

Customer Satisfaction Assessment in Management Quality System of Industrial Enterprises

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Abstract: The study observes the problems of customer satisfaction assessment of industrial companies. Researchers overview the existing approaches to the problem studied. The methods of customer satisfaction index calculation used by Russian instrument engineering enterprises are investigated and their shortcomings are identified. Researchers present the satisfaction assessment technique taking into account the type client cooperation with an industrial enterprise. The satisfaction index is calculated according to the following criteria: overall satisfaction, matching expectations, comparison with perfect company. The characteristics, on which the satisfaction analysis is based, reflect clients' requirements grouped in compliance with the type of cooperation with company. The key feature of the approach applied is the use of subjective estimates reflecting the clients' perception of the product quality and service. The results of customer satisfaction study are given in graph, the axes of which are the satisfaction indices of each characteristic and their priority. A system similar to traffic lights is introduced to visualize the level of customer satisfaction. This satisfaction assessment technique has been tested at a one of Russian instrument engineering enterprises of the Saratov Region. The analysis has revealed the main sources of clients' dissatisfaction of company under study and demonstrated that its business processes are to be investigated. The testing of this approach has shown practical significance of technique used and productivity of its application.

Key words: Client satisfaction, customer satisfaction, satisfaction index, quality management system, efficiency

INTRODUCTION

Customer focus is one of the key principles of quality management, in accordance with which a company has to maintain its focus on enhancing customer satisfaction. Taking into account the requirements of the standard ISO 9001-2015 "organization shall monitor customer perceptions of the degree to which requirements have been met (ISO, 2000)".

"Satisfaction is the consumer's fulfillment response. It is a judgment that a product/service feature or the product or service itself, provided (or is providing) a pleasurable level of consumption-related fulfillment, including levels of under- or overfulfillment (Oliver, 1996)". Satisfaction analysis for business leaders is not just a formal requirement, it is a real tool to assess the customer perception of the product quality and a way to define opportunities for continuous improvement (Yashin *et al.*, 2015). When there are no specific recommendations for the evaluation of customer satisfaction in international standards each certified to ISO company has to work out its own methodology of such assessment.

In accordance with the requirements of the State Military Standard GOST RV 0015-002-2012, a number of customer satisfaction indicators has been developed for Russian enterprises of the military-industrial complex within the technique of QMS performance evaluation. This technique studies the satisfaction with the product quality, not taking into account the overall customer satisfaction. In this standard, the satisfaction is measured by the following indicators:

- The share of acceptance certificates of research, design and development work as well as the stages that do not contain customer's comments in the total number of acceptance certificates of scientific-technical products (weight ratio index (WRI)-1)
- The share of production, accepted right the first time by the military representative of the Ministry of Defense of the Russian Federation (WRI-1)
- The share of production without complaints in the total number of delivered products (WRI-1)

- The share of the products with some shortcomings, which has no reclamation, but accepted by enterprise, in the total number of delivery products (WRI-0.6) (Military Register, 4)

Undoubtedly, the issue of quality improvement, including reliability of defense products is important in ensuring the combat effectiveness and readiness of the Russian Armed Forces. About 70% of the prototype units of AMSE (armament, military and special equipment) correspond to the requirements for quality and reliability (Mayanskiy, 5). Product quality falling manufactured by companies of defense-industrial sector poses a real threat to national security (Kramin *et al.*, 2014). Thus, we try to substantiate the emphasis of this technique on such characteristics as lack of comments and complaints on the work and company products and right the first time acceptance of product by the Ministry of Defense.

In its turn, the Russian military standard «GOST RV 0015-002-2012» indicates that organizations should take into account (GOST RV 0015-002-2012, 7):

- Requirements including those for delivery and post-delivery activities
- Requirements not defined by customers but necessary for specified or intended use, when they are known
- Statutory and other regulatory requirements applied to products
- Any additional requirements considered necessary

Thus, for all industries, regardless of the type of product it is necessary to analyze the level of customer satisfaction including analysis of all customer requirements.

MATERIALS AND METHODS

To carry out the analysis of customer satisfaction degree the organization initially should determine the expectations and requirements of clients. Customers expectations play an important role in the evaluation of product/service performance (Karna *et al.*, 2004). If the expectations and requirements of enterprise customers are significantly different, it is necessary to analyze the satisfaction of all categories of clients.

