INFLUENCE OF QUALITY OF THE GOODS ON SATISFACTIONS OF CONSUMERS

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***Abstract* – In process of work the problems are set and solved. There are problems of social welfare research in conditions of nonhomogeneity of objects and subjects of management, of revealing and substantiating insuperable difficulties in rising of social welfare by approaches, worked out before. Also there developed a new direction in implementation of the most important aim of any socially-oriented economy (Abstract).**

Key words – consumer demand, quality, qualitative growth of welfare, competitiveness (key words).

I. INTRODUCTION

Quality – great mistery of economy, its misfortune and hope. Low quality of goods and labour – is a «black hole» of economy that devours more than a half of already underutilized resources; overloads the planet with harmful waste. Drastic, continuous quality escalation – the source of rapid benefication and development, scare resources economy. The choice between devastation and prosperity should be made be each enterprise, institution, government, and country.

The structure of national wealth sources has undergone profound changes. Up to the recent time the country was considered to be rich if it had natural resources abundance, energy, fertile land, an educated workforce. These factors estimated the level of national heritage, the prospects for economic and social growth. Scientists discovered a fundamentally new source of wealth (confirmed by the post-war development experience in Germany and Japan) - the high quality of products.

Lack of effective models for improving quality is largely due to a lack of understanding and transfering of practical and theoretical experience, forming a whole philosophy of quality management that requires a fundamental change in worldview, away from stereotypes.

The level of resolution of quality problems determines economic situation of organization, region, sector, and country. Lack of quality is one of the most obvious symptoms of the real problems in the organization. Quality is the key to the revival of the economy, enterprises competitiveness increase. Quality has become the most powerful corporate arm of the organization by effectively raising the maximum customer satisfaction and reducing losses.

Quality improvement based on a new philosophy of management was created in Japan. It is the country's crisis has prompted a general quality improvement in Japan to the level of the national idea, which led to the rapid growth and prosperity of the economy, which has become in many ways the best in the world. Japanese success lies not only in the defect-free production, but also in systematic and continuous quality improvement of products and processes, relationships with customers, suppliers and internal staff.

The importance of quality in the 1990s increased significantly. Modern industrial and other customers expect, in fact, perfect quality of products and services, which covers all areas of human activity in civilized countries (public and privately owned industrial organizations, education and health care, etc.). Companies' ability to long-term survival is determined by their continuous adaptability to market conditions, faster renewal and improvement of products, which should not only follow the growing demands of consumers, but also anticipate them.

In nowadays increase of goods quality is one of the conditions of actual satisfaction of customers' demands (interests). However estimation of goods quality and level of satisfaction is difficult task [6, 11].

At present time producers of goods for determining coefficients of quality of objects (goods and services) widely use instrumental and expert methods. Instrumental methods are based on physical effects and use of special apparatuses. Expert methods are used there, where physical phenomenon is not open or very difficult to use. Variety of expert method is so-called organoleptic method, based on use of human organs of sense. There exist some different approaches to estimation of goods quality, which use multifactor models. The most widespread among them is the method of neighboring point. However known methods lead to different estimations of consequence of consumers relation coefficients.

In spite of existence of different approaches in the sphere of determining of quality coefficients there are some unsolved problems. Difficulties are connected with transformation of the notion of quality from technical category to economical. They began to consider quality in interconnection with demand, satisfaction of consumers demand, and amount of expenses and so on. Quality is an aggregate of features and characteristics of object (goods or service), which enables it to satisfy, provided or supposed needs. Consumers demands are characterized both by qualitative and qualitative parameters of goods. In such conditions use of known methods is inconvenient since the abilities of the known methods do not respond to difficulty and many-sided character. In this connection the most difficult and less formalized and actual in theoretical relation and practical use of the notion of quality of objects, oriented on consumers demand, is development of generalized coefficients of quality.

1. Target setting.

Satisfaction of consumers' demand – is a peculiar measure of concordance of parameters of object to parameters of consumers' demand. Concordance of those parameters can be measured by generalized coefficients of quality, which we suggest to introduce on the basis of choice of corresponding measure. To this measure the following demands are made. Objects and demands of consumers are characterized by arbitrary number of parameters, among which is the definite number of parameters, specified by quantitative data and several parameters only by qualitative data.

