau_i = \left\rceil \frac{\tau}{T_{s\_p}} \right\rceil \cdot T_{s\_p}, \quad i = 0,1,2,\ldots.$$

The total number of received components can also be determined by a formula that is similar to (14)

$$r(\tau_i) = r_i = \frac{\tau_i}{T_{s\_p}} \cdot \Delta_{s\_p} .$$

But in a period between τ_i and τ_{i+1} the size of total number of received components is random and lies within

$$r(\tau_i) \le r(\tau) \le r(\tau_{i+1}) \quad \text{with} \quad \tau_i < \tau \le \tau_{i+1} .$$

Therefore, the total number of components can take two fixed values $r(\tau_i)$ or $r(\tau_{i+1})$ depending on the time of occurrence of an event – the arrival of a batch of Δ_{s_p} components. Then, time of the arrival of a batch of components $\tau_{s\_p\,(i,j)}$ is a random variable having a uniform distribution law

$$\left.\begin{aligned} f\left(\tau_{s\_p(\mathrm{i,j})}\right) &= \frac{1}{\tau_{\mathrm{i+1}} - \tau_i} \quad \text{with} \quad \tau_{\mathrm{i}} < \tau \le \tau_{\mathrm{i+1}} \\ f\left(\tau_{s\_p(\mathrm{i,j})}\right) &= 0 \quad \text{with} \quad \tau \le \tau_{\mathrm{i}} \quad \text{and} \quad \tau \le \tau_{\mathrm{i+1}} \end{aligned}\right\}.$$

So, for the probability of supplying r components depending on the time, we have:

- for τ_i

$$P_{r=r_i}(\tau_i) = 1, \quad P_{r\ne r_i}(\tau_i) = 0;$$

- for $\tau_i < \tau \le \tau_{i+1}$

$$\left.\begin{aligned} P_{r=r_i}(\tau) &= \frac{\tau_{i+1} - \tau}{\tau_{i+1} - \tau_i} \\ P_{r=r_{i+1}}(\tau) &= \frac{\tau - \tau_i}{\tau_{i+1} - \tau_i} \\ P_{(r\ne r_i)\wedge(r\ne r_{i+1})}(\tau) &= 0 \end{aligned}\right\}.$$

We will find probability of an occurrence when at this form of the organization of activities the equipment stands idle.

Let us suppose that at the initial moment of time in the warehouse of the enterprise there are s units of the instrument, and for a certain period of time τ the enterprise received r, and spent m instrument units.

The equipment will stand idle when $r < m–s$.

Obviously, this event will occur when the expenses of components will be $m = s + 1$ with receipt $r = 0$, at $m = s + 2$ – will be $r \le 1$, at $m = s + k$ – will be $r \le k - 1$, etc. Then the probability of such an occurrence can be considered by a formula

$$P_{r<m-s}(\tau)=\sum_{m=s+1}^{\infty}\left(P_m(\tau)\cdot\sum_{r=0}^{m-(s+1)}P_r(\tau)\right). \quad (15)$$

For practical use we will rewrite formulas (15) using the rule of "three sigmas"

$$P_{r<m-s}(\tau)=\sum_{m=s+1}^{M[m(\tau)]+3\cdot\sigma_{m(\tau)}}\left(P_m(\tau)\cdot\sum_{r=0}^{m-(s+1)}P_r(\tau)\right).$$

For the Poisson law defined by (3) we have

$$\left.\begin{aligned} m(\tau)&=z\cdot\tau\\ \sigma_{m(\tau)}&=\sqrt{z\cdot\tau}\end{aligned}\right\}.$$

The assessment of rationality of the resulted forms of business will be made by their modeling in the environment of Matlab.

As for an organizational form such as partnership with allocation of the enterprise – integrator, a possibility of changing the frequency of deliveries and units of products in batch is important, therefore, we will perform calculations for this form for three various conditions of interaction which the coordinator can provide: with determined periods of delivery and batch size.

Results of the calculation of the initial level of a stock (s) depending on the current time of operation of the long-term supply agreement in usual partnership and partnership with the enterprise-integrator which previously determined frequency and volumes of single party of a single delivery lot, are shown in Fig. 2, graph 2.

