

## DEVELOPMENT OF PROCESSES OF QUALITY MANAGEMENT SYSTEM IN THE ENGINEERING ENTERPRISE

**Zabit Yunus Aslanov**

Phd., assoc.prof.,UNEC

E-mail: aslanov.zabit@mail.ru

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### **Abstract**

The purpose of this paper is to design the process of quality management at the engineering enterprises of Azerbaijan. On the basis of previous works, author proposes the procedure for definition of management processes by production quality according to ISO 9001:2001. Also the article describes the ways of establishment of integrated systems of quality management with business orientation. It is concluded that in search of optimal solutions in the quality management system, in the evaluation of stakeholders' satisfaction with engineering production quality, the theory of inaccurate sets can be applied. Further research may be appointed in order to develop methods for modeling and optimization in the process of manufacturing engineering products, as well as the use of software systems. This paper provides new evidence about a still unexplored topic, trying to bridge the existing gap in the literature about the quality management system and its implementation at the Azerbaijan enterprises.

**Key words:** business management, quality control, mechanical engineering, system analysis

**JEL Classification:** M1 10, L620

### **Introduction**

During the last years in Azerbaijan the substantial attention is paid to the problems of machine-building industry development. The issue of mastering of manufacture of competitive production is brought to the limelight, as the most priority problem. Taking into account that machine-building enterprises basically produce die high-end, purposefully responsible and componentially complex products, the provision of these products quality is very important scientific and technical problem [Aslanov Z.Y., 2013,- 8 p.].

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In accordance with the modern management practice, provision of the production quality is impossible without creation and successful functioning of the quality management system (QMS), so the issue of the development of quality management system processes at the machine-building enterprise is topical one, the results of which can be used for improvement both processes of this system and improvement of the enterprise management system wholly [Osipov Y.I., 2003,-230 p.].

For quality of production and services in the engineering enterprise, the quality management system (QMS) is to act in accordance with standards of ISO 9001:2001. And establishment of QMS in the enterprise consists of design and realization stages of this project, which is studied in detail in corresponding literature [Osipov Y.I., 2003,-230 p.].

However, the procedure of solution of such issues, as detection of QMS processes, its definition and description isn't developed sufficiently [Aslanov Z.Y., 2013,- 8 p.]. With this purpose, first of all, it is necessary to maintain the classification of all processes and procedures (figure 1), taking place in the engineering enterprise. During classification of processes, it is possible to take classification of set of processes, obtained on base of the system analysis, as a primary base [Miroshnikov V.V., 2005, -10 p.].

According to this classification, a set of processes, connected with production quality, is divided into the following five main classes:

1. Business processes of manufacture of production or services.
2. Processes of life cycle of production or services.
3. Main technologic processes of production or services.
4. Providing processes of manufacture of production or services.
5. Processes of quality management system.

The experience of engineering enterprises indicates, that detection and description of QMS processes, is an important factor for development of the plant program on analysis of defects of manufactured production, its elimination or decrease. Within QMS frames such program promotes to realization of the quality management principles according to standards ISO 9001:2001. Along with this, favorable conditions are being created for improvement of the quality of QMS processes and provision of integration of QMS with business [Koshkin D.K., 2007, -220 p.].

For integration of QMS with business in the engineering enterprises, it is necessary to restructure the management system, which doesn't meet modern requirements and to direct this system, as a whole, towards production quality, that is, it is required to conduct business reengineering of processes. With aim to facilitate solution of this problem, it is possible to design and introduce the quality management system with business process orientation [Storablev M.L., 2009, -122 p.].

The basis of quality management system with typical business process orientation is the business process, and the business process consists of sub-processes of the product life cycle. On base of typical business process, specific business processes, depending on purposes of enterprise in quality area are to be formed. Establishment of the quality management system with the business process orientation contributes not only to certification of meeting with requirements of ISO 9001:2001 standards, but also to provision of increase of competitiveness and economic productivity of the enterprise.

**Figure 1: Classification of processes in the engineering enterprise**

Classification of processes
Description and assessment of processes
Selection and description of processes, taking place in subdivision of the enterprises
Information modeling of process
Functional modeling of process
Analysis of errors of processes
Definition of criteria of process quality
Compilation of program of decrease of error
Organize of process management

**Previous Research**

Introduction of the quality management system with typical business process orientation in the engineering enterprises of Azerbaijan allows decreasing difference existing between certification of quality systems and actual results of improvement of production quality, to increase, as a whole, operation productivity of like enterprise [Morozova O.L., 2009, -15p.].

