

Ensuring Consumer Satisfaction of Products in the Quality System of the Enterprise Based on the Application of the «Consumer's Risks» method

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Abstract. The paper deals with the basics of ensuring customer satisfaction as one of the conceptual principles of the quality management system (QMS) of the enterprise, based on "Consumer's risks" method, which is a modification of the well-known "Consumer Voice" method. The paper analyzes scientific approaches to the problem under study. The paper gives ground for the prospects of studying personal risks of consumers in order to anticipate their expectations from the company's products based on the application of "Consumer's risks" method, which allows to extrapolate the risks of interested parties to the product characteristics expressed in professional terminology that is understandable for the manufacturer who can implement it. The authors propose a procedure for transferring consumer's risks into product characteristics and a statistical justification of the priority of their implementation, which allows to balance the requirements of all interested parties. The expediency of using the developed procedure in order to ensure customer satisfaction and increase the competitiveness of the enterprise is proved.

1 Introduction

Nowadays an effective tool for ensuring the product quality and, as a result, the effectiveness of the enterprise is the quality management system (QMS), the purpose of which is, among other things, to meet the requirements of consumers.

Scientific studies of the nature of consumer requirements for products have revealed their heterogeneity and differentiation [1, 2]. At the same time, risk-based approach in accordance with international standards ISO 9000:2015 provides that ensuring and anticipating consumer expectations from products of an enterprise means the study of personal risks of interested parties, which reduces the level of uncertainty in understanding the degree of the product value from the consumer's point of view.

It should be noted that meeting the consumer's requirements includes statistical justification of the priority of implementing product characteristics extrapolated from personal risks, when the company's resources are limited.

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In this regard, it is advisable to study scientific approaches to identifying personal risks of consumers, transfer them into product characteristics, and provide statistical justification for the priority of implementing the considered characteristics.

2 Materials and methods

The analysis of papers in this subject area has shown the interest of the scientific community in the study of personal risks of interested parties in products in order to anticipate their expectations and ensure the competitiveness of the enterprise [2-10]. In this regard, it may be promising to study the personal risks of consumers, which are considered within this study as problems, threats, errors, damage, etc., i.e. negative consequences associated with the use of products [4, 5]. However, difficulties in solving this problem are caused by the following disadvantages:

- difficulties in identifying personal risks of the parties interested in the product, due to the fact that consumers, as a rule, do not voice them;
- absence of formalized models for extrapolating consumer risks to product characteristics expressed in professional terminology that is understandable to the manufacturer;
- underestimating the possibilities of applying statistical justification for the priority of product characteristics implementation, formulated in the context of identified consumer risks, in conditions of limited enterprise resources.

In this regard, the use of the following methods and tools seems promising in this study: quality management tools, in particular, modifications of one of the methods of the QFD (Quality Function Deployment) – Consumer Voice; a conceptual risk-based approach to ensuring customer satisfaction in the interpretation of international standards ISO 9000:2015; statistical methods for justifying alternatives.

It is possible to eliminate the identified shortcomings if to ensure and anticipate customer satisfaction by solving the following tasks:

- to develop a procedure for transferring personal risks of consumers into product characteristics based on "Consumer's risks" method, which is a modification of "Consumer Voice" method;
- to justify statistically the priority of choosing the implementation of product characteristics extrapolated from personal risks;
- to integrate the procedure for ensuring and anticipating customer satisfaction based on "Consumer's risks" method in the enterprise's QMS.

Solving these tasks will reduce uncertainty in decision-making related to product improvement and will increase customer satisfaction.

3 Results and discussion

In order to solve the given tasks, a procedure for transferring personal risks of consumers into product characteristics and statistical justification of the priority of their implementation is developed, which is shown in Fig. 1. The proposed procedure is considered on the example of identifying personal risks of consumers (office workers with different levels of training) caused by the use of the computer program "XX".

3.1 Transferring of consumer's personal risks into product characteristics based on "Consumer's risks" method

The application of "Consumer's risks" method is based on the following assumptions: personal risks of consumers are considered as problems that interested parties have while using products; the study of problems is carried out by questioning respondents with open questions in order to prevent distortion of consumer requirements; extrapolation of consumer's personal risks into product characteristics does not have a linear relationship, i.e. consumer's personal risk can be projected onto several product characteristics.