Many industrial companies producing products for civil and military purposes work simultaneously on two different markets-b2b (sales of products to other businesses) and b2c (sales of goods or services directly to customers for their own use). Each category of customers is characterized by peculiar and different parameters according to which their satisfaction is analyzed (Gulnara *et al.*, 2014).

Thus, the first step in customer satisfaction research is to identify requirements and if there is a high differentiation of the needs and requirements the customer segmentation is necessary.

The parameters on which the assessment of satisfaction is conducted should be designed on the basis of the perception analysis of customer value, exploring their expectations and requirements. The classification of the requirements and expectations of Noriaki Kano still remains relevant and presents the three types of requirement: the must-be requirements (basic criteria of a product), one-dimensional requirements (usually explicitly demanded by the customers), attractive requirements (neither explicitly expressed nor expected by the customer) (Kano *et al.*, 1984). To determine the requirements of customers it is recommended to use of VOC method (Voice of Customer) (Hauser, 1993). It is important to listen to the client and understand what is important for him/her.

For further analysis the identified requirements should be transformed into specific characteristics of the customer value which includes characteristics of products/services important for client and parameters of customer cooperation with company. The characteristics of products/services consists in their quality, price and execution time of order. The satisfaction with the appropriate product or service is estimated only by consumers. There is a separately group of customer value characteristics cooperation with company which represents the quality of client services. Thus, the set of identified customer value characteristics constitutes the model for customer satisfaction assessment. If customers' values are significantly different the model for customer satisfaction assessment of each client segment should be individually designed.

Customer value features depend on industry and character of clients' interaction with company. We have interviewed the clients of one of the Russian companies of instrument engineering industry which delivers products mainly on the b2b market and performs the state defense-industrial sector orders. Having analyzed customer requirements and the features of client cooperation with this enterprise, we grouped the customer value characteristics as following: orders for serial production, orders for development and production of prototype units, repair work and cooperation with company.

There is the content of the model of the customer value characteristics of instrument engineering company under study presented below. The first characteristics group of this model "orders for serial production" contains following:

- Quality of products (functionality, reliability, safety of exploitation, technical production level)
- Execution time of order
- price

The value characteristics of the second group “orders for development and production of prototype units” includes:

- Quality of advanced production samples (the novelty and patentability of enterprise, the quality of the technical documentation developed, the technical level of developed prototype units, technical characteristics of developed prototype units)
- Execution time of development and production of prototype units
- Price

The value characteristics of the third group “repair work” are: quality of repair, execution time of repair work, price. The fourth group “customer cooperation with company” includes:

- Quality, speed, availability of information and consultation
- Relationship with customers
- Time of contract conditions negotiation
- Time of claims processing
- Products delivery
- Payment system

To estimate the customer satisfaction with the price, two criteria have been identified, they are the price matching the quality and the price level. Customers are always interested in lower prices and assessment of satisfaction level of prices, thus is always understated. For greater objectivity we have used an additional criterion that is satisfaction with price matching quality. The price of the similar products from other manufacturers may be lower but the quality of the products may also differ. In addition to the satisfaction with the quality other factors can influence the perception of the price, for example image of the company. Each group of products/services characteristics includes such criteria as price-quality ratio, the level of product prices.

The importance weights have been determined for each customer value characteristic basing on clients interviews and competitive analysis of enterprise under study. They are for product/service characteristics: quality-0.5; time-0.2; price-0.3 (the sum of the weights of these requirements equals to 1,0). The importance weights also are determined for each quality characteristic. Groups

of customer value characteristics have equal weights. Determination of weights makes calculation objective to the total index of customer satisfaction. The model of customer characteristics value allows to systematize the processes that affect the customer satisfaction level. That indicators to identify sources of customer dissatisfaction.

Such approach to a customer requirements structure can be used by companies of other industries operating in the b2b market. That contributes to precise identification of customer dissatisfaction sources. Such approach to can be used by companies of other industries operating in the b2b market.

When the goods or services are produced to customers for their own use (b2c-market) we recommend the structuring of customer value characteristics as following: product quality, customer cooperation with company, price, time. Analysis of the end-consumer satisfaction has its own characteristics and requires independent study. The next stage of the study of customer satisfaction is the choice of measuring each value characteristic technique.

