DOI: 10.15587/978-617-7319-66-4.CH5

Diana Raiko, Irina Fedorenko, Olena Kitchenko,
Valerii Kobieliev, Mariia Litvynenko, Tatiana Romanchik

CHAPTER 5

MANAGEMENT OF THE INTERACTION OF THE ENTERPRISE WITH PARTNERS AND CONSUMERS: MODELS, METHODS AND INFORMATION INTERACTION

ABSTRACT

The management of the interaction of an enterprise with partners and consumers is based on the system "enterprise – consumer – partner", takes into account the ratio of economic parameters of the processes of production, supply and distribution of products, including an assessment of the competitiveness of the enterprise, the attractiveness of the partner, the readiness of the consumer and the developed complex of economic and mathematical models for forming the composition of the system "consumer – enterprise – partner", determining the effect of its operation and the budget of information interaction, the features of which are the allocation of four blocks of models, which allows for a reasonable choice of the composition of consumers, partners for each enterprise, taking into account their characteristics and information interaction strategies, allowing enterprises to model communication in the system "consumer – enterprise – partner" according to the criterion of maximizing income and use the results of modeling for the implementation of information interaction.

KEYWORDS

Interaction management, enterprise, partners, consumers, economic and mathematical models, information interaction.

In the process of functioning in the market, the social component of the enterprise is revealed, which characterizes the internal relations between members of the team and external relations between the enterprise and potential or real consumers, competitors, partners, government bodies, and other contact groups. Therefore, the key factor in the strategic management of the development of the marketing activity of an enterprise is the refinement and development of the theory and practice of managing the interaction of an enterprise in the system "consumer – enterprise – partner", which together allows solving an important problem – scientifically sound generation of information interaction strategies for each enterprise [1].

Within the framework of the concept of strategic management of the marketing activity of an enterprise, it is proposed (**Fig. 5.1**): to consider a modern enterprise as an open socio-economic

system, the basis for the development of which is marketing as a business philosophy; when studying an industrial enterprise, separately investigate its social and economic components; to improve the efficiency of the functioning of the enterprise and its market counterparties, to implement the association in the system "consumer – enterprise – partner"; to form marketing strategies for an industrial enterprise based on an assessment of three components – its competitiveness, the business attractiveness of partners in cooperation with them and the consumer's readiness to consume the products of this enterprise; define the concept of "information interaction" as a process of formation and implementation of long-term relations for the exchange of information between an enterprise, partners and consumers, where the enterprise plays a leading role, indirectly uniting its partners and consumers, in order to ensure an increase in the profits of all subjects of the aforementioned system based on the usefulness of the information received, contributing to the formation of the surplus value of the received resources and products. The implementation of the concept is carried out according to the proposed methodological approach to the formation of strategies for information interaction of an enterprise, which is based on three components – the competitiveness of an enterprise, the business attractiveness of its partners in cooperation with it, and the readiness of consumers to consume the products of this enterprise. Each quadrant of the developed approach corresponds to a specific position of consumer readiness, business attractiveness of a partner and competitiveness of an enterprise, which allows to reasonably choose an appropriate strategy for information interaction between an enterprise and market entities (with a definition of types, information interaction tools, types of expenses) according to an improved classification and methods for calculating the budget on marketing communications that can be used in the formation of the budget for the information interaction of this enterprise. Information interaction should take place on the basis of the formed budget, so it is necessary to improve the methodological approach to modeling the information interaction budget [1–12].

The main idea of managing the interaction of an enterprise with partners and consumers is that the object of management is the relationship (communications, information interaction) with consumers and partners implemented in the system "consumer – enterprise – partner". The presence of two-way communication in the system "enterprise – partner – consumer" is an information interaction that promotes active exchange between all types of communicators: the enterprise and its supply partner, and the enterprise and the consumer to meet the demand that arises in the process of activating the needs of consumers [2]. Within the framework of the "enterprise – partner – consumer" system, not only communication flows, but also information flows take place, which is largely due to the development in addition to traditional, virtual communications; and virtual communications. Due to the wide range of virtual communications, the concept of marketing communications is no longer enough to determine all the processes that take place between the subjects of interaction in the market. Marketing communications are a narrow understanding that constitutes information interaction. Thus, it allows to expand the boundaries of marketing communications and talk about such a concept as information interaction, which becomes much more understandable.