Today the issues, connected with creation, registration, operation and monitoring of QMS are topical ones for Azerbaijan enterprises The theoretical and applied aspects of the quality management on the industrial enterprises found reflection in the scientific works of such native and foreign scientists as [Ovseenko A.N., 2009, -110 p.] and etc. However, the range of problem issues of the development of quality management processes are still not considered in the scientific literature, or they are acknowledged as the general ones without their final scientific substantiation in application to the problems of the machine-building level of the enterprise.

The significance of above stated problems for modern machine-building enterprises, as well as pendency of the range of practical and theoretical tasks in

direction of the effective formation of QMS processes conditions the topicality of the theme of this scientific article.

The aim of study lies in the developments of the quality management system processes in machine-building enterprise on the basis of analysis of effecting the QMS processes on the correspondence of the production quality of the consumers' demands and classification of the processes and procedures, which take place in the machine-building enterprise.

### **Statement of the Material**

One of basic QMS principles in accordance with DSTU ISO 9001:2009 [Osipov Y.I., 2003,-230 p.] is application of the process approach in organization and management. The principle of "process approach" foresees provision of the any activity implementation as an aggregate of interrelated and interacting types of activity.

The QMS processes are traditionally divided into three groups [Aslanov Z.Y., 2013,- 8 p.].

1) the management processes (QMS control, budgeting, product manufacture planning, setting the products for manufacturing);

2) basic processes (purchase management, production manufacture, acceptance, storage and shipment of the finished products);

3) auxiliary processes (material and production control, production environment, staff management, infrastructure).

QMS model grounded on the process can be generally represented in the image of scheme of PDCA "*Plan-do-Check-Aci*" on the basis of uninterrupted QMS improvement. At that the responsibility of the management is focused on the uninterrupted QMS improvement in order to establish the qualitative aims, provide orientation on the client and also assignment of the responsibility and authorities.

As a result of the reference analysis it was established that:

It is necessary to determine the system of characteristic management for each subprocess, which allows its complete measurement. These works are executed in two stages:

1) Preparation of the production life-cycle processes to application in accordance with the standards of ISO 9001:2001 (figure 2);

2) Organization of business-process management (is executed in accordance with the scheme, represented on figure 3).

The described methods of business-process quality management are represented for usage at the machine-building plant that produces the oil-field equipment. At that the method of analysis are used [Morozova O.L., 2009, -15p.]:

functionality - cost;

functionality - cost - labour - intensiveness.

For measurement of the effectiveness indicators of QMS process it is necessary to determine the criteria of effectiveness, and significance of these effectiveness indicators. It is important to select such indicators of the effectiveness process, which would reliably reflect the process operation and planned results [Storablev M.L., 2009, -122 p.]. As the effectiveness criteria, we accept:

- the quantity of the non-executed control terms;
- completeness and timeliness of execution of all plans;
- relation of external and internal discrepancies to the quality of services provided.

Figure 2: QMS scheme of the process of the product's life cycle

Development of flow diagram of the process for assigned detail levels
Organization of performance measurement. Definition of disparity level. Analysis of disparity level, its classification and definition of reasons
Development of motivation system for decrease of disparity level for assigned process
Definition of costs on quality of process( costs for correspondence and disparity)
Definition of key works of assigned process. It is expedient to apply statistic system for quality management of these works
Preparation of proposals on decrease of disparity and increase of productivity of assigned process
Definition of enumeration of processes of the quality management system, subjected to registration in accordance with ISO9001:2000
Definition of primary data, required for organization of product issue
Definition of production relations of the plant with other structural subdivision

The existing factor that provides the rightness of the QMS effect is the documentation control that relates to:

- QMS documentation;
- construction and technological documentation;
- statutory regulations, which adjust the enterprise operation.

The substantial role in the system belongs to the planning process of the technological procedure implementation, *i.e.* the technical preparation of the products. The technological process of manufacturing of the machine-building enterprise products, especially in the situation of manufacturing of the big range of products with differentiated characteristics is very complex process that requires big discipline in the area of technology implementation. In the majority of cases the separate stages of production process are affected by many factors. Their synchronization, connection with the next stages, adjusted in the separate procedures represents the most substantial difficulties in QMS implementation.

