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DIVERSIFICATION OF ENTERPRISE AS METHOD OF PATTERN PRODUCTION OPTIMIZATION

В статье рассмотрен алгоритм оптимизации структуры производства с учетом выпуска новой продукции предприятия. В работе осуществлена оценка оптимальной структуры производства предприятия кабельной отрасли по укрупненным позициям производства кабеля.

Ключевые слова: диверсификация, оптимизация структуры производства, рентабельность, выпуск новой продукции.

У статті розглянуто алгоритм оптимізації структури виробництва з урахуванням випуску нової продукції підприємства. В роботі проведена оцінка оптимальної структури виробництва підприємства кабельної галузі за укрупненими позиціями виробництва кабеля.

Ключові слова: диверсифікація, оптимізація структури виробництва, рентабельність, випуск нової продукції.

In the article the production structure optimization algorithm with the release of new products is considered. The work was carried out to estimate the optimal structure of production enterprises in the cable industry on the integrated position of cable production.

Keywords: diversification, optimization of production structure, profitability, new products production.

Relevance. Diversification of economy - one of basic priorities of modern economic development of country. The achievement of this aim supposes the active search of ways development of such forms in economic relations on mezo- and microlevels which will promote the competitiveness of economy on the whole both on internal and external markets and will provide large efficiency of the use of raw material resources on domestic enterprises.

Questions related to diversification, many Ukrainian and foreign authors examined in the works. So, the first researches of diversification and integration carried out to M. Gort in 1962 and T. Esinara in 1979. Developments in the same direction were continued by such authors as I. Ansoff, F. Kotler, M. Porter, A. Tompson, and J. Strikland and other. Organizational aspects diversifications explored in the works of M. Korinko, L. Marmul and others, the problems of it efficiency investigated by L. Shutenko and Dmitruk, V. Kutovoy. The features of diversification level determination of enterprise touched V. Andreychuk in the works. forming of diversification mechanism and management of diversification M. Radeva, V. Shishkin examined [5].

However, without regard to the far of publications, the questions of necessity determination in the beginning of diversification strategies realization on an enterprise, its depths and determining the optimal amount of the diversifyed directions of enterprise activity are studied yet not enough.

The aim of the article is an estimation of production pattern for a decision-making about the diversifyed development of enterprise.

Strategy of production diversification on an enterprise is a difficult, many-sided process which elects an enterprise as alternative to the further actions. Diversification always presents a considerable risk, as investments are required in great numbers in present, and a return will happen only in the strategic future [1].

Permanent search of such combination of nomenclature and assortment of the produced products, which in changing market conditions will result in the most high indexes of effectiveness, must become a basic action for an enterprise. For an enterprise, adhering to strategy of specialization, the loss of demand and decline of activity efficiency can result in substantial financial losses, if timely development of measures complex will not assist the increase of stability to the quickly changing terms of external environment for avoidance of it.

Going near diversification must be based on the account of recurrence of diversification on the stages of life cycles of commodities (essence of which is in that the downstream of one commodity must be accompanied by the period of getting up of production of other commodity). Diversification of production for domestic industry is perspective, because can serve to the decision of next problems: the use during conversion of highly skilled personnel and material resources, demonopolization of economy, market saturation competitive commodities.

Both in a theory and in practice, there are different types of diversification strategies, however most scientists accede to distribution of diversification strategies on principle of the use of synergetics effect on two kinds:

1. Conglomerate strategy of diversification (implies passing of enterprise to the area unconnected with current business of enterprise, - to new technologies and market necessities).

2. Synergetics strategy of diversification (foresees being beyond an industrial chainlet, which an enterprise, search of new types of activity, which complement existing in a technological or commercial plan with the purpose of receipt of synergetics effect, operated into). Such strategy can be:
- concentric (during an orientation on existent necessities at the change of technology);
- horizontal (during an orientation on the existent technological method of production);
- vertical (receipt of synergetics effect from the use of technologies which are preceded or follow after an existent productive cycle).

The type of diversification strategy depends on the specific of enterprise and its aims. As scientists mark, if an enterprise puts before itself such aims, as a conquest and withholding of certain market share, employment of positions of technological leader, creation of certain character, are in the eyes of public, leaderships in charges, then strategy of synergetics diversification is more frequent used. If an enterprise pursues a financial goal is a receipt of income, - that it comes running to conglomerate diversification.