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Besides even at high enough quality level goods or service cannot satisfy consumer (customer), if its fixed price is too high. In other words quality cannot be defined without price taken into consideration. It is significant at planning and projecting of quality. Providing of proper quality is impossible without regulation of prices incomes and costs. The same can be said about the volume of supply (production). If enterprise doesn't have data about volume of supply, amount of production waste, rejection rate, or necessary alterations, it is impossible to define the share of faulty units, and failure rate on enterprise. Without those coefficients providing of necessary quality level is impossible.

Insufficient volume of supply of goods or service, which is in requisition, causes inconvenience of consumers. Excessive volume of supply means over-expenditure of labor force, raw material, and energy. Regulation of expenses and providing of required level of quality are two sides of one medal. That's why it's always necessary to aim at delivery of goods or services at exactly specified volume, specified level of quality and at defined price. Therefore price and non-price parameters of goods should correspond to consumers' demand. That's why they must be considered by coefficient of quality. Coefficients of quality must allow the successful economic interpretation of obtained results. To our point of view measure of similarity fully corresponds to all these requirements [3]. Hereinafter as a generalized coefficient of quality of object oriented on satisfaction of consumers demand we will use measure of similarity $q_{nki} = q(\Pi_{ni}, T_{ki})$ between i parameters k goods $T_k = [T_{k0}, T_{k1}, ..., T_{ki}, ..., T_{kI}]$ and corresponding i parameters of demand n consumer, taken as a base of comparison. $\Pi_n = [\Pi_{n0}, \Pi_{n1}, ..., \Pi_{ni}, ..., \Pi_{nI}]$.

Measure of similarity, being generalized coefficient of quality of goods, connected with measure of closeness of vector parameters T_k and Π_n, by the simple ratio $q_{nk} = 1 - d_{nk}$, $n = \overline{1, N}$, $k = \overline{1, K}$.

By generalized coefficient of quality we mean measure of similarity q_{nk} between parameters of k object T_k ($k = \overline{1, K}$) and need of n consumer Π_n ($n = \overline{1, N}$). Coefficient of quality is – qualitative measure of consumers' satisfaction on goods and service market. (q_{nk} –is positive real number describing quality of goods). Quality is one of determining factors of function of utility and competitiveness.

2. Bases of comparison.

By the measure of similarity we mean non-dimentional index, used in different sciences, particularly in biology, for quantitative definitions of similarity measure of bodies of interest. The given term is also known as measure of association, similarity measure and other more rare names.

In a wider sense we can speak about similarity measures to which refer: measure of diversity, measure of concentration (homogeneity), measure of inclusion, measures of closeness, distance measures, measures of consistency of events, measure of inconsistency of events, measures of interdependence, and measures of mutual independence. The theory of closeness measures is now in the stage of formation and so there are a lot of different ideas about formalization of relationship of closeness and similarity.

One of the most important aspects of the given theory is the right choice of comparative base, which will define accuracy and objectivity of the results.

The majorities of indexes of similarity measures are normed and are in range 0 (no similarity at all) to 1 (complete similarity). Similarity and difference mutually supplement each other (mathematically it can be expressed as similarity=1 – difference).

The indexes of similarity can be conditionally divided in three groups, depending on number of considered objects:

Unary – one object is considered. This group contains measures of difference, measures of concentration; binary – two objects are considered. This is well-known group of indexes; nary – n objects are considered. This group is least known.

For our situation the measure of similarity allows to estimate subjective preferences of consumer with regard to purchase product of one or another quality.

Precision of estimation of quality and decisions significantly depends on choosing bases of comparison. Starting from the set target, bases of comparison can be:

- consumers' needs;
- value of necessary efficiency;
- hypothetic sample;
- group of analogues.

In case when bases of comparison is needs of consumers, there must be carried out the choice of nomenclature and preset of parameters of customers needs values, parameters of evaluated or competing production, which consumer use estimating production on market, and also ponderability of those parameters in their general set.

When as a base of comparison we take value of production coefficient, needed for consumer, and also amount of funds, which consumer is ready to spend on purchase and consumption, we choose as a standard coefficient itself or the amount of funds.

If estimated product has competitor then product – sample models need and acts as materialized demands to which estimated product must correspond.

