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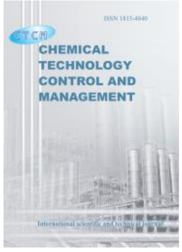

Since 2005

CONTROL OF THE FACIAL DESIGN PROCESS OF INNOVATIVE DEVELOPMENTS

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Abstract: *The role and place of visual design in the process of creating an innovative development have been stated. It is shown that the tasks of the face stage of the product life cycle are devoted to systemic issues, in the center of which is the resolution of the contradiction between the desired and the achievable. The first is determined by the need to create a new system of a higher level, and the achievable is determined by the level of development of science, technology and production technology, as well as by the conditions of operation and repair. The work is devoted to the presentation of the theory of utility for the analytical comparison of alternatives to the created system as a key stage in system analysis.*
Keywords: *innovative development, visual design, consumer utility of products, theory of utility.*

Аннотация*: Инновацион ишланмаларни яратиш жараёнида кўринишли лойиҳалашнинг роли ва ўрни баён этилган. Маҳсулотлар ҳаётий циклининг кўринишли босқичининг масалалари маркази кутилган ва эришилган натижалар ўртасидаги қарама-қаршиликларни ечимларидан иборат бўлган тизимли масалаларга бағишланганлиги кўрсатилган. Кутилган натижалар янада юқорироқ сатҳдаги янги тизимларни яратишдаги талаблар билан, эришиладиган натижалар эса ишлаб чиқаришдаги техника ва технологияларнинг ривожланиш даражаси, шунингдек қурилмалардан фойдаланиш ва таъмирлаш шароитларини белгилаб беради. Мақола яратилаётган тизимларнинг муқобилларини аналитик солиштириш учун тизимли таҳлилнинг асосий босқичи каби қараладиган фойдалилик назариясини ифодалашга бағишланган.*
Таянч сўзлар: *инновацион ишланма, кўринишли лойиҳалаш, маҳсулотларнинг истеъмолчиларга фойдалилиги, фойдалилик назарияси.*

Аннотация*: Показана роль и место обликового проектирования в процессе создания инновационной разработки. Продемонстрировано что задачи обликового этапа жизненного цикла изделия посвящены системным вопросам, в центре которого находится разрешение противоречия между желаемым и достижимым. Первое определяется потребностями в создании новой системы более высокого уровня, а достижимое – определяется уровнем развития науки техники и технологии производства, а также условиями эксплуатации и ремонта. Работа посвящена представлению теории полезности для аналитического сравнения альтернатив создаваемой системы как ключевого этапа системного анализа.*
Ключевые слова: *инновационная разработка, обликовое проектирование, потребительская полезность продукции, теория полезности.*

Introduction

The work is devoted to the problem of control the process of making managerial decisions at the stage of visual design of innovative developments. The control of the decision support process is understood as the creation, based on the methods of system analysis and synthesis, of the appropriate methodology for design decisions at the stage of the life cycle of the visual design of a technical system or industrial product [1]. At the same time, the subject of the research is the method of decision-making at the stage of visual design of a promising development.

Prospects and competitiveness of promising innovative development using the following groups of indicators [2]:

- the usefulness of the product or products;
- customer costs;

- ways to promote a product or develop it on the market (terms of delivery, warranty, service, marketing support, etc.).

The concept of "usefulness of innovative development" can be disclosed with the help of a special utility function formed on the basis of the theory of utility [3]. Competitiveness can be measured by market response to a specific product. The main direction of increasing the competitiveness of innovative development is the modernization and creation of appropriate modifications of the ongoing development. The considered circumstances determine the relevance of the development of innovative projects on the basis of a system analysis of the decision-making methodology at the stage of the life cycle - the visual design of innovative developments. At this stage of the design, informal concepts are widely used, as well as heterogeneous information presented at a qualitative level. It should also be noted that technological capabilities in a decade and a half will significantly exceed the current level of science and technology and, therefore, the potential of future production should be taken into account when creating an innovative development. It follows that the adoption of design decisions at the stage of visual design should be attributed to semi-structured problems, the solution of which is the area of application of the arsenal of systems analysis and synthesis.