Examining the questions of practical realization of diversification strategies, it is necessary to take into account the next methods of diversification:
- expansion of nomenclature and assortment of products;
- updating (improvement) of products;
- scope of new market segments;
- territorial expansion of markets;
- creation of own raw material or sale base (with possibility of providing of services to other enterprises);
- organization of new production on a present enterprise;
- creation of new enterprises (including branches and associated companies);
- purchase of operating enterprises (competitors or unconnected with activity of own enterprise);
- association with other enterprises, confluence and absorption;
- creation of alliances between enterprises without the transition of right ownership;
- acquisition of debt obligations or production capacities of flat-broke enterprises.

For determination of diversification degree of enterprise scientists suggest to use such indexes:

Absolute level of diversification - determined by the general amount of industries which are technologically unconnected inter their. For more complete description an amount and specific gravity (in the general amount of industries on an enterprise) of basic production industries, apeak integrated industries, apeak not integrated industries are distinguished.

The degree (or level) of enterprise diversification does not give information about her efficiency and expediency. The considerable degree of diversification does not guarantee the increase of activity efficiency on enterprise. There can be a threat of superfluous diversification, that results in the loss of management flexibility an enterprise, to dispersion of resources, decline of profits on unit of the invested capital [2].

M. Korinko marks that for the estimation of diversification efficiency it is possible to use the indexes of enterprises activity (height of sales volumes, increase of market share, height of profits from the sales of and other) or financial indexes (dividends, height of shares value on the market and other).

V. Kutovoy suggests to use such indexes of diversification efficiency, as net discounted profit from diversification; index of investments profitability in diversification, internal norm of project profitability on diversification; term of return on investments; index of general (total) economic effect from diversification and index of diversification efficiency.

The following come forward the basic indexes of strategy estimation of enterprise diversification: relation of profit yield from sales on a certain market segment to the expenses on its mastering; relation of profit yield from sales to the expenses on maintenance of the stake of this segment; attitude of income toward expenses for development, production and production distribution for a concrete market segment; annual rate of height of sales volume of products on a market segment.

In that case, when research is conducted in the context of complex diagnostics for finding out of provision of company at the market and making of effective strategy, it is expedient to conduct the comparative analysis of enterprises a self-reactance method, that is by comparison of the investigated enterprise and its competitors on certain strategies. For example: strategy of Cheap is strategy on advancement of products in a low-price segment; strategy of Mid - Price - on advancement in a mid-price segment; strategy of High - Price - on advancement in a high-price segment; Premium strategy is strategy on advancement of premium foods.

The correct choice of diversification strategy requires the construction of model of their dependence in the process of portfolio production optimization.

The construction of such model requires the ground of criteria and limitations choice at forming an optimal pattern of production and validity in the decision-making of purchase of raw material, that it is related to the limited resource possibilities of enterprise and having a special target values of production cost.

In this connection the process of optimization of production pattern on enterprise means portfolio diversification with the set having a special purpose orientation in the conditions of limitations and resource possibilities of enterprise.

Under diversification most authors understand distribution invested or loaned money capitals between the different objects of investments with the purpose of risk decline of possible capital losses or profits from it. In Ukrainian practice of investing diversification comes true on the classes of assets, on currencies, on the sectors of economy [6].

However a portfolio of production construction only by means of wide set of types of products does not guarantee the decline of general risk of sales and profitability. Under certain circumstances profitability can go down simultaneously all types of products, formed by inefficient diversification.

Thus, the effect of diversification, that is possibility of pattern optimization in portfolio production, shows up only at negative profitability's correlation of different products types.

The result of diversification is portfolio optimization, here not always a maximally possible result will be optimal. At the same time separate authors use the category of the best result as analogy of maximal income or set level of income for a minimum risk, that not really correctly.

Coming from aforesaid, the result of optimization is a construction of optimal structure of portfolio of production taking into account producing of new products on her kinds taking into account external risk and profitability factors.

In accordance with the presented determination the algorithm of pattern production optimization on enterprise is worked out, which includes the next basic stages (fig. 1).