Sometimes hypothetical sample acts as bases of comparison. It is average value of parameters of a group of items. Such procedure is used in such a case when information on specific sample-analogue is insufficient. In fact we talk about analyses of need, which may not exist, and this estimation must be considered as preliminary and a subject for further specification.

More often as bases of comparison there is taken group of analogues, singled out according to correspondence of classification parameters of sample and estimated production from which are chosen the most stately and then progressive items, having the best prospective for the further widening of sales volume.

The estimation of satisfaction of production consumers' demands is made by comparison of parameters of analyzed production with parameters of bases of comparison of consumers needs. Comparison is made by groups of technical and economical parameters.

3.Generalized coefficients of goods quality and consumers satisfaction.

Generalized coefficient of quality and satisfaction of consumers, introduced on the basis of measure of similarity

between parameters of object and bases of comparison must correspond to the three following conditions [5]:

1. $q_{nk} = \max q_{nk}$, if $\Pi_n = T_k$;
2. $q_{nk} = q_{kn}$, if $q[\Pi_n, T_k] = q[T_k, \Pi_n]$; (1)
3. $0 \le q_{nk} < \max q_{nk}$, if $\Pi_n \ne T_k$,

$\Pi_n, T_k \in \Pi$, $n = \overline{1,N}$, $k = \overline{1,K}$,

where Π – range of variation of parameters of bases of comparison, for example, consumers needs.

The first condition of quality coefficient is the condition of maximum object correspondence to bases of comparison; for example, satisfaction of consumers means perfect or potentially reachable level of quality.

The second condition is a condition of symmetry, and the third condition satisfies the request of monotone decrease of quality coefficient (measure of similarity) q_{nk} on distance d_{nk}, i.e. from $d_{nk} \ge d_{nj}$ with the necessity there follows satisfaction of inequality $q_{nk} \le q_{nj}$.

The case of equality of maximum value of quality coefficient to unity i.e. $q_{nk} = \dfrac{q_{nk}}{q(\Pi_n, \Pi_n)} = 1$ corresponds to normalized value of generalized coefficient of quality and is introduced as follows:

1. $q_{nk} = 1$, if $\Pi_n = T_k$; $q_{nk} = \dfrac{q_{nk}}{q(\Pi_n, \Pi_n)}$;
2. $q_{nk} = q_{kn}$, if $q[\Pi_n, T_k] = q[T_k, \Pi_n]$;
3. $0 \le q_{nk} \le 1$, if $\Pi_n \ne T_k$ for all $\Pi_n, T_k \in \Pi$, $n = \overline{1,N}$, $k = \overline{1,K}$. (2)

Economic meaning of symmetry of measure of similarity is connected with its single-valued possibility of application of the given coefficient, both by consumers and producers.

In the area of research of consumers' relation the measure of similarity can be used as coefficient of consumers and goods relations. Coefficient of consumers to object relations – is value of measure of similarity between parameters of consumers' needs and goods. During research of goods quality on market the measure of similarity is used as coefficient of goods quality.

It should be noted that analogues of quality coefficient are ordinary weigh-scales or measuring bar "meter". They are used both by sellers and customers for determining of weigh or measuring of lengths of goods.

Therefore, coefficient of quality – is the value of the measure of similarity between parameters of comparison bases and object (goods or service).

4. Analyses and evaluation of goods quality and satisfaction of consumers wants.

Comparing among themselves quality coefficients of objects in relation to each consumer, it's able to determine level of quality of each goods in relation to other goods.

Obviously quality of *j* goods in relation to *n-st* consumer will be determined by formula:

$$q_{nj} = \max\{q_{n1}, q_{n2}, \ldots, q_{nj}, \ldots, q_{nK}\}, \quad (3)$$

$n = \overline{1,N}$.

It's also able to introduce relation of *l-st* consumer to the level of quality of *k-st* goods:

$$q_{lk} = \max\{q_{1k}, q_{2k}, \ldots, q_{lk}, \ldots, q_{Nk}\}, \quad (4)$$

$k = \overline{1,K}$.

Naturally it's necessary to compare value q_{nj} with some threshold value of quality h_j, which is determined in each case in its own way. Exceeding the threshold level by the coefficient of quality is written as

$$1 - q_{nj} > h_j,\ n = \overline{1,N},\ j = \overline{1,J}, \quad (5)$$

and $1 > n_j$ is the condition of sufficing on market *j* goods to *n* consumer.

