Management of the organization of production of building materials and products

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Abstract. The article describes the main stage of technological techniques and methods of automation of technological objects for the production of building products for the formation of structural schemes of organizational (manufacturing and implementation) control systems. A static characteristic of demand for construction products and a system of coordinated decision-making between the technical services of production and sales of products are developed. A generalized block diagram of the supply and demand management system for building materials and research is given. The functional dependence of the amount of profit on the quantity of produced building materials and products at the enterprises of the construction industry is formulated. Key words: production of building materials and products; management systems for the production and sale of building materials and products; demand, price and supply of products in the market; decision-making bodies of the organization of production and distribution of products; static characteristics of the demand for the product, its prices and profits from sales; feedback principle; adaptive (with fuzzy logic) control system; external disturbances; mismatch signals between supply and demand.

1. Introduction
Demand for a specific type of high-quality building materials and products is one of the effective methods for making operational decisions, which are determined by the science of management, including the need to automate the management of technological processes in the construction industry, for the production of building materials and products (BM&P). [1] Currently, the center of gravity of the science of production management is gradually shifting to the field of solving problems associated with problems in the release of new BM&P and their implementation in modern market conditions, when it is necessary to manage a developing construction project and implement an organizational management system. [2] Therefore, there is a need to study the possibility of using classical techniques and methods of automation of technological objects for the formation of structural diagrams of organizational control systems, using the example of production and marketing BM&P of mass consumption (concrete mix, brick, cement, slate, concrete blocks, contact network supports, road curbs, wall panels, etc.), which are necessary to meet the needs of owners-developers of summer cottages, cottage, garden, personal and garden plots. [3]

2. Research Methodology
The object of management of the system for the sale of consumer goods is their potential buyers. Satisfaction of an individual need for a specific product is determined, firstly, by the material
capabilities of a particular customer, and secondly, by the availability of such a product on the market and, finally, by the cost of a building product (BP), which has a common property for such goods: with increasing prices for a particular product, demand for it decreases, and with lower prices - it grows. In this case, each value of the price $I_i$ for a specific type BP corresponds to the established value of the amount of consumed this type of product $W_i$.[4]

This relationship between the input of the control system and its output is called a static characteristic of demand for the specified type of product (Fig.1): $W_i = f(I_i)$, where: $i$ - nomenclature BP. Each price value ($b_1 - b_4$) corresponds to a specific demand value ($a_1 - a_4$) for this product per unit time. Consumer system BP is the object of management of the implementation system. The only controlling influence of the system is the price BP. [5]

The need for this product determines the main goals in the industry - its manufacture (production) and implementation (marketing, distribution). At the enterprises of the construction industry, these goals are achieved using a special production system led by the chief engineer of the company ((Technical Director - TD), determining the volume of issue BM&P and a sales system led by a commercial director (CD), determining at what price these products must be sold. [6]

Suppose that both decision-making bodies (TD and CD) of an enterprise independently make decisions without coordinating them with each other. The governing body of the TD of the production system determines the number of BP produced, and the governing body of the CD of the sales system determines the price for this type of product in accordance with the order of the general director. [7]

If the TD policymaking body has been instructed to issue BP in a unit of time in an amount equal to the value of the “0-a2” segment, then the product sales body, depending on the instructions received by the CD policymaking body, sets the price of the product equal to “0-b3”. Moreover, the demand value “0-b3” for this product will be less than the supply, i.e. BP will be produced more than can be implemented (Fig.1.).

![Figure 1. Static characteristics of product demand](image)

**Figure 1. Static characteristics of product demand**

The segment "a2-a3" determines the rate of increase in the number of BP in the folds, which will lead to unjustified costs of labor and material resources associated with an increase in storage costs. If the price for BP is equal to the segment “0-b1”, then the value of demand “0-a1” is greater than the supply. In this case, fewer products are produced than can be realized: the “a2-a1” segment determines the growth rate for this BP.

This situation creates a number of inconveniences: for the buyer - the loss of time to search and purchase the necessary BP and excess demand over supply (direct “b1-b2”) creates the possibility of obtaining super-profitable sources of income, which leads to an artificial redistribution of incomes of the population - incomes of some increase excessively and decrease in others.

In addition, this circumstance leads to the transition of individual products from the state “supply exceeds demand” to the state “demand exceeds supply” (Fig. 1. - shift upward of the static
characteristic). This, in turn, will increase the number of BP for which the Customer will not receive a certain amount of cash revenue, which will lead to an increase in the state's output of a new mass of money for the development of BM&P. And, if the growth rate of the amount of money exceeds the growth rate of goods, then this, as you know, will lead to the depreciation of the money supply (inflation) with all the ensuing consequences.

Thus, the main goal of the totality of production and sales systems is to make demand equal to supply. And this is only possible if the CD set the price for BP equal to "0-b2" (Fig. 1) and corresponds to all the indicators of the system shown in Fig. 2.

**Figure 2. Coordinated Decision Making System**

With the coordinated work of decision-making bodies (CDs and TDs), the static characteristic of demand 1-1 (Fig. 1) is known, and then for a given number of BPs issued per unit time, making a decision on setting the price for BPs is not difficult: it is enough to find the intersection point of demand with direct proposal (a2), design it on the price axis (0-Iji) and get the price for this type of i-product. If demand does not match supply, then this factor can be adjusted using price changes. If the type of the statistical characteristic of demand is unknown, it is not constant in time and depends on many factors fn: change in the solvency level of the Customer, demand for the type of BP among developers, the appearance of competing BP, etc., then change, for example, the statistical characteristic of demand 1-1 to 2-2 to achieve this goal entails the need to either change the price from “o-b2” to “o-b4” or change the number of BP issued per unit time from “o-b2” to “o-b4”. It should be noted that the statistical characteristics of BP production, as a rule, can also change as well as the characteristics of demand. Therefore, the need arises to solve an important problem: to build a control block diagram (Fig. 3) in the process of functioning, if the managers did not have static characteristics of demand and production, it would make it possible to determine: at what price to sell BP, so that at any quantity the demand would correspond to supply, and how much BP is necessary to produce per unit of time to get maximum profit.