1. Determination of investing aims and existent strategy.

2. Choice of great number of product's types.

3. Formalization of optimization task implies presentation of great number of types of products as an initial vector {Ri} with distribution of their actual profitability of production (r_{ij}) for period of T [3].

$$r_{ij} \in \begin{Bmatrix} R_1 \\ R_2 \\ \dots \\ R \end{Bmatrix} = \begin{vmatrix} r_{11} & r_{12} & \dots & r_{1m} \\ r_{21} & r_{22} & \dots & r_{2m} \\ \dots & \dots & \dots & \dots \\ r_{n1} & r_{n2} & \dots & r_{nm} \end{vmatrix} \quad (1)$$

$i = \overline{1;n}; j = \overline{1;m}$,

Where, $i = \overline{1;n}$ - number of product's types;

$j = \overline{1;m}$ - number of time points in allocation of profitability for period of T.

Then every type of products will be characterized by the profitability and will occupy a certain stake in a portfolio (d_i), which settles accounts as correlation of production cost volume is in a portfolio (x_i) and total worth of portfolio ($\sum_{i=1}^{n} x_i$):

$$d_i = \frac{x_i}{\sum_{i=1}^{n} x_i}. \quad (2)$$

Consequently, general profitability of production is maximized on the basis of next assumption:

$$R = \sum_{i=1}^{n} \sum_{j=1}^{m} r_{ij} d_i \rightarrow \max, \quad (3)$$

where R – general profitability of goods production.

3. Determination of limitations in optimization model:

➢ the sum of stakes of products in a portfolio is equal to unit: $\sum_{i=1}^{n} d_i = 1$;

➢ the general volume of expenses on new products will be limited to resource possibilities of enterprise :

$$\sum_{i=1}^{n} x_i \leq S_{\max}, \quad (4)$$

где x_i - expenses volume on separate type of goods;

$S_{\max}$ – maximally possible volume of the invested resources in enterprise.
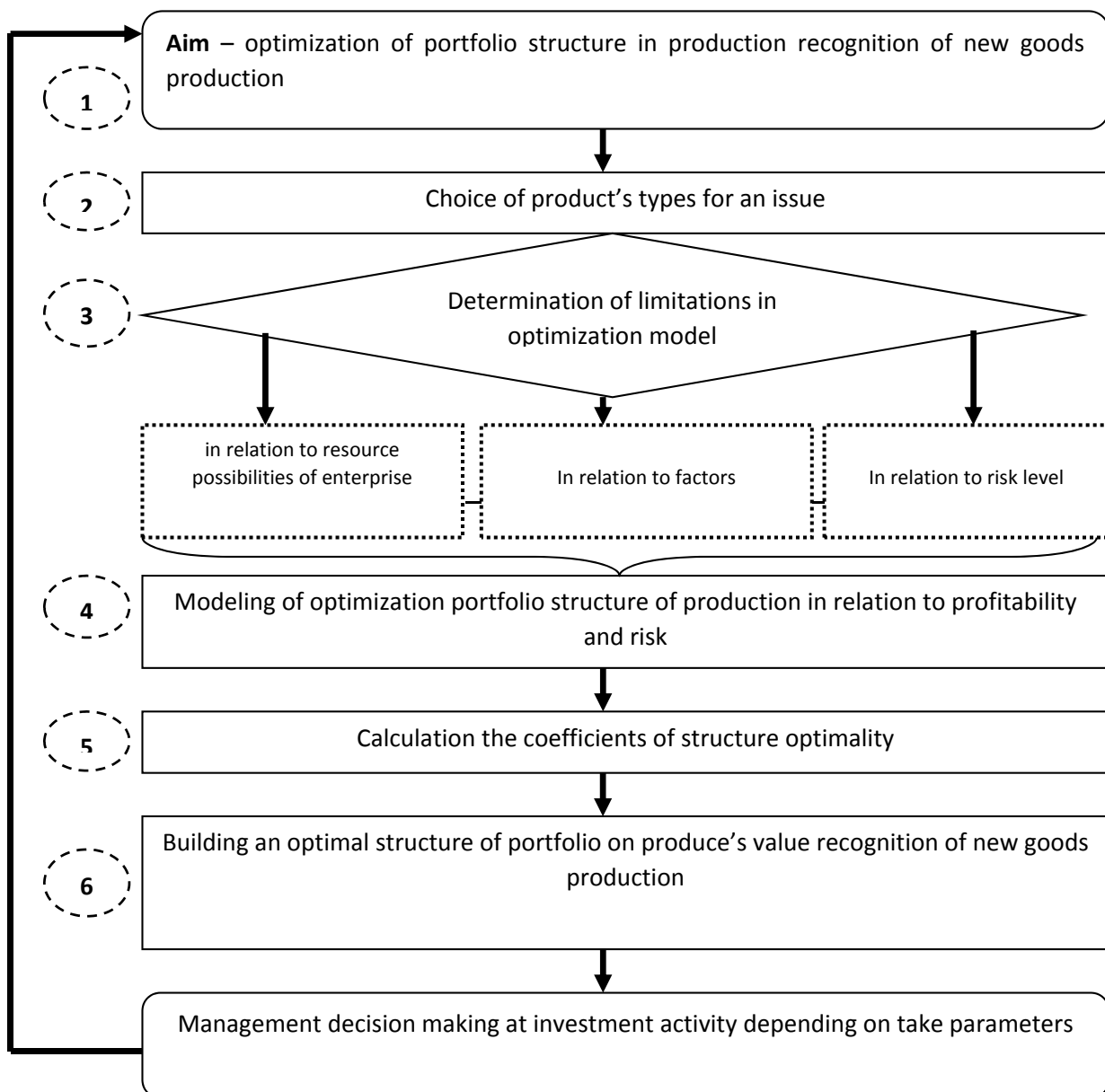
Fig 1. The pattern optimization of production algorithm recognition producing of new products of enterprise