Besides let's introduce difference threshold ε of goods by quality:

$$|q_{nj} - q_{nk}| \le \varepsilon_{j,k},\ k \ne j, \quad (6)$$

where $\varepsilon_{j,k}$ - minimum difference between coefficients of goods quality. By the threshold of difference we mean the smallest change of quality coefficient between goods, which consumer is able to notice. Otherwise *n* consumer with the same possibility can be satisfied by *j* goods or *k* goods.

5. Certain forms of generalized coefficient of quality.

Let's consider certain forms of generalized coefficient of quality as applied to parameters of consumers' wants and goods, quantitatively and qualitatively defined.

To quantitative parameters belong price coefficients and characteristics of goods, defined quantitatively. Coefficients of quality for such parameters can be formed on the basis of use of particular kinds of measure of similarity, metrics of nearness (distance) d_{nk}, connected to the measure of similarity $q_{nk} = 1 - d_{nk}$ and parametrical correlation methods.

Suppose that on finite aggregate of positive parameters of consumers wants Π_n and goods T_k it is required to determine the measure of similarity. Suppose that Π_{n1}, $\Pi_{n2}, \ldots, \Pi_{ni}, \ldots, \Pi_{nI}$ and T_{k1}, $T_{k2}, \ldots, T_{ki}, \ldots, T_{kI}$ any positive numbers. Then the expression of unit coefficient of quality is determined as:

$$q_{nki} = \frac{2\sqrt{\Pi_{ni} \cdot T_{ki}}}{\Pi_{ni} + T_{ki}} = \frac{2\sqrt{T_{ki}/\Pi_{ni}}}{1 + T_{ki}/\Pi_{ni}} = \frac{2\sqrt{\Pi_{ni}/T_{ki}}}{1 + \Pi_{ni}/T_{ki}},\ i = \overline{1,I}, \quad (9)$$

complies with all three conditions of the measure of similarity

For the proof let's consider difference. $\Pi_{ni} + T_{ki} - 2\sqrt{\Pi_{ni} \cdot T_{ki}} \ge 0$, which comes from the third expression (2). Then the correlation $\left(\sqrt{\Pi_{ni}} - \sqrt{T_{ki}}\right)^2 \ge 0$ is just. Equal sign $\sqrt{\Pi_{ni}} - \sqrt{T_{ki}} = 0$ takes place then and only then, when $\Pi_{ni} = T_{ki}$.

If parameters of consumer's demand and goods consist of positive and negative numbers, then the measure of similarity can be given in a little changed way:

$$q_{nki} = \frac{2|\Pi_{ni} \cdot T_{ki}|}{\Pi_{ni}^{\ 2} + T_{ki}^{\ 2}}. \qquad (10)$$

For life-cycle phase, parameters of consumers wants $\Pi_{ni}(t)$ and object $T_{ki}(t)$ are continuous functions of time *t*. Then the measure of similarity respectively, will be written in integral form..

It should be also noted that as a measure of similarity can be used parametrical and non-parametrical methods of estimation of correlation connections between vectors T_k and Π_n, widely used in different statistic and economic researches.

In this context non-parametrical methods of correlation connections must be considered in context of correspondence of satisfaction of qualitatively given parameters of goods and consumers wants. Then as a measure of similarity there are used coefficients of correlations between parameters of consumers' wants and goods. Among these are coefficients of correlation of Spearman, Candall, coefficients of concordance, association, contingency, and others [4]. These coefficients for direct relationship of parameters of demand and goods are measured in limits $q_{nk} \in [0,1]$ and for inverse relationship respectively - $q_{nk} \in [-1,0]$.

The case when market is presented by one buyer *(N=1)* and one seller *(K=1)* corresponds the market of bilateral monopoly. In this case, customer demand satisfaction is defined be the quality threshold level.

On picture 1 there is a diagram showing quality exponent of *K* goods in reference to *n* customer that are collocated in order of decrease of each commodity from the level of appropriate maximal quality level $1>S_{n1}>S_{n2}>\ldots>S_{nK}>h_n$ to zero level.

This series shows a drop in competitive advantages of *K* goods from a growth of index *k*.