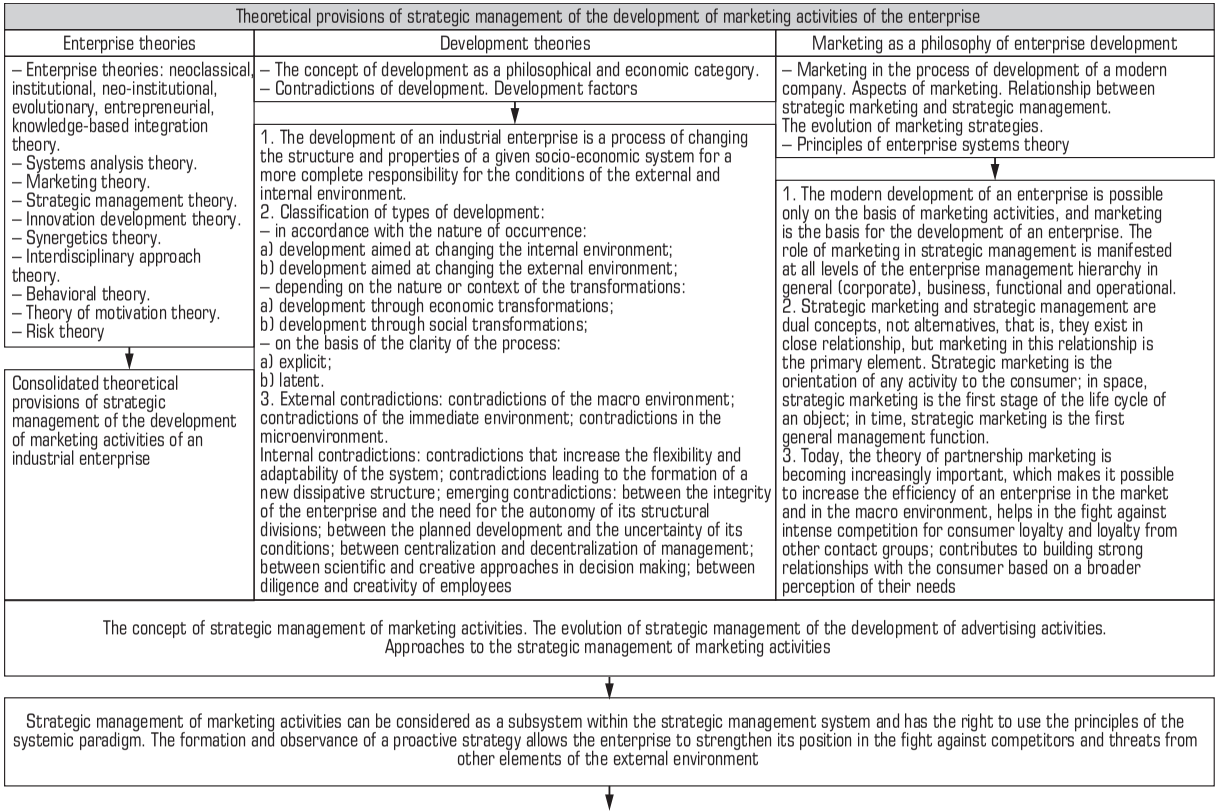

Fig. 5.1 (beginning) Structural and logical scheme of work

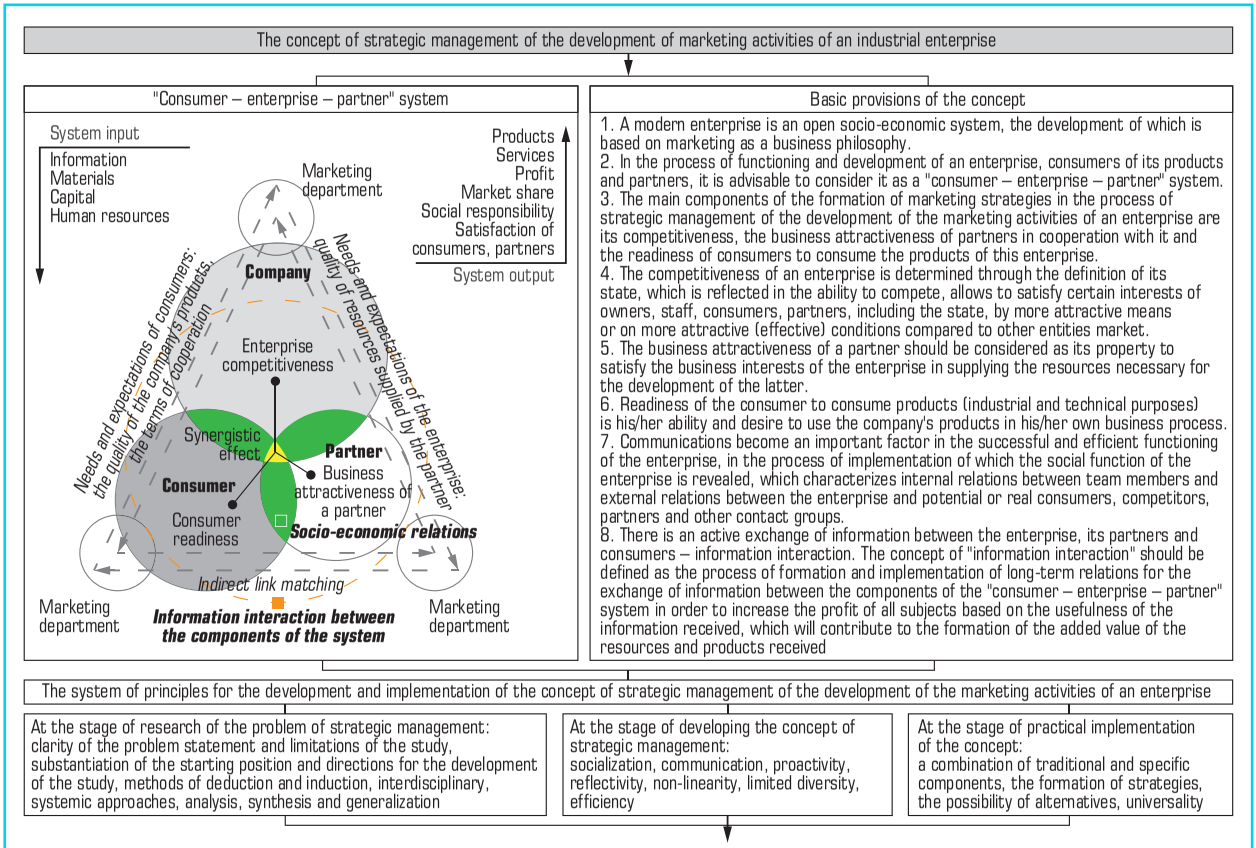

Fig. 5.1 (continuation) Structural and logical scheme of work

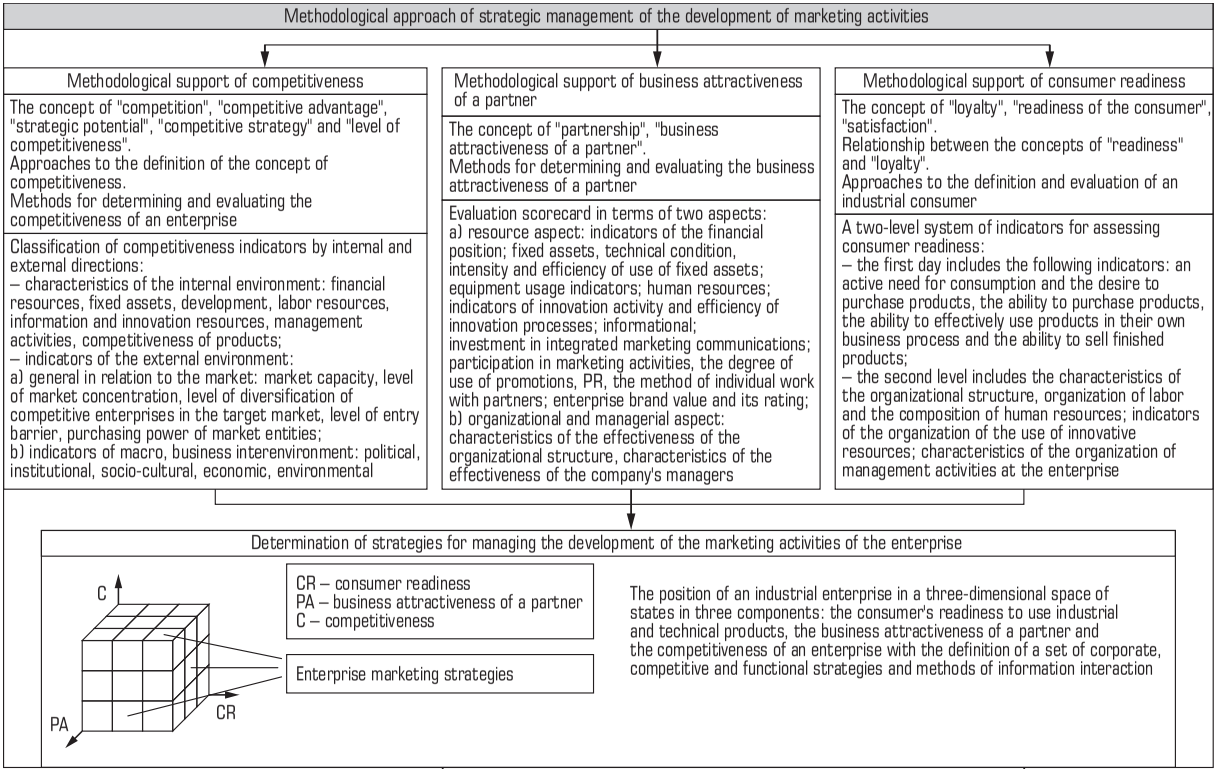

Fig. 5.1 (continuation) Structural and logical scheme of work

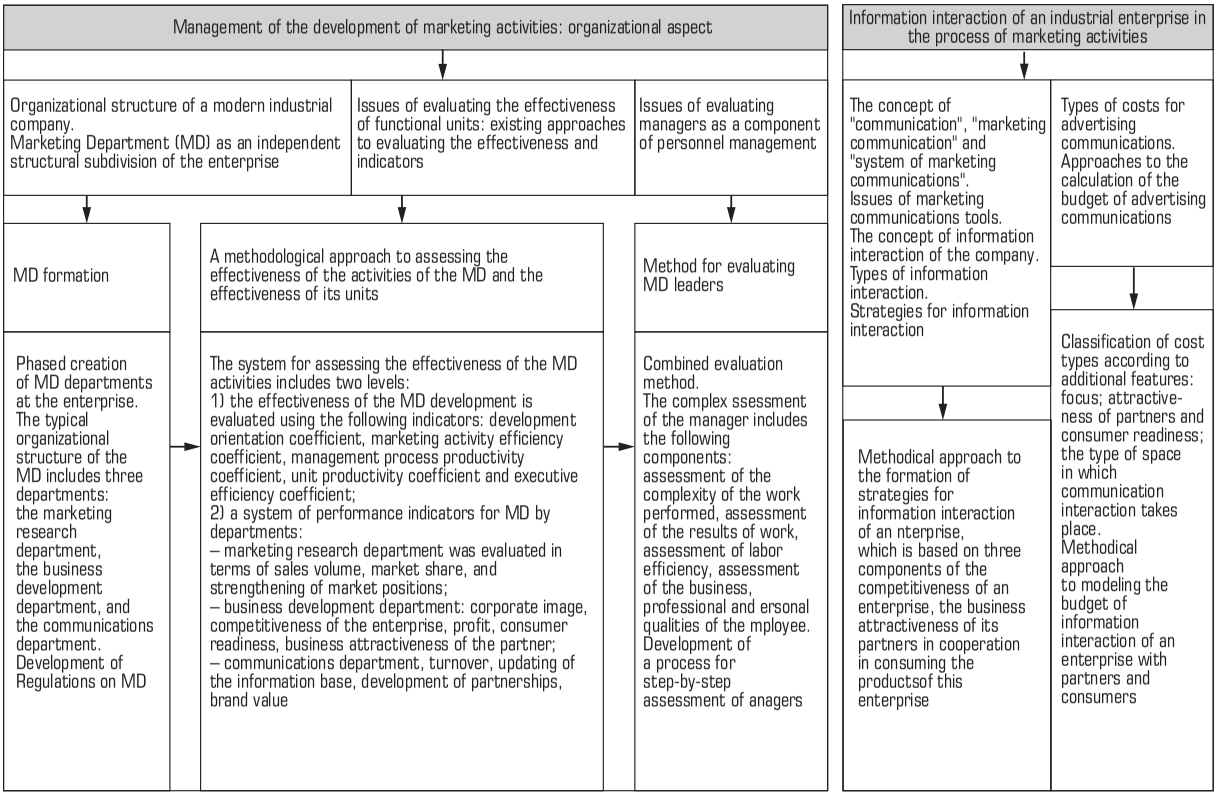

Fig. 5.1 (continuation) Structural and logical scheme of work

Marketing communications are one of the tools of information interaction, therefore, properly formed marketing communications will allow to fully approach the goal of information interaction – establishing long-term and mutually beneficial relationships with partners and consumers. Realization of this goal is one of the most important and at the same time complex tasks. This is due to the formation of an effective combination of means of advertising communications, with the correct selection of tools for information interaction. The overall size of the company's costs and their effectiveness depend on this.

Therefore, the purpose of this section is to manage the interaction of an enterprise with partners and consumers according to the proposed set of economic and mathematical models for determining the relationship of an enterprise, partners, consumers, taking into account the conditions of competition and the formation of an enterprise communications budget as part of the "consumer – enterprise – partner" system, which will allow determining the level of profit of the enterprise, depending on the competitiveness, the ratio of the attractiveness and readiness of partners and consumers of different levels with whom the enterprise works and to make a choice of an information interaction strategy. This complex allows enterprises to model communications in the "consumer – enterprise – partner" system according to the criterion of profit maximization, which is subsequently used to implement information interaction.

To achieve this goal, the following conceptual model for the formation of the composition of the "consumer – enterprise – partner" system, the definition of the effect of their functioning and information interaction, presented in **Fig. 5.2**.

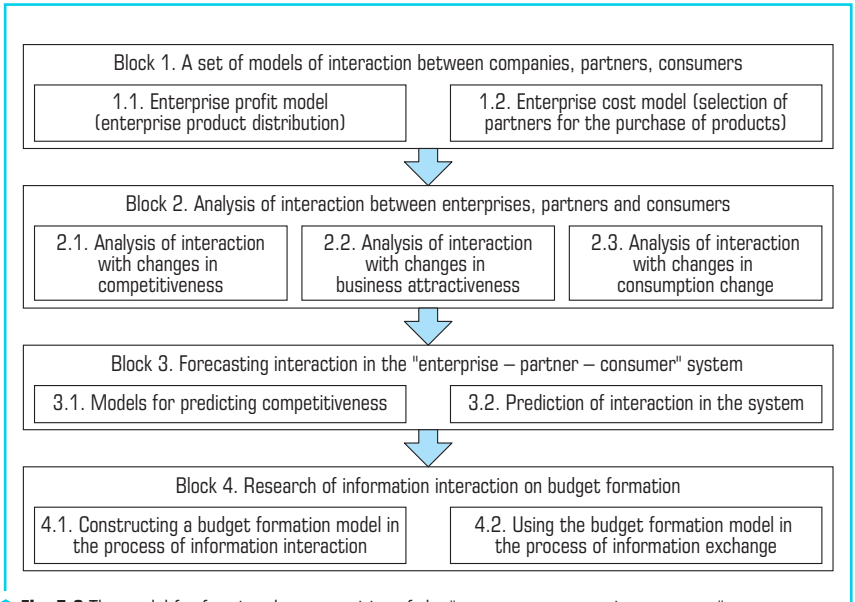

Fig. 5.2 The model for forming the composition of the "consumer – enterprise – partner" system, determining the effect of their functioning and information interaction

Block 1. A set of models of interaction between companies, partners, consumers.