Fig. 2 shows the dependence of the minimum stock of the tool in a warehouse at which risk of their exhaustion with the accepted probability is minimum, on the term of interaction. That is, for the given schedules for each term it is possible to determine what stock of products should be in the warehouse so that no situation of "lack of products" can occur with the probability no less than the set

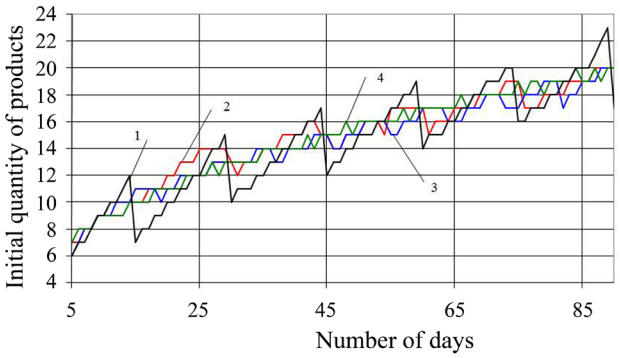

Fig. 2. The results of calculating the critical initial number of products in the warehouse, depending on the current time of the operation of long-term relationships with the pre-determined terms of delivery:
1 – under the terms of regular partnership; 2–4 – according to the conditions of flexible partnership with different supply terms regarding the period and volumes of the batch

one at this particular time. Graph 1, describing usual partnership, shows shortcomings which were proved mathematically, namely, the local maxima are brightly expressed. This suggests that there is a strong dependence on the frequency of supply and, as a result, the need to increase the minimum stock in the warehouse is observed. In this regard, the time needed to make a decision on adjusting the terms of supply is reduced, as the terms of the partnership provide for established long-term interaction with a predetermined period and the volume of supplies. This indicates the need to increase the stock of products for ensuring stability of network functioning.

In contrast to the usual partnership, the partnership with the enterprise-integrator integrating from the number of participants (Fig. 2, graphs 2–4), there is an absence of local maxima in the dynamics of the interaction time and the initial level of the stock. At the same time, the critical stock of products in the warehouse weakly depends on the frequency of interaction. So, the situation when the tools are out of stock is less likely than in usual partnership with the same initial stock. It allows ensuring the possibility of stabilizing the interaction of enterprises in the network and quickly adjusting volumes and time of supply through timely coordination by the enterprise-coordinator in the long-term. Therefore, the integrator due to support of coordination of activities of partners and continuous monitoring of conditions of interaction has an opportunity to stabilize partnership and to reduce an initial stock in a warehouse by 15 % at least in case of different conditions of deliveries relative to the period and the volume of supply.

Conclusion.

1. Due to the fact that the markets of the mining industry of Ukraine are in the process of permanent transformations, enterprises must dynamically adapt to the conditions of the external environment. Studies have shown that under these conditions, the reorganization of the enterprise management of production and supplying components requires changes in several directions simultaneously: formal structures and systems, and organizational behavior.

2. The approach to forming the models of the network organization of business, based on the mathematical description of probabilistic processes in the economic system, which allows describing the behavior of business partners formally, is proposed and justified.

3. Models of forms of the industrial enterprise relationship in the network structure which allows comparing different marketing forms of the organization for coordination of activities under equitable conditions for all network participants are offered.

4. Based on the modeling, the new type of partnership within network structure is suggested. It assumes existence of the enterprise-coordinator (integrator) from the number of participants with certain functional responsibilities that allows minimizing risks of demand fluctuations for product in unstable markets.

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Мета. Розробка способу координації взаємодії промислового підприємства з партнерами на засадах маркетингу шляхом аналізу виникнення й запобігання негативних подій.

Методика. Запропоновано підхід до створення моделей мережевої організації бізнесу, що має властивість адаптації всіх учасників партнерства до зовнішнього середовища, яке безупинно змінюється. Підхід базується на математичному описі ймовірнісних процесів в економічній системі та дозволяє формально описувати поведінку бізнес-партнерів без участі та за участю координатора для вибору економічно вигідної в конкретній ситуації.

Результати. Запропоновані моделі порівняння маркетингових форм організації взаємовідносин промислових підприємств від постачальника й виробника до споживача, що мають властивість оцінювати форми управління мережевою структурою за різних умов зовнішнього та внутрішнього середовища. Побудовані математичні моделі дозволяють співставляти різні маркетингові форми організації взаємовідносин за параметрами виробничої діяльності підприємства за однакової ймовірності настання негативної ситуації. Показано, що найбільш доцільною формою маркетингової діяльності підприємства, що виготовляє витратні інструменти, є гнучкі партнерські відносини, які передбачають формування партнерської мережі з підприємством-інтегратором.