Calculation of the ACSI-index (American Customer Satisfaction Index American customer satisfaction index) (CFI-group, 9) is one of the tools for objective measurement of satisfaction index. Such national indices are used in other countries, for example, in Germany (NCSB-German Barometer, Norwegian Customer Satisfaction Barometer), Switzerland (SWICS - Swiss Index of Customer satisfaction), in Korea (KCSI-Korean Customer Satisfaction Index), in Malaysia (MCSI-Malaysian Customer Satisfaction Index).

The ACSI-index is calculated according to the following criteria: overall satisfaction, matching expectations, comparison with perfect company (Fornell *et al.*, 1996). The index of satisfaction with each customer value characteristic (STch) is calculated by the Eq. 1:

$$Stch_i = \left(\frac{(CR_i - 1)W_{cr} + (CE_i - 1)W_{ce} + (CI_i - 1)W_{ci}}{9} \right) 100\%$$

Where:

- CR = Level of the overall satisfaction
- CE = Level of matching expectations
- CI = Level of matching perfect company
- W = Importance weight of criteria
- I = Estimated characteristic

Importance weight of each criterion (overall satisfaction, matching expectations, matching perfect company) is determined individually. For instance, when ACSI-index is calculated, overall satisfaction is typically given a higher weight than expectancy which, in its turn,

is given a higher weight than performance (The Regents of the University of Michigan (Fornell *et al.*, 1996). Satisfaction index of each group of customer value characteristics (STg_i) is calculated as follows Eq. 2:

$$STg_j = \sum_{i=1}^n STch_i W_i,$$

where W_i is importance weight of customer value characteristic. The total assessments of criteria (overall satisfaction, matching expectations, matching perfect company) are weighted for each group of customer value characteristics. The total customer satisfaction index (Index SAT) is calculated as follows Eq. 3:

$$\text{Index SAT} = \sum_{j=1}^4 STg_j W_{ij},$$

where:

- W_{ij} = Importance weight of group of customer value characteristics
- J = Group of value characteristics

Interpretation Satisfaction Index offer to carry out the following criteria:

- The >80% is the highest level of satisfaction
- From 70 to 79.99% is not completely satisfied
- The <69.99% is not satisfied

Using such a satisfaction index allows not only to follow the dynamics of its changes within a certain period of time but to identify sources of quality improving of enterprise products, services and processes.

RESULTS AND DISCUSSION

This satisfaction assessment technique has been tested at a number of Russian instrument engineering enterprises of the Saratov region. We have analyzed the enterprise technique used for assessing customer satisfaction and identified their shortcomings.

The index of total satisfaction is calculated by most companies as weighted average overall satisfaction with main characteristics considering their importance. One of the companies under study evaluates customer satisfaction as satisfied or dissatisfied with characteristics, total index being calculated as the difference between satisfied and unsatisfied customers.

Among the disadvantages of the methods used is the absence of a systematic definition of groups of requirements/value characteristics. For example, three groups of characteristics are defined by the other company:

- The quality of supplied products, delivery time, warranty
- The operational characteristics of products

Work of managers: The content of group characteristics does not always corresponds to its title. When the first group includes such a characteristic as availability of staff of the organization to the consumer it would be logical to shift it in the other group work of managers. The issue of value characteristics grouping is important because a logical systematization of them allows to bind the indices of customer satisfaction with characteristics and business processes. The characteristics on which the customer satisfaction index is calculated should reflect the features of client value obtained in the process of interaction between customers and the enterprise.

In practice, the number of orders fulfilled without complaints from the customer is the principle index of clients satisfaction. The claims are the result of customer dissatisfaction when customer requirements are not met properly. The complains contain a lot of important information such as product design, quality control and improvement of management which are helpful to the firms for providing more satisfactory products and services (Fornell, 1992). The number and nature of complaints are important informative indicators to identify sources of customer dissatisfaction. Number of complaints can be considered in the assessment of current quality management system efficiency but should not be used in determining of the satisfaction level. If there is a complaint it will affect the given satisfaction scores. The rise in customer satisfaction results in reduction of the number of complaints.