Many possible buyers and partners are legal entities, for each of which a marketing strategy can be applied in accordance with the ratio of the levels of competitiveness of the enterprise, business attractiveness and readiness as a consumer.

The structure of the set of possible consumers of each company can be used to form the composition and size of information interaction, taking into account the peculiarities of using information interaction tools, restrictions on the low level of consumer readiness and allocated funds.

Let's assume that we are considering the production and consumption of certain products in the field of mechanical engineering with the corresponding provision with the necessary components produced by partners, namely components, materials, semi-finished products for this enterprise, supplied in batches or by the piece (using the example of 2019).

Details, equipment in reporting are in batches and in pieces. To ensure the production of the main competing industrial enterprises that provide the demand for the same type of products, the corresponding functionally similar products of partner enterprises, which differ in the price of supplies, can be used. In this case, the supply volumes can be measured in batches containing the assortment of products necessary for production or their parts in accordance with the production need or the creation of stocks for future production. According to the assumptions made regarding the composition of enterprises in the engineering industry, their possible partners and possible consumers, let's consider the formation of a mathematical model to determine the set of reasonable buyers and the set of reasonable partners. As an objective function, it is advisable to use the total income from attracting potential partners and consumers to the relationship.

Thus, it is advisable in this block to construct models in two directions:

1) the profit model of enterprises;

2) the enterprise cost model.

Let's consider any of the models.

1.1. Profit model of enterprises.

This model allows to determine the set of partners and consumers consuming the products of the enterprises under study.

Let's introduce the following notation:

I – a set of enterprises;

J – a set of partners;

K – a set of consumers;

x_{ij} – a variable that determines the choice for consumption of products of the i-th enterprise by the j-th partner, $i \in I$, $j \in J$;

y_{ik} – a variable that determines the choice for consumption of products of the i-th enterprise by the k-th consumer, $i \in I$, $k \in K$;

k_i – integral indicator of competitiveness of the i-th enterprise, $k_i \in [0,1]$, $i \in I$;

a_j – integral indicator of business attractiveness of the j-th partner, $a_j \in [0,1]$, $j \in J$;

b_k – integral readiness index of the k-th consumer, $b_k \in [0,1]$, $k \in K$;

v_j – annual volume of consumption products for the j-th partner, [thousand UAH], $j \in J$;

w_k – annual volume of consumption of products by the k-th consumer, [thousand UAH], $k \in K$;

p_{ij} – proceeds from the purchase of products of the i-th enterprise by the j-th partner, [thousand UAH], $i \in I$, $j \in J$;

q_{ik} – proceeds from the purchase of products of the i-th enterprise by the k-th consumer, [thousand UAH], $i \in I$, $k \in K$;

V_i – total volume of products of the i-th enterprise, produced for its partners and consumers, [thousand UAH], $i \in I$.

In these notations, variable indicators of competitiveness, business attractiveness and readiness for consumption are introduced.

The proposed definition of the content of the business attractiveness of partners and the readiness of consumers allows to interpret them as the probability of an appropriate interaction of an enterprise with a partner or consumer, and on the other hand, the competitiveness of an enterprise – as the probability of cooperation with potential partners and buyers, that is, these indicators affect the probability of making a profit enterprise. Due to the fact that the profit of enterprises needs to be adjusted for the magnitude of the probability, from the point of view of studying the economic effect, let's consider not the absolute indicator of profit, but its expected monetary value (taking into account the probability). This value can be represented by the following decision tree (**Fig. 5.3**).

Thus, the expected monetary value (EMV) of profit is defined as the sum of EMV of the profit (EP) received from sales of products to partners and EMV of the profit received from of sales of products to consumers.

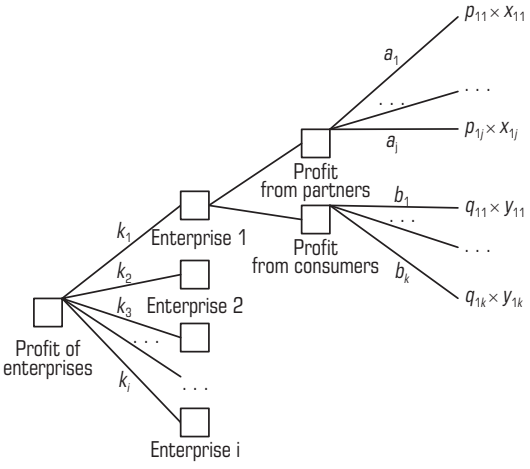

Fig. 5.3 Decision tree for model construction 1

The objective function takes the form:

$$EP = \sum_i k_i \left(\sum_j a_j \cdot p_{ij} \cdot x_{ij} + \sum_k b_k \cdot q_{ik} \cdot y_{ik} \right). \quad (5.1)$$

Each enterprise will sell its products to partners and consumers in order to maximize its profit, so the objective function must comply with the maximization criterion, i.e.

$$EP \to \max.$$

To solve this problem, let's construct a system of constraints:

1. Restriction of output by each enterprise.

The available volume of consumption of the products of each enterprise by partners and consumers is limited by the volume of production of each enterprise, that is, the share corresponding to the competitiveness of the enterprise:

$$\sum_j v_j x_{ij} + \sum_k w_k y_{ik} \le V_i. \quad (5.2)$$

2. Limiting the consumption of partners and consumers. The volume of satisfaction of consumers and partners should not exceed their needs, i.e.

$$\sum_i v_j x_{ij} \le v_j, \ \sum_i w_k y_{ik} \le w_k.$$

3. Limitation of the number of satisfied consumers and partners by one enterprise. The maximum number of partners and consumers served by one enterprise should not exceed their maximum number, as well as the values and should not be negative:

$$\sum_j x_{ij} \le j, \ x_{ij} \ge 0; \ \sum_k y_{ik} \le k, \ y_{ik} \ge 0.$$

Thus, model 1.1 takes the form:

$$EP = \sum_i k_i \left(\sum_j a_j \cdot p_{ij} \cdot x_{ij} + \sum_k b_k \cdot q_{ik} \cdot y_{ik} \right) \to \max,$$

$$\begin{cases} \sum_j v_j x_{ij} + \sum_k w_k y_{ik} \le V_i, \\ \sum_i v_j x_{ij} \le v_j, \sum_i w_k y_{ik} \le w_k, \\ \sum_j x_{ij} \le j, \ x_{ij} \ge 0, \\ \sum_k y_{ik} \le k, \ y_{ik} \ge 0. \end{cases} \quad (5.3)$$

1.2. Enterprise cost model.

With the help of the cost model, a set of partners is formed, in which the enterprise will purchase products for itself:

z_{ij} – a variable that determines the level of supplies of products of the j-th partner for the i-th enterprise, [batches], $i \in I$, $j \in J$;

c_j – price of products of the j-th partner, [thousand UAH/batch], $j \in J$;

s_i – annual volume of consumption for the i-th enterprise of the products of partners, [thousand UAH], $i \in I$;

d_j – annual output of the j-th partner required for the main production of enterprises in the engineering industry, [thousand UAH], $j \in J$;

The principle of constructing this model is similar to the principle of constructing model 1.1. The target variable is the expected monetary value of the costs, which has the form:

$$EZ = \sum_i k_i \sum_j a_{ij} \cdot c_j \cdot z_{ij} \cdot d_j.$$

Since the costs at the enterprise are better the lower they are, this objective function must be minimized, i.e.

$$EZ \to \min. \tag{5.4}$$

The limitations are:

1) limitation of partners' own products.

Each partner has limited volumes of its own products:

$$\sum_i z_{ij} d_j \le d_j; \tag{5.5}$$

2) ensuring production.

The volume of deliveries of partner products should ensure the main production of each enterprise:

$$\sum_j z_{ij} d_j \ge s_i. \tag{5.6}$$

Thus, model 1.2 has the form:

$$EZ = \sum_i k_i \sum_j a_{ij} \cdot c_j \cdot z_{ij} \cdot d_j \to \min,$$

$$\begin{cases} \sum_i z_{ij} d_j \le d_j, \\ \sum_j z_{ij} d_j \ge s_i. \end{cases}$$

The constructed models 1.1 and 1.2 will help to form the budget for information interaction in the "enterprise – partner – consumer" system.

Block 2. Analysis of interaction between enterprises, partners, consumers.

When solving models 1.1 and 1.2 with fixed values of competitiveness, business attractiveness and readiness for consumption, let's obtain a fixed maximum depreciation of profits and a minimum value of enterprises' costs. However, it should be noted that since the economic system is prone to change, the value of competitiveness, business attractiveness and readiness for consumption may change over time, in addition, there may be a purposeful change in these parameters to achieve greater profits and lower costs. Let's analyze the interaction between enterprises, partners, consumers when changing the parameters of their competitiveness and changing indicators of business attractiveness of partners and consumer readiness for consumption.

Let's conduct research for three enterprises Enterprise 1, Enterprise 2 and Enterprise 3, which have functionally similar products, nine partners and 29 consumers.

Data on enterprises are presented in **Table 5.1**. The set of possible consumers of the products of these enterprises, estimates of their consumption levels, obtained on the basis of marketing research, statistical analysis and retrospective data of enterprises on the volume of product consumption and assessment of readiness for consumption are given in **Table 5.2**. The set of possible partners of the enterprise and their selected characteristics are given in **Table 5.3**.