Наукова новизна. Розвиток теорії управління маркетинговою діяльністю шляхом створення модельного інструментарію, що сприяє обґрунтованому вибору різновиду координації взаємодії промислового підприємства з партнерами при мережевій організації бізнесу для отримання рівновигідних умов для всіх учасників. Перевага моделі полягає в її адаптивності до зовнішнього середовища, що динамічно змінюється, та врахуванні ризиків, що виникають унаслідок формування споживчого попиту, що має ймовірнісний характер.

Практична значимість. Запропоновані ймовірнісні критерії оцінки маркетингових форм взаємодії підприємств у межах мережевої структури дозволяють обирати нові різновиди партнерства, що мінімізують ризики коливань попиту на продукцію за допомогою організації діяльності підприємства-інтегратора.

Ключові слова: *маркетингові форми організації діяльності, промислове підприємство, мережеві структури, партнерство, витратні комплектуючі, імовірнісні моделі*

Цель. Разработка способа координации взаимодействия промышленного предприятия с партнерами на принципах маркетинга путем анализа возникновения и предотвращения негативных событий.

Методика. Предложен подход к созданию моделей сетевой организации бизнеса, имеющий свойство адаптации всех участников партнерства к внешней среде, которая непрерывно меняется. Подход базируется на математическом описании вероятностных процессов в экономической системе и позволяет формально описывать поведение бизнес-партнеров без участия и с участием координатора для выбора экономически выгодного в конкретной ситуации.

Результаты. Предложены модели сравнения маркетинговых форм организации взаимоотношений промышленных предприятий от поставщика и производителя к потребителю, имеющих свойство оце-

нивать формы управления сетевой структурой при различных условиях внешней и внутренней среды. Построенные математические модели позволяют сопоставлять различные маркетинговые формы организации взаимоотношений по параметрам производственной деятельности предприятия при одинаковой вероятности наступления негативной ситуации. Показано, что наиболее целесообразной формой маркетинговой деятельности предприятия, производящего расходные инструменты, являются гибкие партнерские отношения, которые предполагают формирование партнерской сети с предприятием-интегратором.

Научная новизна. Развитие теории управления маркетинговой деятельностью путем создания модельного инструментария, который способствует обоснованному выбору вида координации взаимодействия промышленного предприятия с партнерами при сетевой организации бизнеса для получения равновыгодных условий для всех участников. Преимущество модели заключается в ее адаптивности к внешней среде, которая динамично меняется, и учетом рисков, возникающих вследствие формирования потребительского спроса, который имеет вероятностный характер.

Практическая значимость. Предложенные вероятностные критерии оценки маркетинговых форм взаимодействия предприятий в рамках сетевой структуры позволяют выбирать новые разновидности партнерства, минимизируют риски колебаний спроса на продукцию посредством организации деятельности предприятия-интегратора.

Ключевые слова: *маркетинговые формы организации деятельности, промышленное предприятие, сетевые структуры, партнерство, расходные комплектующие, вероятностные модели*

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THE MANAGEMENT FEATURES OF THE UNIVERSITY PREPARATORY DEPARTMENT

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ОСОБЛИВОСТІ УПРАВЛІННЯ ПІДГОТОВЧИМ ВІДДІЛЕННЯМ УНІВЕРСИТЕТУ

Purpose. To reveal the management features of the university preparatory department in the philosophical tradition of Plato, according to which the acquisition of knowledge is regarded as a way of life. The authors focus on: 1) the frequency of renewal of student flows; 2) the hybridization of education in the prospects of global transformation of education; 3) the need to adapt university entrants to higher education.

Methodology. The authors used the dialectical, system-structural, structural-functional method, as well as methods of comparison, analysis, synthesis, and expert assessment.

Findings. It is proposed to organize the management of the university preparatory department according to the philosophical tradition of Plato's line, which allows university entrants to view knowledge as a way of life, and not as a service. The authors identified and considered the three major features in the management of university preparatory department that currently require special attention: 1) the frequency of renewal of student flows; 2) the hybridization of education in the prospects of global transformation of education; 3) the need to adapt university entrants to higher education. The author's solutions of the above-mentioned tasks are proposed.

Originality. The strategy of managing the university preparatory department according to the philosophical tradition of Plato's line is developed, which allows university entrants to view knowledge as a way of life, and not as a paid service.

Practical value. The use of the results obtained in educational practice makes it possible to reveal the possibilities of knowledge as a guide to the fullest possible self-realization in life; knowledge as the possibility of achieving the goal in life; knowledge as an opportunity to find life predestination.

Keywords: *university preparatory department, university entrants, Plato's line, knowledge as a way of life, management*