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MATHEMATICAL MODELING AND OPTIMIZATION OF PARAMETERS OF STANDARDIZATION OBJECTS IN THE FOOD INDUSTRY

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Abstract. *The article presents the economic significance of standardization in the food industry, optimization of standardization objects, analysis of the scientific, technical and economic foundations of standardization and standardization activities, as well as the legal aspect based on the methodological approach of mathematical modeling parameters in standardization.*

Keywords: *standard, standardization, optimization, modeling of the object of standardization, parameter, indicators, normative document.*

Introduction

In accordance with the interstate regulatory document, the term "standard" is defined by the following description: standard - a regulatory document that is developed on the basis of consensus, adopted by a body recognized at the appropriate level and establishes rules, general principles or characteristics for various types of activities for general and repeated use or their results, and which is aimed at achieving the optimal degree of ordering in a certain area [1, 2].

Materials and methods

Based on the above definitions, specific work is required. In these cases, the implementation of purposeful work and activities to establish the norm and optimal parameters for standardization objects is forced. Then we need to clarify the term standardization. Standardization is an activity aimed at achieving an optimal degree of streamlining in a certain area by establishing provisions for universal and reusable use in relation to actual or potential tasks [1, 2]. On the basis of this definition, we will be able to explain the extended definition in the term standardization dusted as follows: standardization is the establishment and application of rules with the aim of streamlining activities in a certain area for the benefit and with the participation of all interested parties in particular in order to achieve universal optimal savings while observing the operating conditions (use) and safety requirements. To achieve overall optimal savings while respecting the production of products, processes or the provision of services, operating conditions or use, and the safety requirements of the standardization object, the conditions and optimization problems are considered. Optimization of standardization objects (products, processes and services) consists in finding the optimal main parameters: destination parameters, characteristics, indicators, as well as the values of all other quality and economy indicators. The effectiveness of standardization in the conditions of developed market relations is

manifested through its following functions. The economic function includes the following aspects:

- provision of information about products and their quality, which allows participants in trading operations to correctly evaluate and select goods, optimize capital investments;
- dissemination of information about new technology, materials and methods of measurement and testing;
- increase in labor productivity and cost reduction
- promotion of competition based on the standardization of test methods and unification of the main parameters of products, which allows for its objective comparison;
- ensuring compatibility and interchangeability;
- rationalization of management of production processes and ensuring a given level of product quality

Results and discussion:

The social function provides for the fixation of such a level of parameters and indicators of products that meets the requirements of health, sanitation and hygiene, ensures the protection of the environment and the safety of people in the production, handling, use and disposal of products. The communicative function provides for the creation of a base for the objectification of various types of human perception of information, as well as the fixation of terms and definitions, classifiers, measurement and testing methods, drawings, symbols, etc., providing the necessary mutual understanding, taking into account international practice, including a system of accounting, statistics and financial and accounting activities, a system of design and technological documentation, process management systems, etc.

Standardization as a technical science is based on the initial provisions - the principles that are set out in GOVST 1.0-2015, Uz GSt 1.10 and the Laws "On Standardization" and "On Technical Regulation" of the Republic of Uzbekistan [3-6].

Standardization occupies an important place in the system of normative management of science, technology and economics, the relationship of these areas is shown in detail in Fig. 1 [7-11].

The scientific principles of standardization consist in that the observance of the principle of progressiveness and optimization of standards allows the indicators, characteristics and requirements in the standards to be brought into line with the world level of science, technology and production, and also to take into account the development trend of standardized objects.

Methods for optimizing standardization objects and mathematical models are considered in GOVST 18.101-82 [8, 9].

Optimization of the parameters of standardization objects consists in determining and setting the values of the parameters under which, under given conditions, the specified goal is achieved with minimal cost.

The proposed mathematical model for optimizing the parameters of objects is a formalized scientific abstraction that describes the process of functioning of a standardization object in the general case at all stages of its existence so that it can be used to calculate the optimal values of the parameters of this object [11].