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The effective implementation of QMS processes of the machine-building enterprise, in author's opinion, will allow providing minimization of the warehouse stocks, and thus preserving the financial resources, and increasing the floating funds. We should relate to the organization QMS effects the systematization of the document circulation in the scale of enterprise, structuring of the information flows, and improvement of the management of separate stages of production process.

Figure 3: Arrangement of quality management of the business process

Arrangement of united functional model of Q. business process from functional charts of sub-processes
Arrangement of computer support on maintaining of functional Q model of the business process
Analyzing of functional-cost model of Q. business process
Mathematic modeling and optimization of Q business process
Establishment of system of relationship with external consumers in Q. business process
Development and introduction AMS of business process
Development and introduction of step-by-step decrease of level of correspondence of Q business process and Increase of effectiveness

### Material and Methods

The most important element of the quality management system, including typical business process orientation is a procedure of a typical quality management [Morozova O.L., 2009, -15 p.]. While applying this procedure, the management of the enterprise must select prospective production or information on base of optimal strategy of range. Then the business process, relating to manufacture and to sale of production and directed to formation of consumer cost of this production is to be identified.

In the organizational chart it is necessary to select the business process of the production manufacture, and then business process of product manufacture is to be subjected to decomposition into internal processes of the life cycle of production. For each sub-process it is necessary to define the management system of characteristics, which allows its absolute measurement.

These works are conducted at two stages: first, the preparation of processes of the life cycle of production for application according to standards ISO 9001:2001 is conducted on base of figure 2, and then organization of the management of business process on base of figure 3 is conducted. Described methodic of the quality management of business processes is introduced for application at the engineering plant, producing the oil-field equipment. Thus, methods of analysis of functionality - cost and functionality - costs - labor content are applied.

Taking into account that in the engineering enterprise QMS does not exist separately from general management, particularly, from labor and environment safety management, the establishment of “Integrated system of quality, labor and environment safety (ISQLES)” is proposed. The Structural model ISQLES may be developed on base of the quality management system ISO 9001:2001 by adding two elements on labor safety and environment protection [Morozova O.L., 2009, -15 p.]. On base of structural model ISQLES the collection of requirements, presented in mathematical form may be developed. By considering these requirements, the hierarchical structure of ISQLES documentation, covering all types of QMS documentation, including policy, goals, general management, registered procedures and records, is formed.

Great influence is exerted to QMS multivariate analysis in new standards of ISO 9001:2000. This issue becomes Complicated repeatedly in integrated QMS. For its solution the method of multivariate system analysis of data on quality is applied. The method is developed on base of multivariate statistical analysis and information technologies with the artificial intellect.

The structural scheme of proposed model is based on multivariate model of data on quality, represented in figure 4. Main elements of this model are as follows:

Information layers are cited in figure 4, as conditional lines, defining multivariate phase of data on quality.

Indicators or facts, that is, backbone node of data.

Data cube is multivariate analysis of data about quality and it is a sub-space of directly accomplished data base. The Cube sides are called, as axes possessing hierarchic structure and play a role of index of analyzed information. Conditional description of data cube, formed at solution of two issues of multivariate analysis of data on quality, is represented on figure