1.   The condition of portfolio diversification is providing of independence between profitability's of separate types of products, that requires establishment of corresponding limitations in the optimization model.

For this purpose verification of hypothesis comes true about absence of multicollinearity on profitability of products types, as a presence of strong correlation between the indexes of products profitability of one portfolio means impossibility of their real diversification. A hypothesis about the presence of multicollinearity between profitability's products is checked up on the basis of pair coefficients of correlation $\rho_{r_i r_j}$, if $\rho_{r_i r_j} \leq 0,7$ at $i \neq j; i = \overline{1; n}; j = \overline{1; m}$, then a hypothesis about the presence of multicollinearity is not confirmed, that testifies to independence of profitability's products and possibility of portfolio diversification.

2.   Portfolio optimization for enterprise subject to the factors of profitability and risk is produced on the basis of the rationed coefficients of optimization. These coefficients

are a vector of the standartized indexes β_{st}, expected on the models of dependence individual to the profitability's products (r_i) from a parameter $\xi_{(t)}$ which reflects the size of rejection of actual demand on products from theoretical. This rejection is a formal unsystematic risk assessment and taken into account in the process of optimization.

A theoretical value of demand on products is a function of its stochastic dependence on the basic factors of market influence and reflects influence of systematic risk.

Such factors, as a rule, are presented by macroeconomic indexes, for example, by the profit of consumers, by volume of orders of and other Consequently, the quantitative estimation of influence of the indicated indexes on market profitability of products means the estimation of influence of systematic factors. Then a difference between the actual size of profitability and its value subject to such influence reflects the size of influence of unsystematic risk.

The estimation of influence of the indicated factors implies the modeling of systematic influence and unsystematic risk factors by means of stochastic models as a result of which it is possible to get the quantitative estimation of sensitiveness of profitability of products to the indicated factors as parameters of equalization. Such parameters characterize the actual level of risk and show its possible vibrations.

Thus, a modeling process comes true through the system of recursive models for every type of products, which the rationed coefficients of optimization settle accounts on results:

$$\begin{cases} \hat{r}_i = f(\xi_{(t)}) = a + \beta_i \cdot \xi_{(t)} \\ \xi_{(t)} = I_f - \overline{I_{x,t}} \\ I_{x,t} = f(I_{GDP}, CPI, I_{nv}) \end{cases} \Rightarrow \begin{Bmatrix} \beta_1 \\ \beta_2 \\ \dots \\ \beta_i \end{Bmatrix} \Rightarrow \begin{Bmatrix} \beta_{st_1} \\ \beta_{st_2} \\ \dots \\ \beta_{st_n} \end{Bmatrix} \Rightarrow \begin{Bmatrix} k_{opt_1} \\ k_{opt_2} \\ \dots \\ k_{opt_n} \end{Bmatrix} \qquad (5)$$

$i = \overline{1; n}$,

where $\xi_{(t)}$ is an account of unsystematic risk in the process of investing;

I_f - actual profitability of products;

$\overline{I_{x,t}}$ - theoretical value of profitability of products subject to influence of factors, reflecting influence of systematic risk on demand;

I - index of the real production of enterprise;

CPI is a cost-of-living-index;

I_{nv} - index of sales;

β_i - actual coefficients of function of dependence of individual profitability of products from the size of unsystematic risk;

β_{st_i} - standartized coefficients in the function of dependence of individual profitability of products from the size of unsystematic risk;

k_{opt_i} - the rationed coefficients are optimizations which settle accounts as correlation of the individual standartized coefficients to their general size.