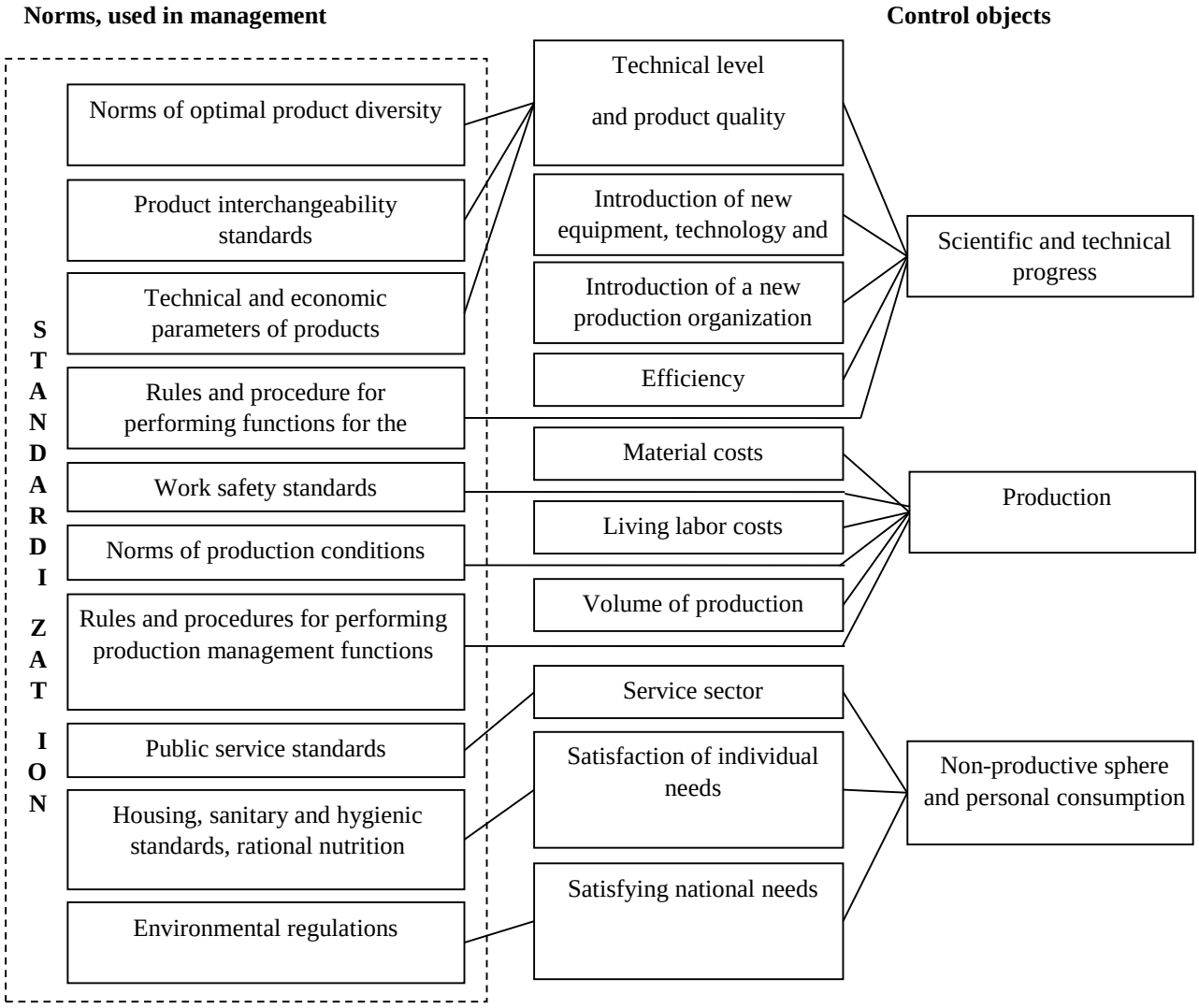

Fig. 1. The place of standardization in the system of normative management of science, technology and economics

The input data for optimizing the parameters of objects are the following functions:

dependency effect ($\overline{E}' = E_1,...,\ E_a$) from optimized parameters $P_i (i = 1,\ 2,...,\ u)$, time of introduction t_{intro}, period of validity of the standard (product model) T_{act}, current time t:

$$E_j = f_{E_j}(P_1,...,\ P_u,\ t_{\text{intro}},\ T_{act},\ t);\ j = 1,\ 2,\ a; \quad (1)$$

cost dependence $\overline{C} = (C_1, C_2,..., C_b)$ for research, development, production and operation (consumption) of the object of standardization from the same parameters.