One of the main research methods for solving this problem is to use the feedback principle used in automatic control theory (TAU). This principle allows you to control control systems (adaptive control systems with fuzzy logic) in the absence of complete information and characteristics of technological objects, its condition and external disturbances FB acting on it. For the demand management system, the only feedback signal is the mismatch between supply and demand, and for the system to work efficiently, it needs to be closed so that the price of the BP depends on the level of the feedback mismatch.

3. **Discussion**

The discrepancy between supply and demand Δoc is submitted to the decision-making body of the CD of the implementation system, in which it is converted into recommendations in accordance with the control algorithm: if there is an excess (overstock) of BP, it is necessary to lower the price, and if there is a shortage of goods, increase the price (Fig. 3).
Figure 3. Generalized block diagram of the demand management and supply BP

In the control system, restrictions may be imposed for reasons of consumer solvency, and considerations of profitability of production. Thus, using feedback you can get data on the optimization of the selling price of BP.

Based on the TAU course, the principle of automatic control with feedback is associated with dynamic (transient) processes in the control system [5].

As applied to our developments, when the price changes, the demand will change in accordance with the static characteristic with a certain delay, and the application of the algorithm to change the price with an excess and lack of BP can lead to sharp price fluctuations with an amplitude far exceeding the value of the price change necessary to compensate for the variation in demand characteristics in static mode.

To reduce the magnitude of the amplitude of price fluctuations, the decision-making body of the CD must decide on a price change based on the sum of two signals: a mismatch signal between supply and demand and a signal of demand change rate.

The feedback principle can be used to control the production system. In this case, the feedback signal giving the TD a recommendation to increase or decrease BP production is the amount of profit. Knowing the price and the number of BP sold per unit of time, it is possible, taking into account the cost, overhead and unforeseen expenses, to determine the functional dependence of the profit per unit of time on the number of BP issued per unit of time (Fig. 4): $P = f(N_{cu})$. This dependence can be called a static characteristic of profit, which, as a rule, is extreme.
Figure 4. Functional dependence of profit $P$ on the number of products $N_{cu}$

With a small volume of production, BP production leads to a loss, since the proceeds from the sale of a small amount of goods, even at high prices, cannot cover all costs. The situation is similar with a very large release of BP. In this case, the price drops to almost zero and the proceeds from the sale also cannot compensate for the costs. Therefore, for most types of BP there is some optimal value of the volume of production, the most profitable from an economic point of view. The choice of this optimal value of the quantity of goods produced is the task of the second control circuit (Fig. 3.)

Since the static characteristic of profit depends on the price, it indirectly depends on the characteristics of demand. Therefore, the management of the production system cannot establish a constant optimal volume of output, but must continuously manage it, although the rate of these changes will be significantly lower than in the first circuit of price management. (Fig. 3) The feedback signal for the release management system is profit, which should be monitored by a special optimization unit. The task of this unit should be to determine the boundaries of the optimum ("+" - increase, "-" - decrease) of the current BP release and issue recommendations to the TD on increasing or decreasing the production of this type of product.

The release by a manufacturer of a new type of product immediately affects the static characteristics of the demand for other types of products, which, in turn, leads to a change in the static characteristics of the profits of these types of BP, which will affect the entire system of production and sale of the totality of these products.

If the static characteristic of profit from the sale of any type of product corresponds to curve $3\rightarrow 3$, then the number of these products $O\rightarrow A$ produced per unit of time corresponds to the maximum value of profit per unit of time (Fig. 4).

On the market (in the distribution system) a new type of product, which, of course, will change the static characteristic of the profit of the old BP, depending on the technical characteristics of the new type of product and its demand by the consumer.

The appearance of a new type of BP will change the static characterization of the profit of the old product from $3\rightarrow 3$ to $4\rightarrow 4$. Then the manufacturer of old products instead of the profit $P_1$, which he received from the sale of these products, will begin to incur losses $P_2$. Characteristic $4\rightarrow 4$ shows that it is necessary to stop the production of old products and switch to the production of new products, since for characteristic $4\rightarrow 4$ there are no longer any values for the number of products whose production was profitable.

Time $T$, during which the manufacturer can produce the same amount of old goods without reducing its production, can be determined by the formula: $T=\frac{\mathcal{D}}{P_2}$, where $\mathcal{D}$ is the stock of cash capital; $P_2$ is the amount of loss per unit time.
If during the time T, during which the manufacturer does not have time to organize the production of a new type of product, then he will be forced to start liquidating production and dismissing workers and employees. The appearance of a certain number of unemployed will affect the static characteristics of demand for other types of BP, and this, ultimately, will lead to the appearance of an additional number of unemployed, etc. Such is an approximate simplified model of a crisis in modern conditions, and as applied to TAU, this phenomenon is called the loss of system stability [1].

4. Conclusions
The given functional dependencies occurring in the system of production and sale of building products of various kinds are the initial stage of the possibility of applying the basic principles of automation of technical systems to the management of organizational systems at enterprises in the construction industry. The application of such a methodology for managing BP production, taking into account the dependences of demand on supply, cost of production downtime, will most cost-effectively ensure the production of high-quality BP of the required quantity and ensure the company's profit in modern market relations.

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