The model of dependence $\hat{r}_i = f(\xi_{(t)})$ has a linear form, where a parameter _ determines the sensitiveness of profitability of *i*-products to the changes of general market profitability subject to an unsystematic risk. If $\beta_i > 1$, then profitability of this products is more sensible to profitability of market and subject to the large vibrations, what market profitability. For most types of products there is a theoretical value $\beta_i > 0$, that means positive

intercommunication between the dynamics of general market profitability and profitability of *i*-products, that is it corresponds to the current state of market affairs. Negative values β_i characterize the high level of unsystematic risk for *i*-products, that it is necessary to take into account to the investor in the process of realization of transactions.

Because these coefficients reflect the influence level of unsystematic risk on profitability of *i*-products, they are the basic parameter of their optimal distribution in the portfolio of enterprise. Coefficients β_i are incomparable for the different types of products, as variation of their profitability always will differentiate.

For providing of comparableness of risk levels and possibility of their integration in the optimization model it is necessary to transform them in comparable sizes by standardization on the basis of mean quadratic deviations.

Equalization of regressive dependence between profitability of products and index of demand at the market on the whole in the standardized expression will look like :

$$t_{\hat{r}_i} = \beta_{st} t_{\xi_{(t)}}. \tag{6}$$

Defining β_{st} is possible through a betweenness by the actual and standardized coefficients of regression:

$$\beta_{st} = \beta_i \frac{\sigma_{\xi(t)}}{\sigma_{\hat{r}_i}}. \tag{7}$$

The standardized coefficients β_{st} determine the measure of influence of separate systematic factors on profitability of products in a pure form, without the account of influence of other factors. The standardized coefficients are shown in identical units, that allows to compare them inter se on an absolute value, to range factors on the degree of influence on the change of profitability of products.

The indicated approach reflects dependence of risk and profitability of products, that is the simplified reflection of actual processes at the market and does not allow to take into account the factor of market flexibility of making decision in activity of enterprise on producing of new products. The indicated factor in modern terms acquires the special meaningfulness, as able to influence on the size of market demand and speed of realization of operations.

The presented system of recursive models allows to estimate, firstly, influence of factors of demand on market profitability of production and sales, secondly, to define the size of unsystematic risk and on this basis to get the parameters of optimization of portfolio as the rationed indexes of model of dependence of individual profitability from the size of unsystematic risk.

The parameters of connection equalization can be used as instruments of market risk and optimization of activity assessment on producing of new products only on condition of their adequacy, that is checked up by means of statistical criteria of approximation. It allows to define the borders of possible risk and subject to the choice of different strategies of optimization.

3. Optimal distribution of structure of products on a cost in the portfolio of enterprise to the proportionally expected coefficients of optimization :

$$s_{opt_i} \in \begin{Bmatrix} s_{opt_1} \\ s_{opt_2} \\ \dots \\ s_{opt_n} \end{Bmatrix} = S \times \begin{Bmatrix} K_{opt_1} \\ K_{opt_2} \\ \dots \\ K_{opt_n} \end{Bmatrix}, \tag{8}$$

where s_{opt_i} is an optimal size of cost of *i*- products in a portfolio taking into account the risks

of demand on the new products of enterprise;

S - set cost of portfolio of enterprise, set depending on investment strategy of enterprise and criteria of limitations in the acceptance of administrative decisions.

This model works on condition of sufficient competitiveness of products, acceptable level of market risk, sufficient level of competition and transparency of operations.

On the basis of the offered algorithm the estimation of optimal pattern of production in cable industry is in-process carried out on large-sized positions of cable production.

In the total the estimations of crowd conditions of connection are expected for determination of dependence between profitability of production and indexes of the real production and sales in the cut of large-sized production groups of cable. Initial indexes on assortment groups are presented in a table 1.

The presented data are used for the estimation of crowd conditions of connection between indexes for the ground of construction the regression equalization.