Another shortage of techniques applied is the use of only one indicator overall satisfaction. The important role belongs to the comparison of customers experience and previously formed expectations. The rate of match expectations and its comparison with the overall satisfaction shows the extent of company's not satisfying or exceeding clients' anticipation (Johnson *et al.*, 1995; Fornell, 1992). General satisfaction with product or service depends on comparison of the real characteristics with the customer's ideal parameters (Mattsson, 1992). The consumers idea of a perfect product or service can be considered as a tool of identifying ways of enhancing enterprise's competitive advantages.

Another shortcoming of the assessment of customer satisfaction used, in our opinion, is the use of indirect company's own data instead of customers' opinion analysis. As an example, the technical level of development of one company was estimated by the ratio

Table 1: The customer satisfaction assessment of instrument engineering company

Characteristics	Importance weight	Overall satisfaction	Matching expectations	Matching perfect company	General satisfaction
Orders for serial production	-	-	-	-	69.10
Quality of products	0.50	7.96	8.40	6.30	73.37
Functionality (technical specifications)	0.25	6.96	8.26	6.17	68.36
Reliability	0.25	6.96	6.04	5.16	56.85
Safety of exploitation	0.20	9.54	9.68	9.05	93.77
Technical production level	0.30	8.36	8.56	6.92	77.71
Execution time of order	0.20	8.21	7.06	6.78	71.13
Price	0.30	6.47	-	-	60.72
The price matching to quality of serial product	0.50	6.76	-	-	64.00
The price level	0.50	6.17	-	-	57.44
Orders for development and production of prototype units	-	-	-	-	79.64
Quality of advanced production samples	0.50	9.04	8.87	8.31	86.51
The novelty and patentability of enterprise	0.35	9.18	8.87	8.04	85.95
The quality of the technical documentation developed	0.10	8.87	8.21	8.36	83.32
The technical level of developed prototype units	0.30	8.56	8.56	8.14	82.60
Technical characteristics of developed prototype units	0.25	9.56	9.85	8.69	93.27
Execution time of development and production of prototype units	0.20	6.05	7.23	5.39	63.70
Price	0.30	8.42	-	-	82.44
The price matching to quality of prototype units	0.50	8.82	-	-	86.89
The price level	0.50	8.02	-	-	78.00
Orders for repairs	-	-	-	-	80.04
Quality of repair	0.50	8.73	8.98	8.21	85.07
Execution time of repair work	0.20	7.40	6.14	5.26	70.20
Price	0.30	8.69	-	-	85.44
The price matching to quality of prototype units	0.16	8.56	-	-	84.00
The price level	0.16	8.82	-	-	86.89
Customer cooperation with company	-	-	-	-	72.90
Quality, speed, availability of information and consultation	0.10	8.81	8.05	6.58	76.56
Relationship with customers	0.20	9.37	9.58	7.79	88.50
Time of contract conditions negotiation	0.15	7.75	7.23	5.56	65.79
Time of claims processing	0.30	6.96	5.29	4.85	53.07
Products delivery	0.15	9.12	9.27	8.82	89.77
Payment system	0.10	8.14	9.84	7.34	82.90

of the number of technical assignments obtained by the company to the number of customers' orders given to competitors. When company studies the customer satisfaction, it is important to hear "voices" of clients and not to appeal with data which can be reflect their dissatisfaction.

Given below are the results of customer satisfaction assessment of one of the companies of instrument engineering industry under study (Table 1). The index of clients' satisfaction of the enterprise under study is 76.49 points.

To visualize the results of customer satisfaction assessment of each value characteristic a system similar to the traffic lights can be applied. Green light indicates the score above 80%, a yellow one from 70 to 79.99 and red one less than 69.99. Where green shows consumers satisfaction with the characteristic; yellow the consumers are not enough satisfied and red clients are dissatisfied (Gost, 2012). The yellow and red lights require managers' attention and identification of the source of the problem.

The graph the axes of which are the satisfaction index for each characteristic and its importance weight have

been designed. Minimum values of satisfaction index and importance weight are marked as lower borderlines of the coordinate axes. Then points that correspond to relevant satisfaction index and weight are inserted on the chart.

Three levels of satisfaction similar to traffic lights mentioned above are marked on the axis "satisfaction index". Opposite each point there is the number of the characteristic from the Table1.