Table 5.1 Enterprises and assessment of their competitiveness

Name	Integral indicator of competitiveness (actual values)	Annual consumption of partners' products, batches/year	Annual output in 2018 prices, thousand UAH/year
Enterprise 1	0.389	22	280
Enterprise 2	0.471	20	370
Enterprise 3	0.358	20	250

Table 5.2 Potential consumers of products

Enterprise	Integral indicator of consumer readiness in 2019	The volume of consumption of products, thousand UAH/year	Profit from the consumption of products of enterprises, thousand UAH/year		
			Enterprise 1	Enterprise 2	Enterprise 3
1	2	3	4	5	6
Consumer 1	0.4855	48	17.48	19.81	22.14
Consumer 2	0.4131	48	14.87	16.85	18.84
Consumer 3	0.6907	32	16.58	18.79	21.00
Consumer 4	0.9983	64	47.92	54.31	60.70
Consumer 5	0.9221	64	44.26	50.16	56.06
Consumer 6	0.5565	48	20.03	22.71	25.38
Consumer 7	0.5667	48	20.40	23.12	25.84

Continuation of Table 5.2

1	2	3	4	5	6
Consumer 8	0.3564	24	6.42	7.27	8.13
Consumer 9	0.4074	58	17.72	20.08	22.45
Consumer 10	0.3197	24	5.75	6.52	7.29
Consumer 11	0.1206	64	5.79	6.56	7.33
Consumer 12	0.5878	48	21.16	23.98	26.80
Consumer 13	0.4864	48	17.51	19.85	22.18
Consumer 14	0.9932	32	23.84	27.02	30.19
Consumer 15	0.7568	32	18.16	20.58	23.01
Consumer 16	0.3946	24	7.10	8.05	9.00
Consumer 17	0.1653	24	2.98	3.37	3.77
Consumer 18	0.5183	32	12.44	14.10	15.76
Consumer 19	0.2002	32	4.80	5.45	6.09
Consumer 20	0.9418	24	16.95	19.21	21.47
Consumer 21	0.9049	24	16.29	18.46	20.63
Consumer 22	0.4328	32	10.39	11.77	13.16
Consumer 23	0.7418	32	17.80	20.18	22.55
Consumer 24	0.9547	32	22.91	25.97	29.02
Consumer 25	0.4934	24	8.88	10.07	11.25
Consumer 26	0.9701	48	34.92	39.58	44.24
Consumer 27	0.5138	24	9.25	10.48	11.71
Consumer 28	0.9258	24	16.66	18.89	21.11
Consumer 29	0.598	32	14.35	16.27	18.18

Table 5.3 Potential business partners

Enterprise	Integral indicator of business attractiveness of a partner, 2019	The volume of consumption of products, thousand UAH/year	Partner's production volume, batches/ year	The price of the partner's products, thousand UAH/batch	Profit from the consumption of products of enterprises, thousand UAH/year		
					Enterprise	Enterprise	Enterprise
Partner 1	0.39	112	10.2	0.24	18.72	21.22	23.71
Partner 2	0.41	128	15	0.22	14.76	16.73	18.70
Partner 3	0.34	64	7.5	0.33	16.32	18.50	20.67
Partner 4	0.45	48	6.4	0.35	16.20	18.36	20.52
Partner 5	0.51	84	4.4	0.3	18.36	20.81	23.26
Partner 6	0.34	48	7	0.3	8.16	9.25	10.34
Partner 7	0.35	48	5.4	0.28	8.40	9.52	10.64
Partner 8	0.56	48	6.2	0.29	35.28	39.98	44.69
Partner 9	0.39	48	3.5	0.35	16.97	19.23	21.49

Block 2.1. Analysis of interaction when changing in competitiveness.

To study the interaction within the "enterprise – partner – consumer" system, let's analyze the interaction with the actual data of competitiveness and a change in competitiveness by 0.1 units (imitation of the system behavior).

Partners of the company and its consumers with the competitiveness of the company 1 – 0.389 are presented in **Table 5.4**.

Partners of the company and its consumers with the competitiveness of the company 2 – 0.471 are presented in **Table 5.5**.

Table 5.4 Interaction of company 1 with partners and consumers

No.	Scope of supply, thousand UAH	Volume of purchase, batches
1	112	5.2
2	1,892,035	4.4
3	6,107,965	7
4	48	5.4
5	48	0
6	32	0
7	32	0
Total	280	22

Table 5.5 Interaction of company 2 with partners and consumers

No.	Scope of supply, thousand UAH	Volume of purchase, batches
1	0	5
2	0	15
3	34	0
4	48	0
5	64	–
6	64	–
7	32	–
8	24	–
9	32	–
10	48	–
11	24	–
Total	370	20

Partners of enterprise 3 and its consumers with a competitiveness of 0.358 are presented in **Table 5.6**.

Table 5.6 Interaction of company 3 with partners and consumers

No.	Scope of supply, thousand UAH	Scope of purchase, thousand UAH
1	128	0
2	0	3.1
3	48	2.8
4	50	4.4
5	0	6.2
6	0	3.5
7	24	–
Total	250	20

The simulation of the system behavior is carried out on the basis of model 1.1 with a change in its competitiveness by 0.1 and under otherwise equal conditions, i.e. the competitiveness of other enterprises, the attractiveness of partners and the willingness to consume do not change.

The results of the simulation, namely the dynamics of the dependence of profits and costs of each enterprise on changes in competitiveness, are given in **Table 5.7**.

The dynamics of the dependence of profits and costs of each company on the configuration of competitiveness is given in **Table 5.7**.

Table 5.7 Dependence of profit on the configuration of competitiveness for different companies

Competitiveness	Enterprise 1 (0.389)		Enterprise 2 (0.471)		Enterprise 3 (0.358)	
	Income	Costs	Income	Costs	Income	Costs
0.1	209.1	3.8	164.6	3.7	207.5	4.1
0.2	221.7	4.4	183.8	4.2	221.6	4.6
0.3	234.2	5.0	203.1	4.8	235.7	5.2
0.4	246.7	5.6	224.9	5.3	252.5	5.7
0.5	260.4	6.0	253.7	5.6	269.6	6.2
0.6	278.4	6.4	282.5	6.0	286.7	6.6
0.7	298.1	6.8	311.2	6.3	318.9	7.0
0.8	317.8	7.2	340.0	6.7	341.4	7.4
0.9	337.5	7.6	368.7	7.1	363.9	7.8
1	357.2	8.0	397.5	7.4	386.4	8.2

Let's conduct a study of the interaction between enterprises, partners and consumers based on the analysis of income and expenses with changes in competitiveness. The dependence of EMV profits on the configuration of competitiveness and growth of EMVs in the enterprise is shown in **Fig. 5.4**, **5.5**.

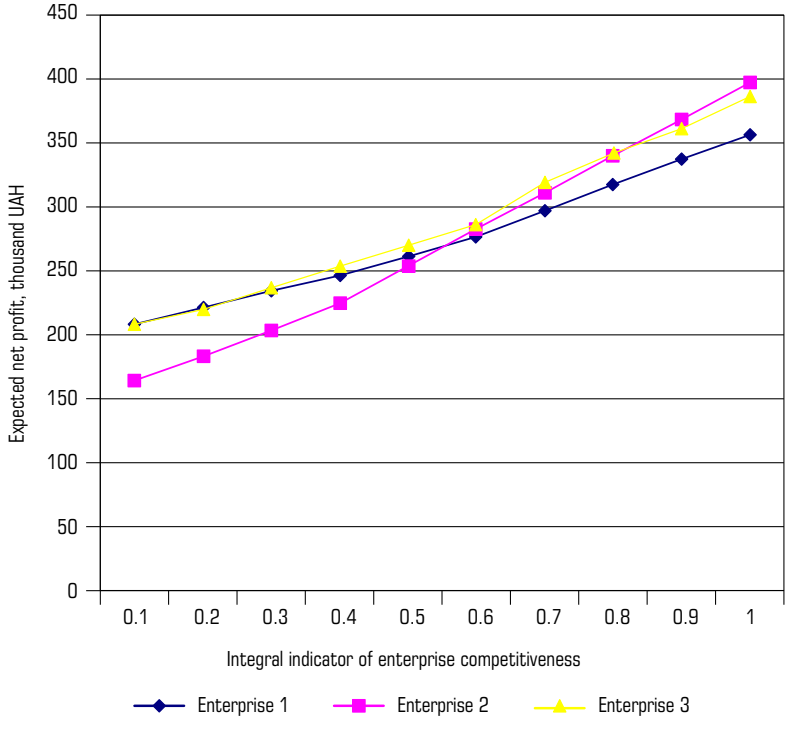

Fig. 5.4 Dependence of the expected monetary value of net profit on changes in the competitiveness of the enterprise

Analysis of **Fig. 5.4**, **5.5** allows to draw the following conclusions:

1) with a change in competitiveness by 0.1 units, the total EMV profit of enterprises constantly increases;

2) the greatest growth is observed at enterprise 2, the smallest – at enterprise 1;

3) for some values of competitiveness, there is a sharp change in the growth of EMV profits;

4) growth in enterprise 1 is, with competitiveness, from 0.1 to 0.3 – 12.5 thousand UAH per 0.1 unit of competitiveness, from 0.4 to 0.6 – the return on increasing competitiveness

increases, from 0.7 up to 1 return of the post and is at the level of 20 thousand UAH from each unit of competitiveness;

5) for the second enterprise, indirect growth is carried out with an increase in competitiveness from 0.3 to 0.5 by 30 thousand UAH;

6) the third enterprise is characterized by a significant increase with a change in competitiveness from 0.6 to 0.7 by 30 thousand UAH.