In recent years, there have been fundamental changes in the methodology and practice of designing and implementing innovative developments, and the understanding is gradually emerging that the success of the implementation of new developments is entirely determined by their competitiveness, which is a common characteristic of the quality of any product. Thus, the general task is to increase the competitiveness of the created products against the background of the unfolding sixth technological order.

Application of a utility function to assess the competitiveness of a product.

At the center of the tasks of visual design is the resolution of the contradiction between the desired and the achievable. The first is determined by the needs for creating a new system, which are formed when solving the problems of creating a system of a higher level within the framework of the formed concept. In turn, the achievable is determined by the level of development of science and technology, maintenance and repair technology.

Currently, an approach has emerged - the formation of prices based on the utility of the product. The theory of utility is based on the attitude of a person to the product in the form of a subjective assessment of the usefulness of the benefits received from the product [3,4]. The concept of the competitiveness of the created product is formed in the form of project competitiveness, which is determined by three groups of parameters:

- consumer utility, determined by the level of performance of the target task;
- economic parameters (price factors);
- organizational and economic parameters.

Let us turn to the basics of the theory of utility in relation to the analytical comparison of alternatives, considered as a stage of systems analysis. Let us present an axiom, using which in [3] the existence of a cardinal value function is proved.

The axiom of measurability: the decision maker can determine the degree of preference between any pair of alternatives from $A = \{a_i\}$, $i = \overline{1, m}$. Any two alternatives a_i and a_j are comparable, i.e. for alternatives a_i and a_j one of the following options is possible: alternative a_i is preferable; alternative a_j is preferable; alternatives a_i and a_j are the same in preference [5]. (The notation for the degree of preference for the transition from alternative a_i to alternative a_j is introduced as $a_i a_j$).

On many alternatives, there is a perfect, reflexive and transitive weak preference relationship:

$$a_i a_j \prec \sim a_g a_k \tag{1}$$

meaning that the degree of preference for alternative a_i over alternative a_j is greater than or equal to the degree of preference for alternative a_i over alternative a_j.

By perfect is meant a preference for which the following statement is true:

$$(\forall a_i, a_j \in \{A\})(a_i \succ a_j \vee a_i \succ a_j). \tag{2}$$

If two statements $a_i \succ a_j$ and $a_i \succ a_j$ are simultaneously true, then the indifference relation $a_i \sim a_j$ takes place.

The axiom of summation of the strength of preference: for any three alternatives for which the following preferences of the decision maker are valid: if alternative a_i is preferable to alternative a_j, and alternative a_j is preferable to a_k, then the degree of preference for alternative a_i over alternative a_k is higher than the degree of preference for alternative a_i compared to the alternative a_j [6]. This axiom can be added as follows:

$$a_i \succ a_j, a_j \succ a_k \Rightarrow a_k a_i \succ a_j a_i. \tag{3}$$

Solvability axiom: for any alternatives a_i, a_j, a_k from the set A ={a_i}, $i = \overline{1, m}$, there is an alternative ah such that

$$a_i a_j \sim a_k a_h. \tag{4}$$

Archimedes' axiom: Absence of infinitely small or infinitely large degrees of preference of the decision-maker; in other words, if the alternative a_i is preferable to the alternative a_j, then there are two other alternatives a_g and a_k for which the condition [7] will be satisfied:

$$a_g a_i \sim a_k a_j. \tag{5}$$

If the above axioms are fulfilled on the set of investigated alternatives $A = \{a_i\}$, $i = \overline{1, m}$ chosen for solving the target problems $O = \{o_q\}$, $q = \overline{1, h}$, there exists a measurable value function $v(a_i)$, with the following properties:

$$a_i \succ a_j \Leftrightarrow v(a_i) > v(a_j); \tag{6}$$

$$a_i a_k \succ a_j a_g \Leftrightarrow v(a_i) - v(a_k) > v(a_j) - v(a_g). \tag{7}$$

To solve the problem under consideration, property (7) - the property of measurability - is of significant interest, because after obtaining the values of the utility function for the considered alternatives with knowledge of the price or other component that is associated with each alternative, one can choose the most advantageous option in terms of value per unit monetary investments.