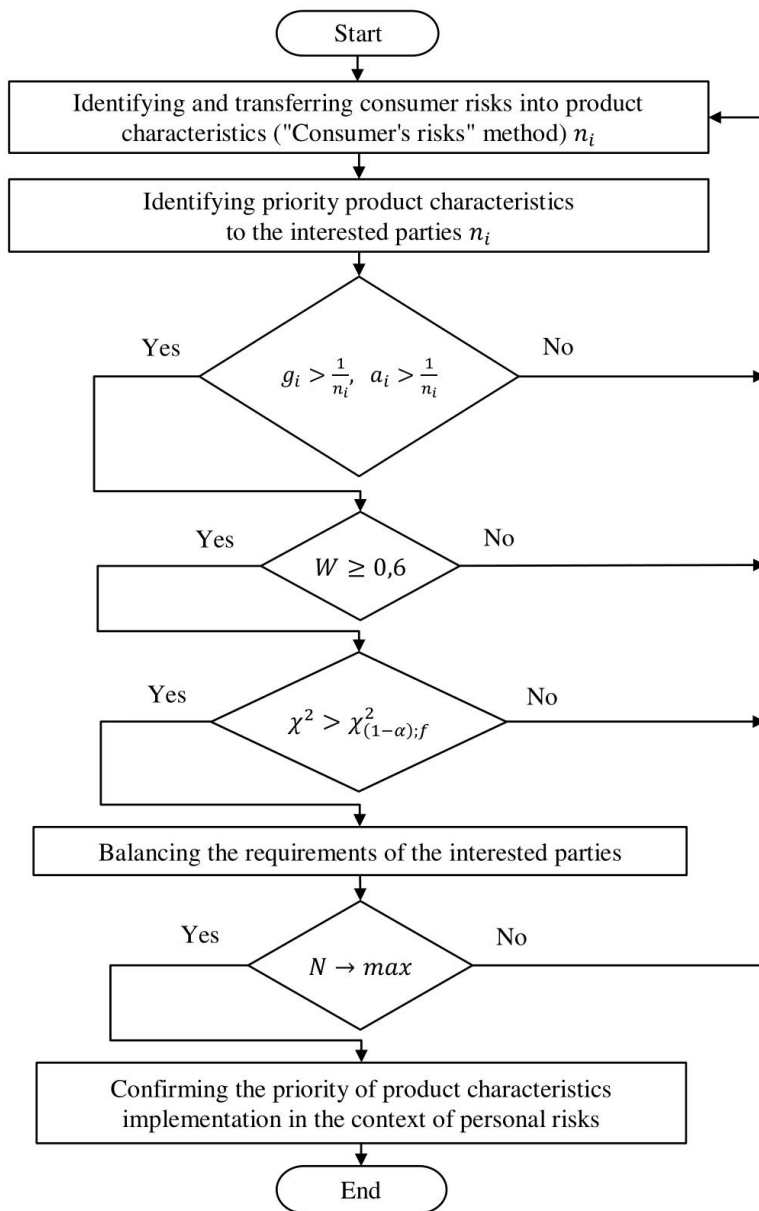


Fig. 1. Extrapolation of consumer's personal risks into product characteristics

"Consumer's risks" method provides for the implementation of the following measures (Table 1):

Table 1. "Consumer's risks" method in relation to a computer program "XX" (segment)

Consumer		Office worker (user of the program)			
Product (service)		Computer program "XX"			
№	Consumer's risks p_i	Task	Refusal	№	Product / service characteristics n_i
3	Risk of looking as an incompetent user	Development of a program that is understandable for users of any level of training	The program is verified, but not validated to meet the consumer's requirements	3	Validated program
				4	...
4	Risk of insufficient information security	Availability of access codes that ensure information confidentiality	Lack of formal indicators confirming the level of information security	5	The program has a license that confirms the level of information security

1. Identification of consumer's personal risks of (Consumer's risks column). At this stage, the requirements formulated by interested parties to the product are identified, taking into account the problems (risks) that consumers encounter when using it.

2. Determination of the way to resolve consumer's problems (Task column). Links are established between identified problems and product characteristics that can be changed.

3. Development of preventive actions aimed at solving potential inconsistencies caused by proposed changes in products (Failure column).

4. Extrapolation of consumer's risks to product characteristics expressed in professional terms that are understandable to the manufacturer, taking into account the elimination of possible problems and inconsistencies (Product/service characteristics column).

3.2 Statistical justification of the priority of product characteristics realization

Statistical justification of the decision to select product characteristics in order to implement them includes the following measures:

1. Formation of independent expert groups, each of which independently studies product characteristics. In this case, experts are focus consumer groups of computer program "XX" and employees of the developing company.

2. Ranking of product characteristics based on their significance while ensuring customer satisfaction and processing the data obtained is presented in Table 2.

3. Definition of the weight coefficient of each product characteristic for groups of experts - consumers (g_i) and employees of the enterprise (a_i), respectively [12].

4. Calculation of significant weight coefficients of product characteristics for each group of experts respectively is done by using the formula

$$g_i' > 1/n. \tag{1}$$

Significant coefficients a_i' are calculated similarly.

5. Definition of the consistency of expert opinion in each group based on the calculation of Kendall concordance coefficient W [12]. The significance of W value is evaluated by χ^2 criterion [11, 12]. If $\chi^2 > \chi^2_{(1-\alpha),f}$, where $f=(n-1)$ is the number of degrees of freedom, then the concordance coefficient W is considered statistically significant. Consistency of

expert opinions is considered acceptable if the concordance coefficient $W \geq 0,6$ is statistically significant with a confidence probability of $P=1-\alpha$.