$$C_k = f_{Ek}(P_1,..., P_u, t_{\text{intro}}, T_{act}, t);\ k = 1,\ 2,\ b; \quad (2)$$

dependence of the purpose of production and the use of the object of standardization $Z_l = f_{Zl}(Z_1, Z_2,..., Z_c)$ from the economic effect, costs and time:

$$Z_l = f_{Zl}(E_1,.E_2,.., E_a, C_1,..., C_b);\ l = 1,\ 2,\ c; \quad (3)$$

dependencies between the parameters of the standardization object $\overline{E} = (E_1,..., E_d)$, which describe scientific and technical possibilities (limitations) at a certain level of scientific and technological progress:

$$E_m = f_{Em}(P_1,..., P_u, t);\ m = 1,\ 2,\ d; \quad (4)$$

restrictions $\overline{H} = (H_1,...,H_c)$ in the form of inequalities describing production capabilities, availability of raw materials, materials, components, personnel, financial resources, etc.:

$$H_n = f_{Hn}(P_1,...,P_u,t);\ n = 1,\ 2,\ e. \quad (5)$$

In addition, the input data may contain dependencies that describe changes in individual optimized parameters over time, criteria for the appropriateness of choosing mathematical models, and other information.

From the input dependencies (1) - (5) form the target optimization function:

$$Tar = f_{Tar}(E_1,...,E_a;\ C_1,...,C_b;\ t_{intro},T_{act},t) \quad (6)$$

The task of optimizing product parameters when using mathematical models is to find the values of product parameters as a result of calculations $P_i = (i = 1,2,...,u)$ and their distribution in time, at which the objective function reaches the maximum (or minimum) value, subject to the restrictions.

A typical scheme for optimizing the parameters of standardization objects (for example, products) is shown in fig. 2.