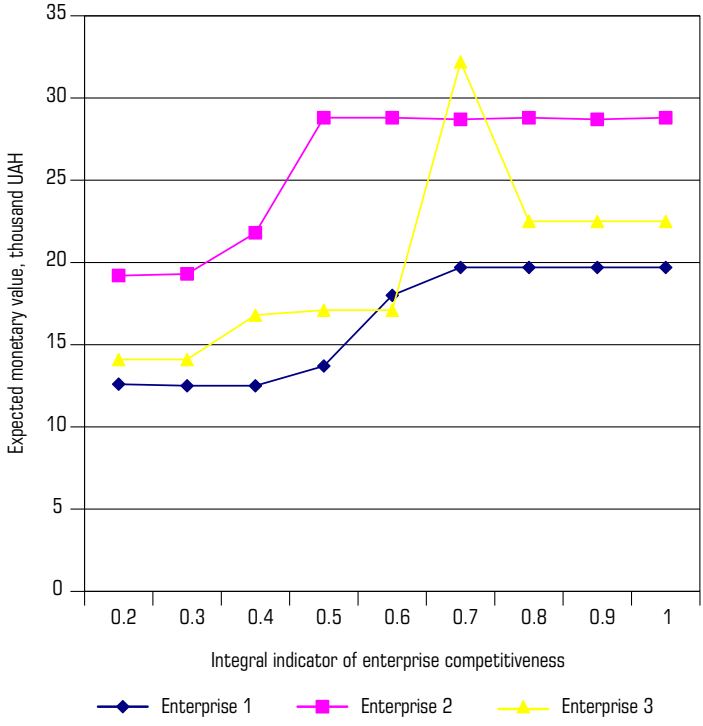

Fig. 5.5 Growth in the expected monetary value of the enterprise

Block 2.1, 2.2. Analysis of interactions when business attractiveness and readiness for consumption change.

For engineering enterprises, it is impossible to influence the change in the consumer market, therefore, to analyze the interaction, it is necessary to analyze what is best for enterprises or a change in their competitiveness or a change in business attractiveness and readiness for consumption. To do this, let's perform a series of experiments. The essence of each experiment

will be to evaluate the effects of a change in competitiveness and a change in business attractiveness and willingness to consume by a certain amount. Since the purpose of the experiments is to determine the best direction of change, the experiments will be carried out until the data allow to unambiguously conclude the best effect. As a step in the experiments, let's determine 0.05, which, on the one hand, is quite small, and on the other hand, it will allow to analyze all changes quite clearly. As a result of the experiments, it was determined that three experiments are sufficient for an unambiguous conclusion, the results of which are given in **Table 5.8**.

Table 5.8 Experiments to evaluate the effect of increasing competitiveness and improving the consumer environment

No. of experiment	Increasing performance	The effect of increasing competitiveness	The effect of improving consumer conditions	Effect difference
1	0.05	274.5	258.1	16.4
2	0.1	303.7	264.8	38.9
3	0.15	332.9	270.2	62.7

Based on the data, the following conclusions can be drawn:

1) the effect of increasing the competitiveness of enterprises is greater than the effect of improving the consumer environment (business attractiveness and readiness for consumption) by almost five times. So, for competitiveness, it is 30 thousand UAH for an increase in the competitiveness of all enterprises by 0.05 units, and for the consumer market – about 6 thousand UAH for a similar increase;

2) since it is easier for enterprises to improve their competitiveness than consumer conjuncture, they need to focus on these actions (they give a greater effect).

Thus, the analysis of interaction in the system "consumer – enterprise – partner" showed that the greatest effect in this system is observed when focusing on increasing the competitiveness of enterprises, namely the second enterprise, for which this effect is greatest.

Block 3. Forecasting interaction in the "consumer – enterprise – partner" system.

The purpose of this block is to study the behavior of the system in future periods of time to develop strategies for information exchange. The results of blocks 2.2 and 2.3 showed that the greatest effect is achieved from a change in competitiveness, therefore, when developing enterprise strategies, it is necessary to focus on predicting the competitiveness indicators of each enterprise and predicting the interaction in the "consumer – enterprise – partner" system.

Block 3.1. Models for predicting competitiveness.

The initial data for predicting competitiveness is the dynamics of this indicator for three enterprises for the period 2010–2019, given in **Table 5.9**.

The following algorithm should be used to forecast competitiveness indicators (**Fig. 5.6**).

Table 5.9 Dynamics of competitiveness indicators for three enterprises

No. Enterprise	Years									
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Enterprise 1	0.21	0.256	0.245	0.276	0.289	0.31	0.309	0.358	0.346	0.389
Enterprise 2	0.259	0.289	0.315	0.345	0.352	0.376	0.382	0.405	0.43	0.471
Enterprise 3	0.178	0.215	0.201	0.235	0.224	0.274	0.282	0.305	0.315	0.358

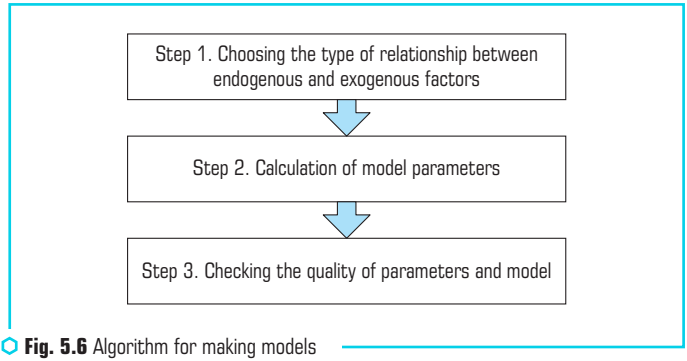

Fig. 5.6 Algorithm for making models

Step 1. Choosing the type of relationship between endogenous and exogenous factors. To implement this step, let's use graphical analysis. The dynamics of the competitiveness indicator is shown in **Fig. 5.7**.

Analysis of **Fig. 5.7** indicates the possible construction of one of two types of models: a linear model $k_i(t) = a_i + b_i \cdot t$ or a nonlinear one – exponential $k_i(t) = a_i \exp^{b_i \cdot t}$.

Step 2. Calculation of model characteristics. The least squares method is used to calculate the parameters. As a result of the calculation, the following predictive models were obtained (**Table 5.10**).

As evidenced by the parameters of the linear model, the highest growth rate of the competitiveness indicator is observed for the second enterprise (0.021), and the enterprise also has the best starting conditions (indicator a=0.246).

Step 3. Checking the properties of the parameters and the model.

To check the quality of the model parameters, the Student's criterion was calculated and compared with the table.

As a result of the test, all parameters are statistically significant. To test the adequacy of the model, the multiple correlation coefficient was used. Its value for all models is greater than 0.9, however, for linear models, the value of the coefficient is slightly higher than exponential ones, so let's use linear models for further fprediction.

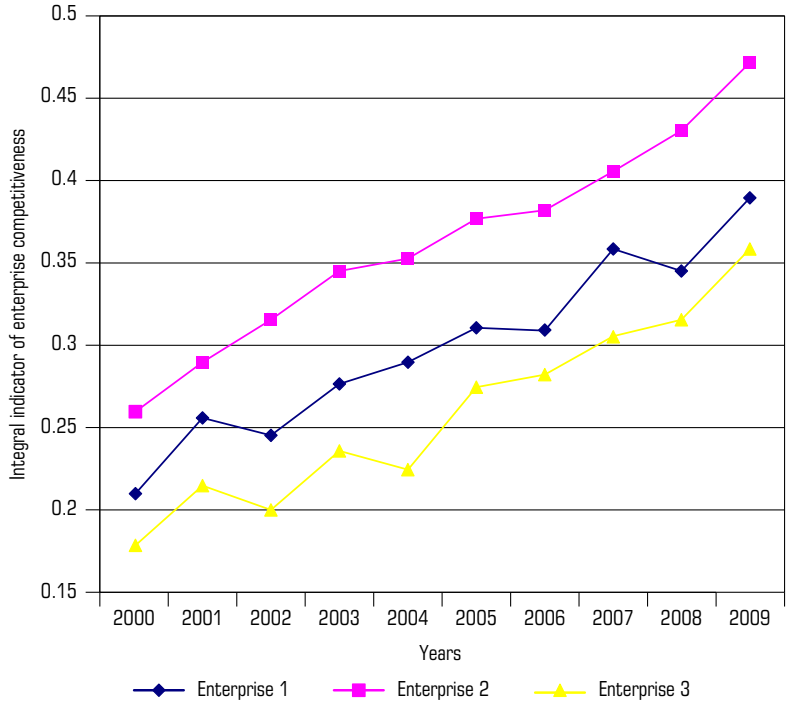

Fig. 5.7 Dynamics of competitiveness indicators

Table 5.10 Predictive models

Linear model	Exponential model
$k_1(t) = 0.201 + 0.017 \cdot t$	$k_i(t) = 0.21 \exp^{0.059 \cdot t}$
$k_1(t) = 0.246 + 0.021 \cdot t$	$k_i(t) = 0.26 \exp^{0.058 \cdot t}$
$k_1(t) = 0.157 + 0.018 \cdot t$	$k_i(t) = 0.17 \exp^{0.072 \cdot t}$

Block 3.2. Prediction of interaction in the system.

To carry out prediction, let's use the models built in blocks 3.1 and blocks 1.1, 1.2.

The results of predicting competitiveness indicators according to the model from block 3.1 are given in **Table 5.11**.

Table 5.11 Competitiveness prediction results

No. Enterprise	Years		
	2020	2021	2022
Enterprise 1	0.396	0.414	0.432
Enterprise 2	0.478	0.499	0.52
Enterprise 3	0.36	0.378	0.396

Let's analyze the interaction for the period 2020–2022 based on the use of models 1.1 and 1.2. The interaction between enterprises and partners in 2020 is given in **Table 5.12**.

Table 5.12 Interaction between enterprises and partners in 2010

Partner	Enterprise		
	1	2	3
1	0	0	0
2	0	0	0
3	0	0	0
4	16.2	0	0
5	0	0	0
6	0	0	0
7	0	0	0
8	0	10.46936	32.98726
9	10.18634	0	0

Interaction between enterprises and consumers in 2020 is given in **Table 5.13**.

Table 5.13 Interaction between enterprises and consumers in 2020

Consumer	Enterprise		
	1	2	3
1	2	3	4
1	48	0	0
3	0	0	32
4	0	64	0
5	0	64	0
6	5.481171	0	42.51883
7	0	0	48

Continuation of Table 5.13

1	2	3	4
12	0	0	48
13	48	0	0
14	0	32	0
15	0	27.28268	4.717324
18	32	0	0
20	0	24	0
21	0	24	0
22	15.18774	0	0
23	0	18.14781	13.85219
24	0	32	0
25	24	0	0
26	0	48	0
27	22.76245	0	1.237546
28	0	24	0
29	7.756374	0	24.24363

Interaction between partners and enterprises in 2020 is given in **Table 5.14**.