Thus, the quality of a product is a factor of its competitiveness, defined by a maximum value of similarity measure in accordance to comparable factors of rival objects involved in this market, and indicators of similarity measures of which are defined relative to the same base of comparison.

Generalized (integral) coefficient of quality of price and non-price parameters of goods is evaluated by expression

$$q_{nk} = \frac{1}{2}\left[1 - \left|\frac{\Pi_{n0} - T_{k0}}{\Pi_{n0} + T_{k0}}\right| + \frac{1}{I}\sum_{i=1}^{I} q_{nki} + \frac{1}{J}\sum_{j=1}^{J} q_{nkj}\right], \qquad (11)$$

Where *I* and *J* – Respectively number of quantitative and qualitative parameters of consumer's demand and object.

Let's consider generalized coefficient of quality q_{nk} on the basis of use of distance d_{nki} between parameters Π_{ni}, $i = \overline{1,I}$ of wants *N* of consumer and parameters T_{ki}, $i = \overline{1,I}$ of goods of one type *K*

$$q_{nk} = \frac{1}{2}\left[1 - \left|\frac{\Pi_{n0} - T_{k0}}{\Pi_{n0} + T_{k0}}\right| + \frac{1}{I}\sum_{i=1}^{I}\left(1 - d_{nki}\right)\right], \qquad (12)$$

$n = \overline{1,N}$, $k = \overline{1,K}$.

where parameters T_{k0} and Π_{n0} - relatively are price of κ goods and consumer value of this goods for *n* consumer.

Price of κ goods T_{k0} forms from prime cost of goods and profit of producer. Consumer value of goods Π_{n0} - is maximum price, which consumer considers advantageous to pay for it. It consists of consumer cost, equal to price of goods, and unpaid part of consumer value, which is equal to additional profit gained by consumer from use of goods.

The first multiplier in (12) is equal to relation of goods to consumer value and contains in its compound costs and income, both of producer and consumer.

That's why this multiplier determines economic share in coefficient of quality. The second multiplier (radicand) in equation (12) determines technical aspect of quality.

Thus the value q_{nk} simultaneously accounts for correlation with bases of comparison and economical and technical properties of goods.

Metrics of nearness – Euclidian and hemming distances and their modifications are used comparatively wide [7, 8].

As an example, we calculated the competitiveness of shoes in quality. Suppose shoe factories produce three brands of sport shoes A, B and C. Footwear is characterized by six indicators:

- whether footwear absorbs or devours shocks and blowsб which allows to run on the asphalt;
- whether it is less than 500 conventional units;
- service life of footwear;
- comfort;
- availability of models of significant color;
- how well it supports foot.

Values for a particular group of consumers of these characteristics are determined by a seven-point scale, with values ranging from "very good" to "very bad" P1 = [+3, +2, +1, 0, -1, -2, -3].

Footwear brands A, B, C, according to consumers, also predicted by a seven-point scale ranging from "very likely" to "unlikely" T = [+3, +2, +1, 0, -1, -2, -3].

It is necessary to assess the competitiveness of footwear brands A, B, C by the quality, from consumers point of view for each parameter and in general for all parameters. Table 1 shows the baseline *(P_{1i}, T_{1i}, T_{2i}, T_{3i})* and calculated *(S_{1i}, S_{2i}, S_{3i}, S_{11i}, S_{12i}, S_{13i})* data.

In this example a long life and comfort were the most essential characteristics of shoes, followed by amortization (absorbption) of shocks and jolts and arch support. Color received relatively little attention, but this characteristic is nevertheless important.

Unlike all the others, the price factor (500 conventional units) received a negative assessment in the sample. This suggests that the low price does not match the quality of shoes, as consumers are largely considered to be the ratio of "price and quality."

From consumers point of view shoes brand A has all the necessary properties. Brand A got a maximum estimate in many characteristics. In addition, consumers believe that brand A hardly costs less than 500 rubles. Competitiveness indicators for quality *S_{11} = 0,91, S_{12} = 0,76 and*

S_{13} = *0,66* mean that shoes brand A is more competitive than shoes brands B and C.

6. Conclusions.

This work offers methodology and methods of evaluation of quality of objects and level of consumer demands satisfaction. On the basis of use of measure of similarity there were developed generalized coefficients of quality. There were introduced specific types of generalized coefficients of quality. There was substantiated the choice of bases of comparison resulted from task setting. The results can be applied in the sphere of quality management and organizing of production in different branches. .