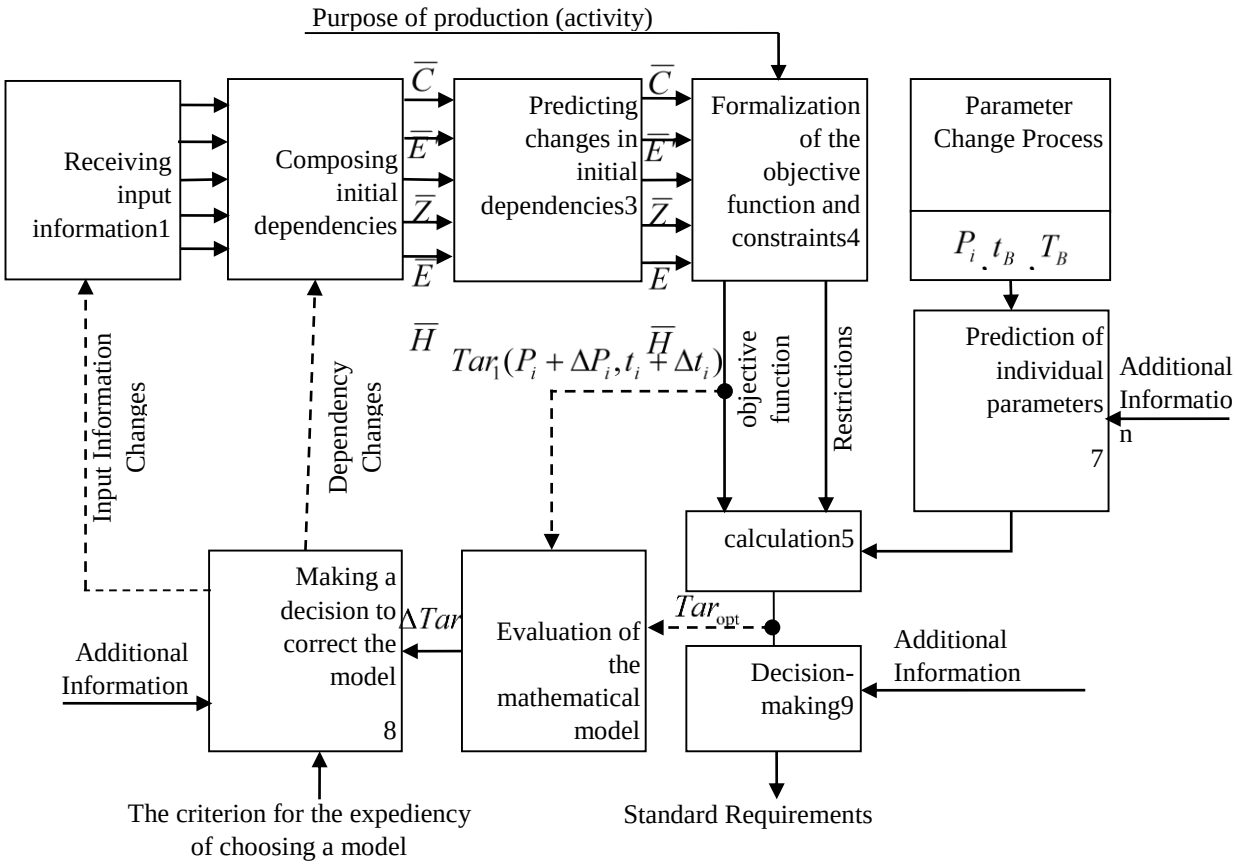

Fig.2. Model for optimizing the parameters of standardization objects

A typical scheme for optimizing the parameters of standardization objects (for example, products) consists of the following blocks:

1 - block for obtaining input information necessary for compiling dependencies (1) - (5);

2 - block for compiling initial dependencies (1) - (5);

3 - block for predicting changes in the initial dependencies in the future period of time;

4 - block for compiling the objective function (6) and dependency constraints (1) - (5);

5 - block for calculating the optimal parameters for the known objective function and restrictions;

6 - block evaluation of the mathematical model;

7 - block direct prediction of individual parameters to simplify the mathematical model;

8 - decision block for correcting the mathematical model;

9 - decision block on the parameters of standardization objects.

To clarify the meaning of the concepts of parameter, objective function, constraints and the process of setting optimization problems, let's consider the simplest example.

Let it be required to determine the dimensions (radius r and length l) of a cylindrical tank for the food industry with a capacity of 10 at a minimum consumption of material of a certain thickness.

The objective function is the surface area: $S = 2\pi r^2 + 2\pi rl$. The limitation is the value of the volume $V = \pi r^2 l$, $V = 10м^3$.

As a result of calculations, we obtain the optimal values of the parameters $r = 1{,}17м$, $l = 2{,}33м$. With these dimensions, the minimum consumption of material is achieved. In the example, the constraint reflects the functional relationship between the optimized parameters.

Conclusion.

Optimization of standardization objects consists in finding the optimal basic parameters and quality indicators. Optimization of standardization objects is carried out by applying special economic and mathematical methods and optimization models, which are exemplified by the proposed methods. The goal of optimization is to achieve the optimal degree of ordering and the highest possible efficiency according to the selected criterion.

REFERENCES

1. ГОСТ 1.1-2002 Межгосударственная система стандартизации. Термины и определения. ВНИИстандарт, 2022. 36 с.
2. O‘z DSt 1.10:1998 Государственная система стандартизации Узбекистана. Основные термины и определения. Узбекский государственный центр стандартизации, метрологии и сертификации, 1998. 34 с
3. ГОСТ 1.0-2015 Межгосударственная система стандартизации. Основные положения. ВНИИНМАШ, 2015. 17 с.
4. O‘z DSt 1.0:1998 Государственная система стандартизации. Узбекистана Основные положения. Узбекский государственный центр стандартизации, метрологии и сертификации, 1998.24 с.
5. Закон «О стандартизации» Республики Узбекистан от 3 ноября 2022 г., № ЗРУ-800
6. Закон «О техническом регулировании» Республики Узбекистан от 23 апреля 2009 г., № ЗРУ-213
7. Общие положения в области стандартизации URL: https://studfile.net/preview/6072787/page:2/
8. ГОСТ 18.101-82 Количественные методы оптимизации параметров объектов стандартизации. Основные положения по составлению математических моделей. Госстандарт СССР, 1982. 6 с.

9. РД 50-559-85 Методические указания. Количественные методы оптимизации параметров объектов стандартизации. Организация работ при оптимизации параметров объектов стандартизации. Издательство “Стандартов”, Москва 1986. 10 с.
10. Владимир Репин. Стандартизация бизнес-процессов: уровни развития системы URL: https://www.businessstudio.ru/articles/article/standartizatsiya_biznes_protsessov_urovni_razvitiya/
11. Никифирова А.Д. Метрология, стандартизация и сертификация: Учеб. Пособие / А.Д. Никифиров, Т.А.Бакиев – 2-е изд. испр.- М.: Высш шк. 203 – 442 с.
12. Eshmuradov D. et al. STANDARTILASHTIRISH, SERTIFIKATLASH VA SIFATNI BOSHQARISH TIZIMLARI SOHASIDAGI ME’YORIY HUJJATLAR //Science and innovation. – 2022. – Т. 1. – №. A8. – С. 595-600.