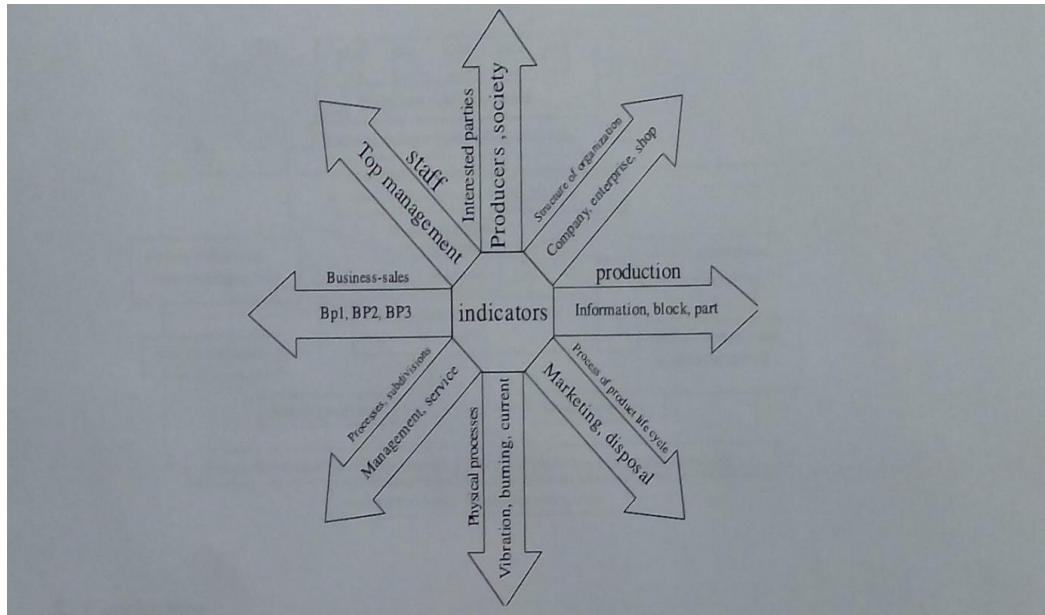
The mathematic support of the data analysis on quality is based on sets and spaces of final measurement and statistical analysis of applied multivariate regression. The software is developed on basis of application of toolbox of Microsoft Server-2000. The method of the multivariate analysis of data on quality is presented to the “Baku plant of oil engineering” for the complex analysis of results of QMS audit. On base of formed data cube (figure 5a) the top management of the enterprise solved issues of QMS benefit analysis. In the shops of the plant producing oil-field equipment, the method of the multivariate analysis, aimed at definition interdependence of quality of processes (figure 5b) is applied.

For development of software of system modeling and management optimization, the subsystem of computer support of process of adoption of optimal

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decisions is proposed. The managers on quality and die auditors are envisaged, as its users. Block diagram of such subsystem is presented in figure 6.

Figure 4: The scheme of multivariate model of data about quality



The nucleus of the computer subsystem of modeling and optimization of decisions in quality system is the multivariate database about quality, which is constructed on base of multivariate mod The multivariate analysis of data about quality and the process of adoption of optimal decisions ; provided in the ECM by means of seven functional modules. Each of these modules may be realized the form of program complex.

Figure 5: Cube data about quality: the multivariate analysis of results; Error of processes and multivariate analysis

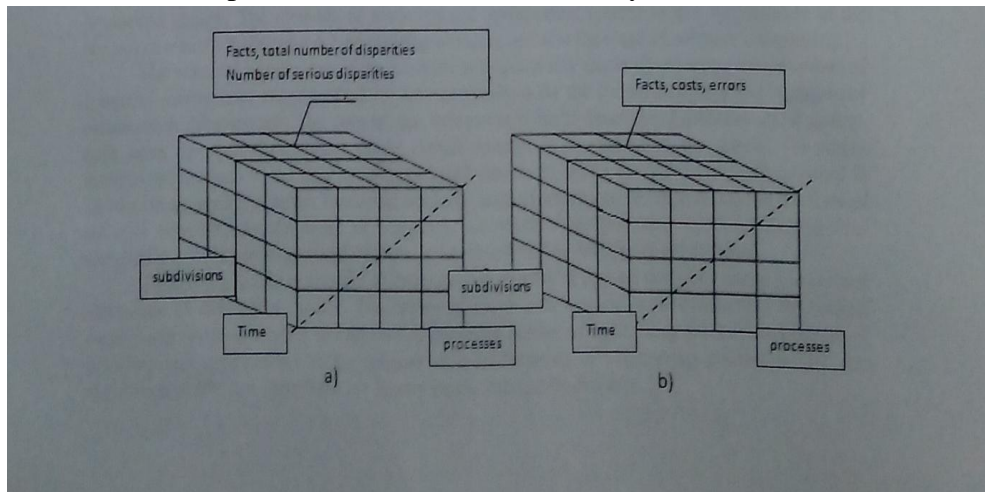
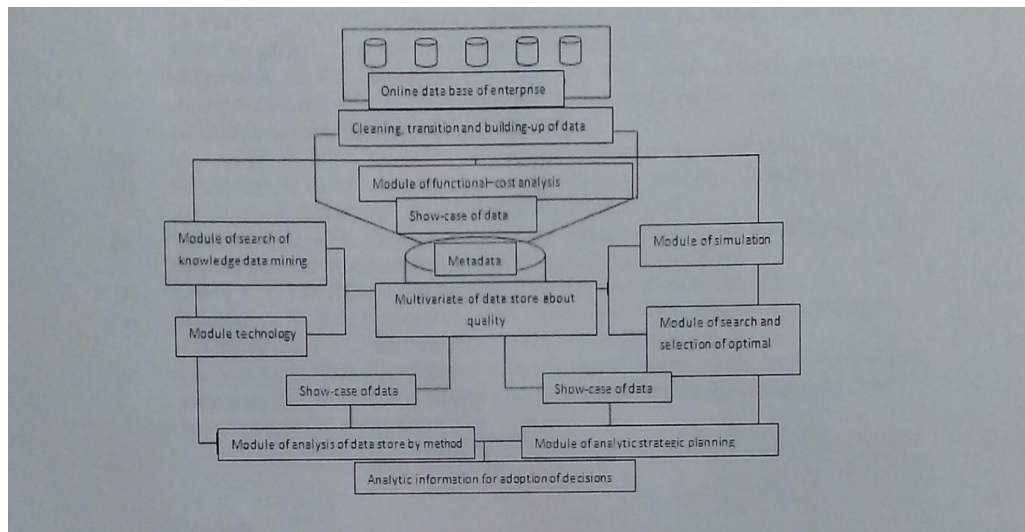