Our proposed method of estimating the quality of product allows to use different approaches related to the choice of comparison basis, more accurately evaluate the integral and differential competitive advantages and disadvantages of the product or service.

In our opinion, it is necessary to study in detail the information data, such as consumer behavior and their impact on competition and product quality. In addition, it should be noted that consumers in the market do not act as one. Consumers react differently to the same product with the same properties, and this must be considered in theoretical development and interpretation of the results. The reliability of product quality assessment will always depend on the initial data. This leads to the need for further study of consumers behavior and their reactions to the product.

Known economic research in the field of quality assessment are based on the ratio use of product parameter to comparison base, and as it was previously mentioned, are only limited by the use of quantitative parameters of the product. They were developed to determine particular and for the most part stationary quality factors.

However, any economic system is dynamically changing structure, which involves the study and definition of transient dynamic indicators of competitiveness. In addition, many product parameters are specified by quality manner. In these circumstances, the known methods for assessing the quality are of little use.

Proposed here is more general evaluation methodology, in comparison with the known quality assessments can be used equally well with quantitative and qualitative parameters of products and take into account the dynamic and unsteady performance of market conditions and consumer behavior.

Consequently, the quality evaluation by this method is the most common, objective and credible, which determines not only theoretical, but also a higher applied significance of the summarized quality measures.

Not least factor of the proposed methodology and the technique is its simplicity, cost transparency, which simultaneously facilitates the interpretation of the economic aspect of the results, accelerates the calculation process and automation of product quality and competitiveness computation.

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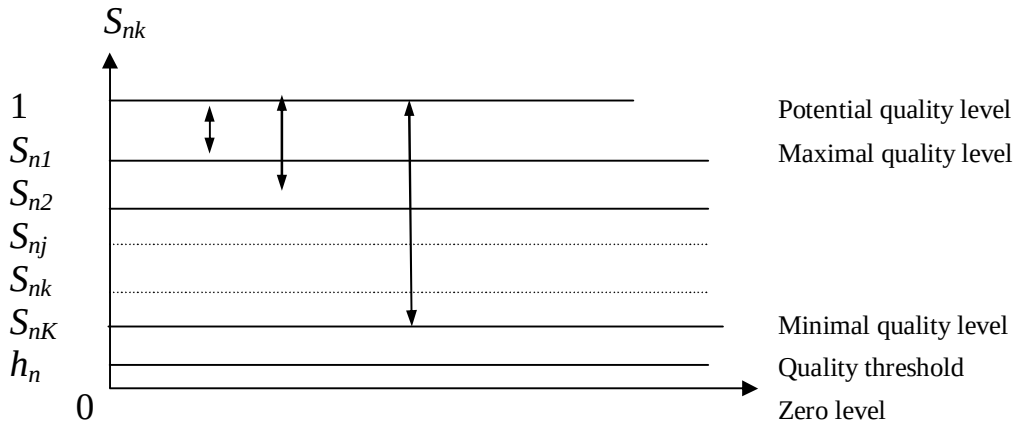
Appendix 1



Picture 1. Object competitive ability level

Appendix 2

Table 1

Footwear quality calculation

№	Показатель	Perfect consumer score, $П_{1i}$	Consumer outlook of shoe brands and similarity measures					
			brand A		brand B		brand C	
			T_{1i}	S_{11i}	T_{2i}	S_{12i}	T_{3i}	S_{13i}
1	Amortization	+2	2	1	+1	0,8	+1	0,8
2	Price 500 rub	-1	-3	0,6	-2	0,8	-2	0,8
3	Life	+3	3	1	1	0,6	+1	0,6
4	Comfort	+3	+2	0,92	+3	+1	+1	0,6
5	Color	+1	+1	1	+3	0,6	+3	0,6
6	Foot support	+2	+3	0,92	1	0,8	+1	0,6
Integrated indicator of competitiveness $S_{nk} = \frac{1}{6}\sum_{i=1}^{6} \frac{2\lvert П_{1i} \cdot T_{ki} \rvert}{П_{1i}^{\,2} + T_{ki}^{\,2}}$			S_{11}=0,91		S_{12}=0,76		S_{13}=0,66	

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