Table 5.14 Interaction between partners and enterprises in 2020

Partner	Enterprise		
	1	2	3
1	3.7	3.1	3.4
2	3.2	9.7	2.1
3	3.0	1.8	2.7
4	3.0	0.6	2.7
5	0.0	0.0	1.2
6	2.6	2.0	2.4
7	2.4	1.4	1.6
8	2.9	0.6	2.7
9	1.1	0.8	1.2

An analysis of the data in **Tables 5.12–5.14** shows that enterprises first try to satisfy the needs of consumers, and then the needs of partners, the needs of consumers are fully satisfied as they bring more profit than interaction with partners. The results of calculating the effects of interaction for 2020–2022 are presented in **Tables 5.15–5.17**.

Table 5.15 Calculation of the effect of interaction in 2020

	Enterprise 1	Enterprise 2	Enterprise 3	Total
Interaction "company – partner"	20.04788	5.338987	27.13893	52.5258
Interaction "enterprise – consumer"	75.77669	282.5849	123.6513	482.0129
Total	95.82457	287.9238	150.7903	534.5387

Table 5.16 Calculation of the effect of interaction in 2021

	Enterprise 1	Enterprise 2	Enterprise 3	Total
Interaction "company – partner"	16.78431	0.878463	32.22922	49.89199
Interaction "enterprise – consumer"	78.40839	286.2402	119.922	484.5705
Total	95.19269	287.1186	152.1512	534.4625

Table 5.17 Calculation of the effect of interaction in 2022

	Enterprise 1	Enterprise 2	Enterprise 3	Total
Interaction "company – partner"	–6.46778	1.26783	52.33954	47.16
Interaction "enterprise – consumer"	104.8552	287.8642	94.77537	487.49
Total	98.38738	289.13	147.1149	534.65

Analysis of the data in **Tables 5.15–5.17** allows to draw the following conclusions:

1) the predictive results of interaction do not change over time, it is stipulated that the system "consumer – enterprise – partner", in which all elements interact only with each other and the overall potential of the system does not change;

2) the second enterprise has the highest profit, which is determined by the presence of the highest level of competitiveness;

3) the second enterprise also has a constant profit, which is maximum for it, at the same time, profits are redistributed between the first and third enterprises;

4) in 2022, the first enterprise did not supply anything to its partners, which gave a negative indicator of the effect in the "enterprise – partner" system;

5) the general trend is an attracting role in the enterprise in the system of consumers. Thus, the first and second enterprises almost do not supply their products to partners.

A graphical representation of the interaction within the "consumer – enterprise – partner" system for three years (2020–2022) and the combined effect of this interaction are shown in **Fig. 5.8**.

As can be seen from **Fig. 5.8**, the balance in the system is maintained by replacing some of its elements, namely, some partners and consumers are excluded from the system. Thus, a mathematical model was proposed that describes the relationship between an enterprise, partners, consumers in a competitive environment.

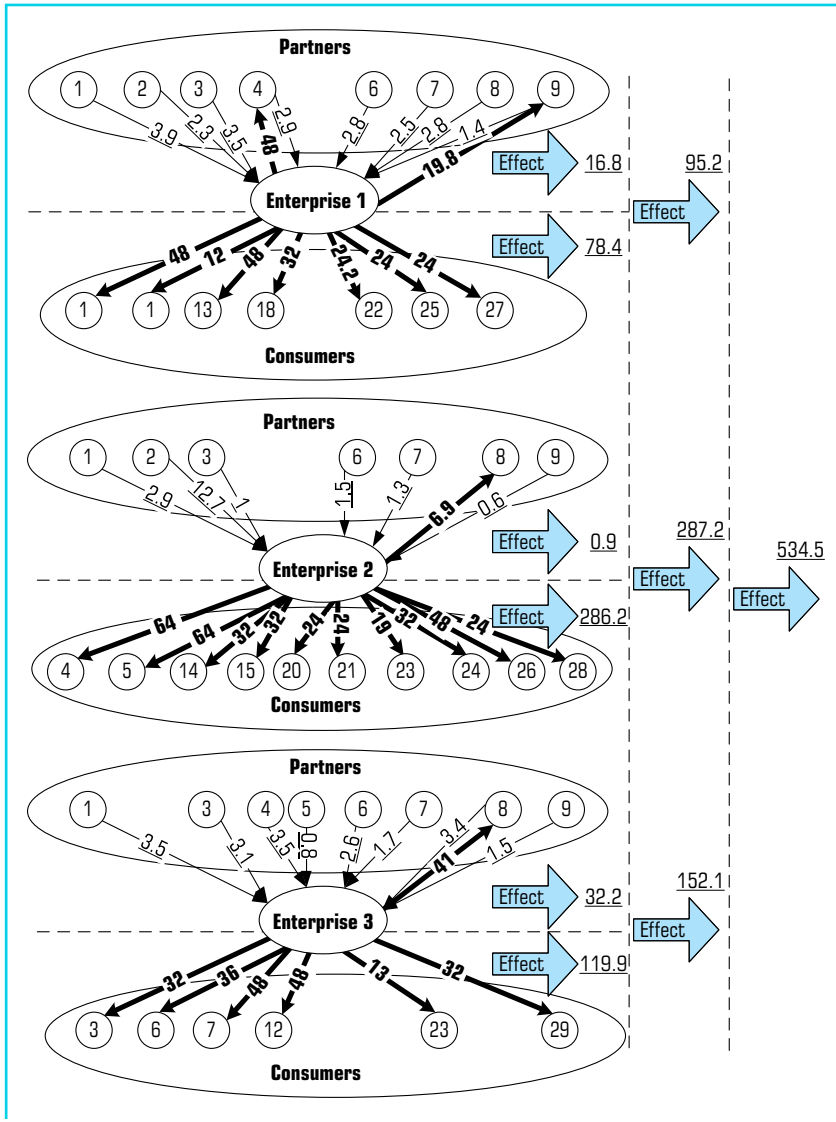

Fig. 5.8 The effect of interaction in the "consumer – enterprise – partner" system in 2021

The interaction model of the "consumer – enterprise – partner" system takes into account the ratio of the economic parameters of the enterprise: the size of the supply and distribution

of products, integral indicators of the enterprise's competitiveness, business attractiveness of the partner and consumer readiness. Having these parameters, it is possible to get the value of the volumes of production, consumption, supply of partners that meet the criterion of optimality (max) profit and restrictions on the volume of production, supply, consumption and accepted concepts.

The proposed approach has shown its effectiveness, which makes it possible to model the market relations of any industrial enterprise considered in a competitive environment as part of a "consumer – enterprise – partner" complex system and operating in unstable conditions of the modern socio-economic environment.

Block 4. Research of information interaction on budget formation.

Conceptually, the information interaction of an enterprise with partners and consumers should provide them with the necessary information in a timely manner with maximum efficiency. Evaluation of the effectiveness of information interaction can be performed using expert assessments that reflect the effect or importance of the real correlation of factors influencing the feasibility of attracting certain partners to cooperation, and consumers – to purchase products manufactured by the enterprise for a period of time determined by an expert.

The level of information interaction is limited to minimum and maximum values that correspond to reasonable amounts of information for a particular time and circumstances or technological limitations. Each period of time has its own limitations, which correspond to the prevailing real circumstances. The period of time for which the task of determining information interaction should be considered can be determined by an expert. The implementation of information interaction can be performed at the expense of funds allocated by the enterprise for these purposes or provided by creditors.

This block is implemented in two stages.

Stage 1. Constructing a budget formation model in the process of information interaction. Considering the foregoing, let's use the following notation to construct a mathematical model. Let:

L – set of types of information interaction;

J – set of existing and potential partners;

K – set of existing and potential consumers;

v_l – volume of information interaction with partners in the l-th type, $l \in L$ [packages];

w_l – volume of information interaction with consumers for the l-th type, $l \in L$, [packages];

c_l – cost of a unit of information interaction for the l-th type, $l \in L$, [thousand UAH/package];

C_0 – amount of funds allocated for information interaction for the period of time under consideration. Since the profit of the enterprise acts as a means for carrying out information interaction, then this model has $C_0 = p_0$ from the previous model;

$v_l^{\min}$, $v_l^{\max}$ – minimum and maximum volume of information interaction with partners in the l-th type $l \in L$;

$w_l^{\min}$, $w_l^{\max}$ – minimum and maximum volume of information interaction with consumers for the l-th type $l \in L$;

e_l^p – expert assessment of the expected effect of information interaction with partners in the l-th type for the considered period of time $l \in L$;

e_l^c – expert assessment of the expected effect of information interaction with consumers in the l-th type for the considered period of time $l \in L$.

Then it is possible to see the following task of determining the size of the company's information interaction with partners and consumers.

Let's find the volume of information interaction of the enterprise with partners and consumers $\{v_l\}$, $\{w_l\}$, providing a maximum estimate of the total efficiency S as an estimate of the total effect from the implementation of all types of information interaction with all possible partners and consumers:

$$S = \sum_{l \in L} \left(e_l^p v_l + e_l^c w_l \right) \to \max, \tag{5.8}$$

under restrictions:

$$\sum_{l \in L} c_l \left(v_l + w_l \right) \le C_0; \tag{5.9}$$

$$v_{l_1}^{\min} \le v_{l_1} \le v_{l_1}^{\max},$$
$$v_{l_2}^{\min} \le v_{l_2} \le v_{l_2}^{\max},$$
$$\ldots\ldots\ldots\ldots\ldots$$
$$v_{l_j}^{\min} \le v_{l_j} \le v_{l_j}^{\max}; \tag{5.10}$$

$$w_{l_1}^{\min} \le w_{l_1} \le w_{l_1}^{\max},$$
$$w_{l_2}^{\min} \le w_{l_2} \le w_{l_2}^{\max},$$
$$\ldots\ldots\ldots\ldots\ldots$$
$$w_{l_j}^{\min} \le w_{l_j} \le w_{l_j}^{\max}. \tag{5.11}$$

$$v_l, w_l \ge 0, \; l \in L. \tag{5.12}$$

Limitations (5.10) and (5.11) are due to the relevant technological and economic factors that affect either the organization of execution or the profitability of the corresponding information interaction. Therefore, problem (5.8)–(5.12) cannot be classified as a linear programming problem, taking into account constraints (5.10) and (5.11). But its solution can be performed using appropriate application packages, such as the above-mentioned WB 7.0 or the "Search for a solution" module as part of Excel, included in MS Office, solving the current sequence of linear programming problems containing part of the constraints of the type (5.10) and (5.11). Without limiting the content and showing the possibilities of the proposed approach,

let's assume that the conditions of information interaction are reflected by the following data. **Table 5.18** shows expert assessments of the effects of information interaction with partners on a 7-point scale.