Table 1

Indexes of efficiency of sales and production types of cable in 2014

Groups of cable	Profitability of production	Index of the real production of enterprise-consumers of products	Index of sales
1	25	1,014	1,159
2	44	1,127	1,357
3	37	1,119	1,258
4	58	1,324	1,453

The calculation estimations of correlation coefficients on the basis of these data are presented in a table 2.

As calculations showed, between the indexes of production efficiency and sales of cable in a cut on the groups of consumers spheres a multicollinearity is absent, that is all coefficients less than 0,7. On these groups realization of pattern optimization of production is possible with the purpose of risks decline and height of general profitability of enterprise.

Table 2

Calculations of pair coefficients of correlation for determination of dependence between profitability of production and indexes of the real production of consumers of products of enterprise and sales

Indexes	Profitability of production	Index of the real production of products consumers of enterprise	Index of sales
Profitability of production	1		
Index of the real production of consumers of products of enterprise	0,658	1	
Index of sales	0,554	0,453	1

Source: it is expected by an author

Thus diversification will be effective in the plan of providing of height of general production profitability, what the signs «+» of pair coefficients of correlation testify to. It allows to expect the parameters of regression equalization in accordance with the offered algorithm of optimization. The results of calculations are presented in a table 3.

Thus, equalization of regression in a normal kind looks like the following:

$$Y_x = -0,965 + 0,363 x_1 + 0,734 x_2$$

The parameters of equalization β_i show that the increase of index of the real production of products consumers of enterprise on 1% results in the height of production profitability on 0,363%, and the height of index of products sale on 1% results in the height of production

profitability on 0,733%.

This equalization is statistically reliable and reliable on the formal criteria of approximation, as be obvious from a table 3. It allows to estimate the standartized estimations β_{st} on the basis of comparison of mean quadratic deviations of equalization indexes and structure of expenses.

Table 3

Calculations of equalization parameters for the receipt of estimations of pattern optimization of production

CONCLUSION OF RESULTS						
Regressive statistics						
Plural R	0,999577					
R²	0,999154					
Rationed R²	0,997462					
Standard error	0,006945					
Supervisions	4					
Analysis of variance						
	df	*SS*	*MS*	*F*	*Meaningfulness of F*	
Regression	2	0,056952	0,028476	590,4109	2,029089	
Remain	1	4,82E - 05	4,82E - 05			
Total	3	0,057				
	Coefficients	*Standard error*	*t -statistics*	*P -value*	*Bottom 95%*	*Overhead 95%*
Y-crossing	-0,96458	0,042417	-22,7403	0,027977	-1,50353	-0,425
Index of the real production of consumers products	0,362998	0,086662	4,188684	0,149193	-0,73814	1,464138
Index of sales	0,73356	0,088512	8,287664	0,076446	-0,3911	1,858216

Source: it is expected by an author

As a result of calculations next estimations (table 4) are got. Thus a coefficient of structure optimization is specific gravity of the standartized parameters of equalization on the types of products.

Apparently on results calculations, most specific gravity the production of goods must occupy 2 groups, that is cable for electrical engineering industry, on the second place on priorities of production is a cable for telecommunications, further follow production for a heavy engineering and mining industry.

Table 4

Estimations of optimal pattern of production subject to consumer demand

Groups of products	Standartized coefficients	Pattern optimization coefficients of production	Grades of priorities of goods production
1	0,870	0,139	4
2	2,530	0,405	1
3	1,190	0,191	3
4	1,650	0,264	2
Total:	6,240	1,000	-

Source: it is expected by an author

On the basis of the stated, it is possible to do next recommendations. It is necessary to increase specific gravity of production of cable for telecommunications, that for today is the

most dynamically developing sector of economy in connection with development of electronic Internet-technologies. Such technologies require the use of optical-fibrous cable of high quality with the set technical descriptions, that requires realization of investment project on the production of such type of cable.

The calculation of quantitative parameters allows to form the different types of administrative decisions on optimization of structure depending on being of actual or having a special purpose profitability in the positive (negative) area of values or after their limits.

Realization of the offered algorithm of pattern optimization of production allows to work out management parameters efficiency of making decision in activity on producing of new products of enterprise. It will provide validity in the acceptance of administrative decisions in activity on producing of products both in short-term and long-term prospects.

The offered model allows to carry out planning of industrial and economic activity of enterprise on the basis of consideration of alternative variants of nomenclature, to the unit and prices cost on products on all positions of nomenclature of producible products.

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