It is known [8] that the effectiveness of alternatives in solving the set target tasks o_q is characterized by n criteria X_j, $j = \overline{1, n}$, which are classified as factors or attributes.

If we use the results of utility theory to establish the conditions imposed on the criteria X_j, $j = \overline{1, n}$, to represent the function $v(a) = f(x_1, x_2, \dots x_n)$ can be represented in the following convenient for practical use form:

$$v(a) = f(x_1, x_2, \dots x_n) = f_3(v_1(x_1), v_2(x_2), v_n(x_n)) \tag{8}$$

where, $v_i(x_i)$ is the value function for the criterion X_j, $j = \overline{1, n}$ [4].

The measurable function of the value of one argument describes the translation of the values of the attribute x_j into the value of the value of this value in additive form [9]:

$$v(a) = \sum_{j=1}^{n} k_j v_j(x_j), \sum_{j=1}^{n} k_j = 1, \tag{9}$$

where, k_j is the scaling factor of the value function $v_j(x_j)$,, normalized to accept a value from 0 to 1.

If we compare the definition of quality as “the degree of compliance of a set of inherent characteristics with a requirement” and the definition of competitiveness as a difference from another proposal “in terms of the degree of compliance with specific social needs”, then among all the characteristics of an object, only those are selected that are essential and important for satisfying the needs of the consumer in the process use of the object. As you can see, there are very similar definitions.

On the other hand, the ability of a product to satisfy needs by solving target problems is the network of the concept of its usefulness [10]. It follows that limiting the set of product characteristics to only those indicators that participate in satisfying the need, thanks to which the product was acquired, leads to the transition from quality to utility.

Further, if we add to the consideration the price and non-cost indicators of the product, then we can come to competitiveness as a combination of three groups of indicators (Fig. 1) [11]:

- the usefulness of the product;
- costs of the buyer (consumer);

- ways to promote the product to the market.

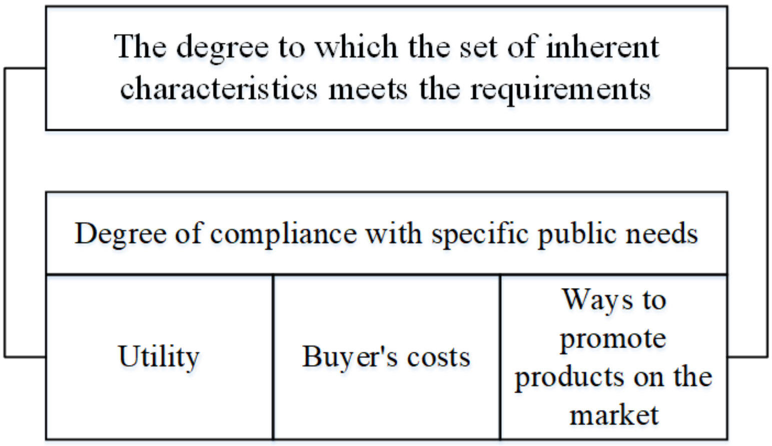

Fig. 1. ***Mutual correspondence of the concepts of "quality", "competitiveness" and "utility".***

Conclusion

The use of utility theory results for the analytical comparison of alternatives has a number of advantages over the well-known cost-effectiveness method. In semi-structured tasks such as visual design problems, qualitative concepts, design experience and decision-makers are of great importance. When constructing mathematical models of efficiency and cost, one has to replace qualitative variables with some numerical indexers - measurable quantitative variables and build pseudo-objective models on their basis. The use of the goal function makes it possible to include a large number of heterogeneous criteria in the process of choosing the best alternative and, as a result, to obtain judgments that are closer to the real world to a greater extent.

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