Table 5.18 Expert assessment of the effect of types of information interaction with partners

Name of partner company	Partners	Expert assessments of the effect of types of information interaction						
		Internet technologies	Advertising brochures	PR	Personal selling	Advertising in magazines	Sales promotion	Direct marketing
1	Partner 1	7	4	3	3	5	6	6
2	Partner 2	6	5	4	5	4	5	7
3	Partner 3	6	6	3	4	4	5	5
4	Partner 4	3	4	4	5	4	4	5
5	Partner 5	5	5	4	5	4	3	6
6	Partner 6	4	4	4	4	3	4	6
7	Partner 7	7	7	6	6	6	6	7
8	Partner 8	5	6	7	6	5	6	6
9	Partner 9	7	7	5	7	5	6	6
	Average value	5.56	5.33	4.44	5.00	4.44	5.00	6.00

The corresponding assessments of the effects of information interaction by experts on a 7-point scale for consumers are given in **Table 5.19**.

The conditions for information exchange are presented in **Table 5.20**.

Table 5.19 Expert assessment of the effect of types of information interaction with consumers

Consumers	Name of the enterprise of the potential consumer	Expert assessments of the effect of types of information interaction						
		Internet technologies	Advertising brochures	PR	Personal selling	Advertising in magazines	Sales promotion	Direct marketing
1	2	3	4	5	6	7	8	9
Consumer 1	1	7	4	3	3	5	6	6
Consumer 2	2	6	5	4	5	4	5	7
Consumer 3	3	6	6	3	4	4	5	5

Continuation of Table 5.19

1	2	3	4	5	6	7	8	9
Consumer 4	4	3	4	4	5	4	4	5
Consumer 5	5	5	5	4	5	4	3	6
Consumer 6	6	4	4	4	4	3	4	6
Consumer 7	7	7	7	6	6	6	6	7
Consumer 8	8	5	6	7	6	5	6	6
Consumer 9	9	7	7	5	7	5	6	6
Consumer 10	10	7	5	5	5	7	7	5
Consumer 11	11	6	5	4	5	6	4	5
Consumer 12	12	7	4	3	3	5	6	6
Consumer 13	13	6	5	4	5	4	5	7
Consumer 14	14	6	6	3	4	4	5	5
Consumer 15	15	3	4	4	5	4	4	5
Consumer 16	16	5	5	4	5	4	3	6
Consumer 17	17	4	4	4	4	3	4	6
Consumer 18	18	7	7	6	6	6	6	7
Consumer 19	19	5	6	7	6	5	6	6
Consumer 20	20	7	7	5	7	5	6	6
Consumer 21	21	7	5	5	5	7	7	5
Consumer 22	22	6	5	4	5	6	4	5
Consumer 23	23	5	6	7	6	5	6	6
Consumer 24	24	7	7	5	7	5	6	6
Consumer 25	25	7	5	5	5	7	7	5
Consumer 26	26	6	5	4	5	6	4	5
Consumer 27	27	7	4	3	3	5	6	6
Consumer 28	28	6	5	4	5	4	5	7
Consumer 29	29	6	6	3	4	4	5	5
Average value		5.86	5.31	4.45	5.00	4.90	5.21	5.79

Table 5.20 Conditions of information exchange

Indicators	Characteristics of types of information interaction						
	Internet technologies	Advertising brochures	PR	Personal selling	Advertising in magazines	Sales promotion	Direct marketing
Unit cost, thousand UAH/package	1.2	2.4	3	0.2	0.7	0.5	2
Minimum amount of information for partners, package	100	20	20	5	20	10	20
Maximum amount of information for partners, package	150	40	30	20	30	20	30
Minimum amount of information for consumers, package	100	20	20	5	20	10	20
Maximum amount of information for consumers, package	150	40	30	20	30	20	30

Stage 2. Using the budget formation model in the process of information exchange.

Depending on the amount of funding, the distribution of information interaction, which corresponds to the maximum effect, has the following form, **Tables 5.21–5.26**.

Table 5.21 Volumes and effect of information interaction with funding in the amount of 100 thousand UAH and actual expenses of 92 thousand UAH

Interaction subjects	Internet technologies	Advertising brochures	PR	Personal selling	Advertising in magazines	Sales promotion	Direct marketing	Effect evaluation
Volumes of interaction with partners, package	0	0	0	5	0	10	20	387.93
Volumes of interaction with consumers, package	0	0	0	5	0	10	20	

Table 5.22 Volumes and effect of information interaction with funding in the amount of 200 thousand UAH and actual expenses of 120 thousand UAH

Interaction subjects	Internet technologies	Advertising brochures	PR	Personal selling	Advertising in magazines	Sales promotion	Direct marketing	Effect evaluation
Volumes of interaction with partners, package	0	0	0	5	20	10	20	574.75
Volumes of interaction with consumers, package	0	0	0	5	20	10	20	

Table 5.23 Volumes and effect of information interaction with funding in the amount of 300 thousand UAH and actual expenses of 120 thousand UAH

Interaction subjects	Internet technologies	Advertising brochures	PR	Personal selling	Advertising in magazines	Sales promotion	Direct marketing	Effect evaluation
Volumes of interaction with partners, package	0	0	0	5	20	10	20	1160.96
Volumes of interaction with consumers, package	100	0	0	5	20	10	20	

Table 5.24 Volumes and effect of information interaction with funding in the amount of 400 thousand UAH and actual expenses of 360 thousand UAH

Interaction subjects	Internet technologies	Advertising brochures	PR	Personal selling	Advertising in magazines	Sales promotion	Direct marketing	Effect evaluation
Volumes of interaction with partners, package	100	0	0	5	20	10	20	1716.51
Volumes of interaction with consumers, package	100	0	0	5	20	10	20	

Table 5.25 Volumes and effect of information interaction with funding in the amount of 500 thousand UAH and actual expenses of 456 thousand UAH

Interaction subjects	Internet technologies	Advertising brochures	PR	Personal selling	Advertising in magazines	Sales promotion	Direct marketing	Effect evaluation
Volumes of interaction with partners, package	100	20	0	5	20	10	20	1929.39
Volumes of interaction with consumers, package	100	20	0	5	20	10	20	

Table 5.26 Volumes and effect of information interaction with funding in the amount of 600 thousand UAH and actual expenses of 592 thousand UAH

Interaction subjects	Internet technologies	Advertising brochures	PR	Personal selling	Advertising in magazines	Sales promotion	Direct marketing	Effect evaluation
Volumes of interaction with partners, package	100	20	20	5	20	10	25	2166.55
Volumes of interaction with consumers, package	105	20	20	5	20	10	20	

It should be noted that the corresponding calculations can be carried out at an enterprise that occupies a free point in the space of "enterprise competitiveness" – "partner's business attractiveness" – "consumer readiness" values. At the same time, it can be expected that with the growth of all the above indicators, expert estimates of the effect of information interaction will decrease. This situation is a consequence of the saturation of all subjects with the necessary information, which leads to the expediency of data exchange in the minimum necessary volumes, reflecting the essence of phenomena without an excess part. An increase in the need and volume of information exchange can be expected with the appearance of a significant modernization of existing or new products with the aim of a more detailed description and increase in production volumes to master new markets and expand partnerships.

For an enterprise located at a certain point in the space "enterprise competitiveness – business attractiveness of a partner consumer readiness", the above calculations can be used to select an information interaction strategy to move the enterprise to another point in the specified space with a higher level of competitiveness and maintain a higher value of partner attractiveness and readiness of consumers There is no doubt the need for cyclical repetition of these actions after the implementation of the planned measures and information interaction with the assessment of the results obtained and the determination of funds that can be directed to continue these procedures in the new conditions.

Fig. 5.9 contains a graphical representation of the modeling of the dependence of the effect of information interaction on the level of funding and the effect of the consequences of the implementation of the chosen strategy.

Fig. 5.9 shows the dependence of the amount of funding and the chosen strategy. At the same time, strategy 1 corresponds to an enterprise with low competitiveness, which has the ability to achieve a higher level of consumption of its products while meeting the requirements of consumers. To do this, depending on the financing of information exchange, more fully depicting the minor achievements of the enterprise, as far as possible, satisfies the demand of consumers as much as possible. Depending on the amount of funding for strategies 2, 3, 4, the change in the effect of information interaction for more well-known enterprises in terms of the quality and functionality

of their products is reflected, while the effect is reduced for enterprises that produce products that are more well-known to consumers.

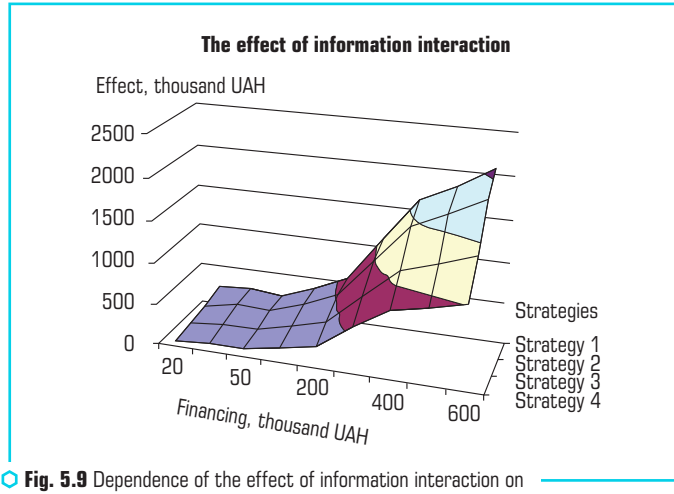

Fig. 5.9 Dependence of the effect of information interaction on the amount of funding and the chosen strategy

The calculated experimental effect for various strategies makes it possible to determine the interaction and effect for the "Enterprise-Partner-Consumer" system in the forecast period. As a result of calculations in block 3, the overall economic effect from the interaction in the system was obtained, which did not change during the study period (2020–2022) and amounted to 534 thousand UAH. Let's use this effect as a budget for information exchange.