Figure 6: Computer support of optimal decisions in QMS



### Conclusions

The quality management system is the original organization construction that combines management, labour collectives and also infrastructure of the machine-building enterprise with the processes, which compose the basic value of the enterprise. Insufficiently effective implementation of the processes generates the losses equally in physical and moral aspect (image), reduces productivity and financial results, and often leads to the conflicts with environment (reclamation,

disputes, and lawsuits). Prevention of these unprofitable phenomena for enterprise considerably requires the development of the quality management processes on each concrete enterprise.

It was determined in the article at the search of optimal solution in QMS, the fuzzy-set theory can be applied for estimation of satisfaction of the concerned parties by the machine-building production quality. The methods of modeling and optimization require further development in the process of manufacturing of machine-building products, and also the usage of software complexes.

The practical significance of the scientific solution of this article allows using the subsystem of computer maintenance support of taking optimal decisions for the system modeling and management optimization development. The core of this subsystem is multi-dimensional database about quality, built upon the multi-dimensional model, which scheme is considered in the article. The multidimensional analysis of the data about quality and process of taking optimal decisions is provided in ECM with assistance of seven functional modules, each of which can be implemented in the form of software complex. As the users of computer maintenance process subsystem of taking optimal decisions the quality managers and auditors of machine-building enterprises are provided.

Thus, it is possible to conduct an estimation of stability of optimal decisions taking into account inaccuracy of data about quality. The theory of rough sets may be applied searching for optimal decisions in QMS, estimating satisfaction of interested parties, as engineering production. Methods of modeling and optimization in the process of manufacturing of engineering production and also application of program complexes are among issues, pending its decision.

## **References**

- Chekmaryov, A.N., "Qualimetry and quality management", *SSAU Publishing* Samara. 2010, -20 p.
- Koshkin, D. K., "Management of QMS processes on base of analysis, its influence on production quality", *State Aviation Technological University*, Moscow. 2007, -220 p.
- Maksimov Y.A., Papkov V.I. and Sabodash V.N., "QMS as a means of improving the competitiveness and efficiency of the enterprise. Features of realization". *Implementation of Quality Management Methods 11*, 2005. p.17-24.
- Aslanov Z.Y., "Qualimetry and production quality management", *ASEU, Baku*. 2013, - 8 p.

Miroshnikov, V.V., “Methodological bases of system modeling and quality management optimization in engineering”, *State Technical University, Briansk*. 2005, -10 p.

Morozova O.L., “Improvement of quality management system of a small enterprise on base of a model of its self-estimation”, *State Technical University, Kursk*. 2009, -15 p.

Osipov, Y. I., “Quality management at engineering”, *Science, Moscow*. 2003,-230 p.

Ovseenko, A. N., V. I., Serebryakov and M., Hajek,. “Technological security of quality engineering products”, *Publishing House of Mechanical Engineering, Moscow*. 2009, - 110 p.

Storablev M.L., “Development: of methodology of product quality management on base of the analysis of interaction of processes and definition of relations between its parameters”, *State Technical University, Kursk*. 2009,-122 p.