The analysis shows that enterprise customers investigated are least satisfied with the requirements most important for them: timeliness of claims processing (4.1.4), the prices for serial production (1.3), the reliability of serial manufactured product (1.1.2). In fact, the company had >50% of the items from the manufactured products do not meet the required parameters of reliability (Fig. 1). There are also rather low values of following indicators of satisfaction, they are; execution time of development and production of prototype units (2.2), timeliness of contract conditions negotiation (4.1.3), the functionality of the serial products (1.1.1). The functionality of serial products meets the customers' expectations. The product functionality is considerably lower than imagined ideal characteristic.

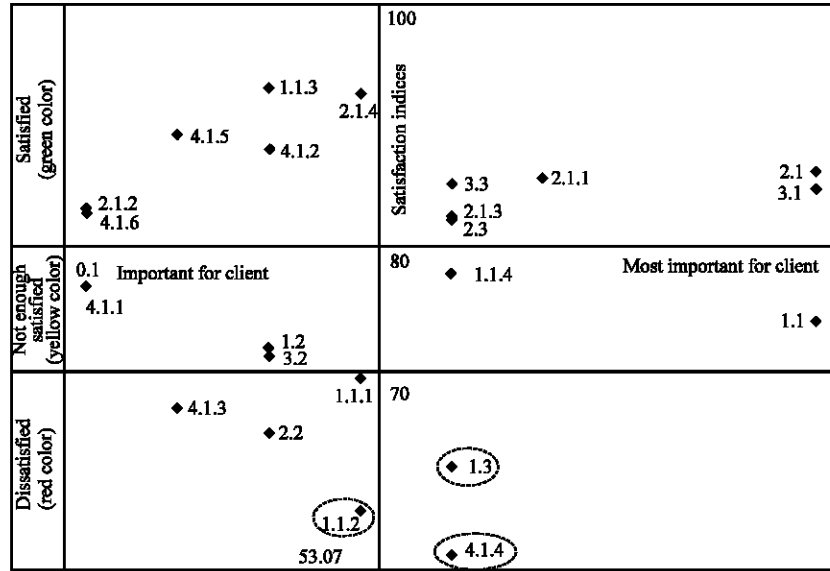


Fig. 1: Visualization of customer satisfaction assessment

The development and production of prototype units are recognized as a quality work and therefore shows a high level of customer satisfaction. The key problem here is execution time of prototype units' development and production. The main reasons of timeliness failures are not-well regulated processes such as registrations of the contract documentation, components production and supplies for prototype manufacture, assemblages of prototypes, and product certifications.

For example, long-term contracts agreements significantly reduce development work time that increases the risks of prototype quality loss. In its turn, the prolonged contract processing at the enterprise results from poorly arranged process of a partner choosing and time consuming pre-arrangement of required operations and their cost. This process is unstable due to the lack of standards for its performance. Lack of component parts at the right time and their poor quality are also responsible for prototype production term violating. All above mentioned failures are interrelated. The identification and analysis of products execution time disruption requires a study of the entire value stream and causal analysis.

There have been only sporadic time disruption claims on development and production of prototype units in the past 2 years despite the low level of customer satisfaction with execution time of orders. The indicator the amount of complaints and claims once again demonstrates that it does not reflect the customer satisfaction.

The main reason for customer dissatisfaction with performing repair work is violation of its execution time, particularly warranty service and repair. In 35% of

products on warranty repair time recovery has been violated in 2014. It has been due to the lack of the necessary accessories and assemblies and difficulties associated with inclusion of repair work in operational plans due to high involvement of equipment and employees in the current production process.

The low level of customer satisfaction with services lies mainly in there sphere of claims' processing time and contract agreement time, including negotiation on technical and commercial specifications. The main reason of prolonged complaint considerations is in complexity of simultaneous study and processing of complaints by different specialist.

Thus, the analysis revealed the main sources of customer dissatisfaction. Most customers are dissatisfied with timeliness and cost of products and services that indicates the low efficiency of the existing value stream of the enterprise investigated. The low indicators of the rhythm of the production also gives evidence of the low value stream efficiency which is to be investigated and reconstructed.

CONCLUSION

Customer satisfaction is one of the most important indicators of the quality management system. The testing of this approach within instrument engineering enterprise has shown practical significance of method and technique used and productivity of its application while analyzing the efficiency of industrial enterprise quality management

system in particular. The approach proposed is a essential tool of quality research and identification of continuous improvement sources.

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