As a result of calculations of information interaction with such financing, the following information interaction data were obtained (**Table 5.27**).

Table 5.27 Volumes and effect of information interaction with financing in the amount of 534 thousand UAH

Interaction subjects	Internet technologies	Advertising brochures	PR	Personal selling	Advertising in magazines	Sales promotion	Direct marketing	Effect evaluation
Volumes of interaction with partners, package	100	20	10	10	20	10	25	2127.7
Volumes of interaction with consumers, package	105	20	10	10	20	10	20	

Graphically, information interaction can be represented as follows (**Fig. 5.10**).

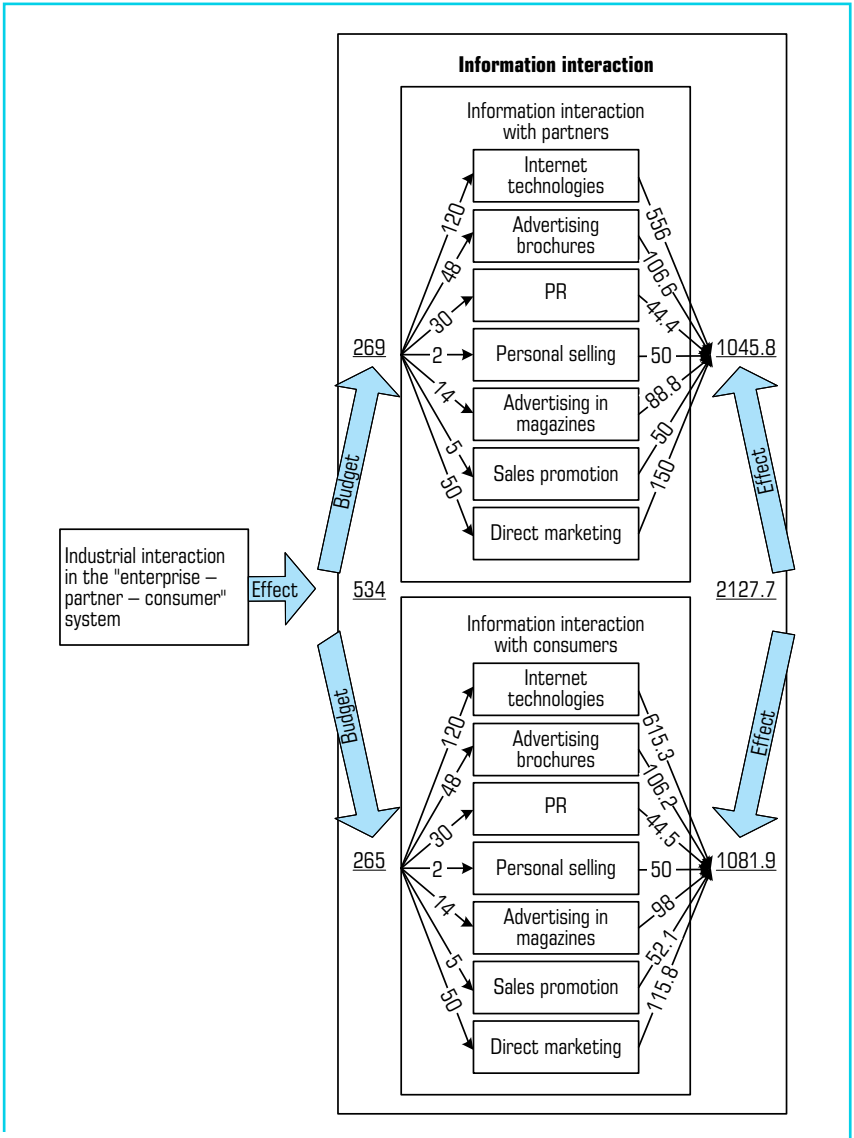

Fig. 5.10 Graphic representation of information interaction in the "consumer – enterprise – partner" system

CONCLUSIONS

Information interaction in the "enterprise – partner – consumer" system is the key to the effectiveness of its functioning. Determining the appropriate areas of interaction and its volume is conceptual in each case in time and space of relations between enterprises, their partners and consumers, especially in a competitive environment. This requires the construction of weighted estimates of the volume of information interaction, which can be carried out using the developed methodology based on mathematical modeling of the formation of a set of probable partners and consumers based on the competitiveness of enterprises, the attractiveness of partners and the readiness of consumers. Thus, the constructed model of information interaction allows, based on the effect of production interaction (forming the budget), to investigate information interaction in the "consumer – enterprise – partner" system and calculate the economic effect of this interaction for each component in the system. The effect of information interaction under given conditions can be estimated taking into account expert assessments of the effect of the relevant areas of interaction, technological limitations and funding volumes using mathematical modeling. The results of numerous studies confirm the above conclusions. The results obtained indicate the feasibility of using the proposed approach in the formation of strategies for information interaction in the "enterprise – partner – consumer" system in market conditions.

An increase in funding for information interaction leads to an increase in its effect. For enterprises that are in more favorable conditions, i.e. with higher competitiveness, a higher level of business attractiveness of the partner and consumer readiness, one can expect a decrease in the effects of information interaction, i.e. a decrease in the values of expert assessments of the usefulness of such interaction due to an increase in the level of mutual awareness of the participants in the interaction about all the necessary aspects of cooperation and consumption. This provision demonstrates a relative decrease in the effect of information interaction with a decrease in the level of effects from such interaction with the appropriate ratios of the competitiveness of the enterprise, the attractiveness of the partner's business and the readiness of the consumer.

With the help of managing the interaction of an enterprise with partners and consumers, based on the "consumer – enterprise – partner" system, and the developed complex of economic and mathematical models for the formation of the composition of this system, determining the effect of its functioning and information interaction, one can obtain estimates of the volumes of production, consumption, supplies from partners that meet the criterion of optimality (max) of profit and are limited in terms of objects of production, supply, consumption, as well as accepted concepts.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest in relation to this research, whether financial, personal, authorship or otherwise, that could affect the research and its results presented in this paper.

REFERENCES

1. Raiko, D. V. (2008). Stratehichne upravlinnia rozvytkom marketynhovoi diialnosti: metodolohiia ta orhanizatsiia. Kharkiv: INZhEK, 632.
2. Raiko, D., Podrez, O., Cherepanova, V., Fedorenko, I., Shypulina, Y. (2019). Evaluation of quality level in managing the development of industrial enterprises. Eastern-European Journal of Enterprise Technologies, 5 (3 (101)), 17–32. doi: https://doi.org/10.15587/1729-4061.2019.177919
3. Raiko, D., Podrez, O., Cherepanova, V., Melnikov, O., Kharchenko, A. (2020). Managing costs of an industrial enterprise when using secondary resources. Eastern-European Journal of Enterprise Technologies, 4 (3 (106)), 53–65. doi: https://doi.org/10.15587/1729-4061.2020.208764
4. Raiko, D., Cherepanova, V., Sylka, I., Podrez, O., Fedorenko, I. (2021). Development of scientific and methodological approach to quantitative and qualitative assessment of intellectual property management in industrial enterprises. Eastern-European Journal of Enterprise Technologies, 2 (13 (110)), 28–41. doi: https://doi.org/10.15587/1729-4061.2021.230262
5. Illiashenko, S., Illiashenko, N., Shypulina, Y., Raiko, D., Bozhkova, V. (2021). Approach to assessment of prerequisites for implementation of strategic directions of innovative development of industrial enterprises. Eastern-European Journal of Enterprise Technologies, 3 (13 (111)), 31–46. doi: https://doi.org/10.15587/1729-4061.2021.233520
6. Pererva, P., Maslak, M. (2022). Commercialization of intellectual property objects in industrial enterprises. Problems and Perspectives in Management, 20 (3), 465–477. doi: https://doi.org/10.21511/ppm.20(3).2022.37
7. Pererva, P., Kobielieva, T., Tkachova, N., Tkachov, M., Diachenko, T. (2021). Management of relations with enterprise stakeholders based on value approach. Problems and Perspectives in Management, 19 (1), 24–38. doi: https://doi.org/10.21511/ppm.19(1).2021.03
8. Pererva, P., Nazarenko, S., Maistro, R., Danko, T., Doronina, M., Sokolova, L. (2021). The formation of economic and marketing prospects for the development of the market of information services. Eastern-European Journal of Enterprise Technologies, 6(13 (114)), 6–16. doi: https://doi.org/10.15587/1729-4061.2021.245251
9. Illiashenko, S, Shypulina, Y., Gryshchenko, O., Illiashenko, N. (2020). The Information Support System's Formation of Marketing Innovative Decisions in Ukrainian Companies. International Journal of Advanced Science and Technology, 29 (6s), 1066–1073.
10. Illiashenko, S., Shypulina, Y., Illiashenko, N., Gryshchenko, O., Derykolenko, A. (2020). Knowledge management at Ukrainian industrial enterprises in the context of innovative development. Engineering Management in Production and Services, 12 (3), 43–56. doi: https://doi.org/10.2478/emj-2020-0018
11. Illiashenko, S. M., Shipulina, Y. S., Illiashenko, N. S. (2015). Knowledge management as a basis for company's innovative development. Actual Problems of Economics, 168 (6), 173–181.
12. Illiashenko, S., Shypulina, Y. (2014). Factor analysis of the enterprise's innovative culture. Economic Annals-XXI, 3-4 (1), 31–34.