Table 2. Processing of data from rank assessments of product characteristics selection in the context of consumer’s risks (segment)

Consumer code, <i>m</i>	Product characteristics extrapolated from consumer’s risks, <i>n</i>						$\sum R_i$	T_i
	<i>n_i</i>	<i>n₃</i>	<i>n₄</i>	<i>n₅</i>	<i>n₆</i>	<i>n_{i+1}</i>		
1	...	5	1,5	1,5	3	...	28	6
...
15	...	4	1	2	3	...	28	-
Data on statistical processing of expert assessments								
<i>S_i</i>	...	72,5	25	31,5	37,5	...	$W = 0,77 > 0,6$ $\chi^2 = 69,3 >$ $> \chi^2_{0,95;6} = 1,63$	
<i>g_i</i>	...	0,11	0,25	0,23	0,21	...		
<i>g_i'</i>	...	-	+	+	+	...		
<i>S_i - \bar{S}</i>	...	12,5	-35	-28,5	-22,5	...		
$(S_i - \bar{S})^2$...	156,25	122,5	812,25	506,25	...		
Employee code, <i>k</i>	Product characteristics extrapolated from consumer’s risks, <i>n</i>						$\sum R_i$	T_i
	<i>n_i</i>	<i>n₃</i>	<i>n₄</i>	<i>n₅</i>	<i>n₆</i>	<i>n_{i+1}</i>		
1	...	1	5	3	2	...	28	-
...
10	...	2	5	1	3	...	28	-
Data on statistical processing of expert assessments								
<i>S_i</i>	...	20	39	25,5	23,5	...	$W = 0,68 > 0,6$ $\chi^2 = 40,8 >$ $> \chi^2_{0,95;6} = 1,63$	
<i>a_i</i>	...	0,24	0,15	0,21	0,22	...		
<i>a_i'</i>	...	+	+	+	+	...		
<i>S_i - \bar{S}</i>	...	-20	-1	-14,5	-16,5	...		
$(S_i - \bar{S})^2$...	400	1	210,25	272,25	...		
<i>S</i>	...	0,085	0,223	0,286	0,274	...		
Note: significant product characteristics are marked with +; priority product characteristics are highlighted								

6. Balance of interested parties’ requirements is calculated according to the formula:

$$H = \frac{a_i g_i}{\sum_{i=1}^n a_i g_i}, \tag{2}$$

where g_i, a_i are weight coefficients of product characteristics for consumers and employees of the enterprise respectively; n is the number of identified product characteristics.

The priority to implement is the product characteristic that has the highest value, i.e. $H \rightarrow \max$.

The proposed procedure makes it possible not only to ensure the satisfaction of interested parties, but also to anticipate their expectations by expanding the set of product requirements while studying the personal risks of consumers.

4 Conclusion

The research conducted for ensuring of customer satisfaction with products of an enterprise as one of the conceptual principles of QMS indicates the interest of scientists in this issue.

Scientific discussions to develop tools and technologies for identifying personal risks of consumers, transferring them into product characteristics, and balancing the requirements of all interested parties make it necessary to develop methods that contribute to solving the issues under consideration.

In this regard, the proposed procedure for transferring personal risks of consumers into product characteristics based on "Consumer's risks" method and statistical justification of the priority of their implementation, which allows to balance the requests of interested parties, will undoubtedly contribute to ensuring consumer satisfaction and competitiveness of the enterprise.

References

1. Y.V. Bragin, V.F. Korolkov, *The way of QFD: design and production based on consumer expectations* (2003)
2. N.S. Yashin, L.F. Popova, S.V. Bocharova, N.G. Bagautdinova, *International Business Management*, **10**, 5720 (2016)
3. S.G. Bozhuk, T.D. Maslova, N.A. Pletneva, K.V. Evdokimov, *IOP Conf. Series: Materials Science and Engineering*, **666** (2019)
4. V.A. Kachalov, *Methods of quality management*, **7**, 24 (2016)
5. T.A. Korneeva, I.A. Svetkina, E.S. Morozova, A.S. Zotova, *Advances in Intelligent Systems and Computing*, **908**, 189 (2020)
6. T.I. Leonova, Y.A. Kalazhokova, *Century of quality*, **2**, 10 (2015)
7. A.V. Selezneva, Y.A. Anikina, *Master's Journal*, **2**, 94 (2014)
8. N.Y. Velichko, *Bulletin of North-Caucasus Federal University*, **5**, 40 (2016)
9. E.N. Eliseeva, *Society, economics, management*, **4**, 62 (2018)
10. M.M. Dvorjashina, E.V. Artemova, *Manager*, **6**, 42 (2019)
11. V.E. Gmurman, *Probability theory and mathematical statistics: textbook for universities* (2020)
12. N.S. Kremer, *Probability theory and mathematical statistics: textbook and workshop for universities* (2020)