About necessity to regulate and automate processes in the quality management systems of the mechanical engineering branch

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Abstract. The article analyzes the effectiveness of the quality management systems that operate at a number of enterprises. The main problem in most cases is determined as weak usage of the process approach in business-process management. To eliminate this problem, the authors offer to apply a process approach in the quality management systems of engineering enterprises for the purpose of receiving actual processes. Based on these processes and modern software tools, regulatory documentation is generated with the subsequent transition to the implementation of executable processes or BPM-systems (Business Process Management System). The regulation of business processes provides employees with regulatory documentation, and application of executable processes eliminates the "human" factor in process management. In addition, it is possible to monitor performance indicators and use the Deming cycle to continuously improve product quality. The practical realization of the project has been done in the framework of the Russian business-modeling software “Business Studio” and “Elma”.

1. Introduction
Quality management based on the use of modern achievements of management theory and a systematic approach to quality management is the main direction in the development of Russian mechanical engineering enterprises. A convenient technology to solve this problem is implemented by quality management systems (QMS), which provide quality management at all stages of the product life cycle. Besides, the existence of QMS according to ISO 9000 standards in contract conditions is the convincing proof of a potential possibility of the enterprise to reliably produce quality products according to requirements of consumers [1, 2].

Application of QMS is not the mandatory requirement of the legislation, but this is unspoken requirement of market participants. QMS at the mechanical engineering enterprises orders and improves interoperability of subdivisions while increasing staff responsibility. Ultimately, it increases the quality and competitiveness of products, allows entering the international markets.

The so-called “process approach” which demands the formation of the production and administrative processes providing influence on the achievement of goals is the cornerstone of any modern QMS. It is the only tool which makes it possible to observe the entire chain of the operations performed by employees. More deep decomposition of processes allows spotting the hidden inconsistencies, bottlenecks, resource conflicts and etc., which are difficult for discerning the structural approach in management.
The basis of the process-oriented QMS is a business process which consists of the sub-processes of the life cycle of a product formed depending on the purposes of the enterprise in the sphere of quality. At the same time, the processes within a certain life cycle of manufactured products define the formation of the organizational structure of a mechanical engineering enterprise. It significantly simplifies the integration of QMS with the business of mechanical engineering enterprises due to the restructuring of a management system which does not meet modern requirements, and completely focuses this system on quality of products.

After analyzing the work of the QMS of several enterprises, the impression has made about the formal approach to their development and implementation. In some cases, systems are developed and introduced only on paper and presented in the documentation package form [3]. As a result, the potential of the quality management system of mechanical engineering enterprises has not been utilized in full, the lack of any positive effect gained from their observed implementation. QMS becomes a burden, without realizing one of the basic principles of quality management: “Decision-making, factual”.

Therefore, the vast majority of used in engineering enterprises systems need modification based on regulation and automation, which will ensure the transition from a “paper” QMS to existing processes and relevant regulatory documentation [4]. However, to solve this problem, the question arises, what exactly to automate and how to automate. There are several approaches to the creation of consolidated information area based on the development of an automated quality management system and its integration with other automated systems of the enterprise to the implementation of the QMS in the form of a separate module in the classical information system.

However, the proposed approaches of regulation and automation are characterized by high labor input, significant cost and almost lack the substantive content of the QMS, namely, the process approach in the management [5]. The concept of automation of the business processes of the engineering enterprise with a view to develop BPM-systems (Business Process Management System) on the basis of two Russian business modeling packages: “Business Studio” and “Elma” is proposed in the paper.

The BPM-system or executable process is created as a result of automatic generation of business processes in BPMN notation. The resulting executable process allows you to track in real time the passage of objects in accordance with the stages of the ideal process model, provides automatic control over the performance of job descriptions by performers.

2. The problem of “paper” QMS

It should be noted that the typical model of the quality system over the past decade has been widely used in Russian enterprises and is not the cause of existing problems in the QMS operation. The problem is the following. At the time of the development of this model were not available software tools and methodologies for creating relevant, working, not “paper” processes. Nowadays such packages have appeared. On the base of their technologies, using the balanced score methodology, in this paper the task of reviving the business processes and implementing on their basis of relevant regulatory documentation and BPM-systems.

It is important to identify the problem list that can be eliminated as a result of automation of QMS processes, before starting to solve the problems of this automation. The main problem is the lack of explicit link of the mission, vision, policy and quality goals with the processes being developed [4]. The description of the processes being developed are performed either in text form or in the best cases as simplified block diagrams and almost always does not correspond to the real domain. The process is developed usually in the form of a “picture” at the time of creation of the QMS and in the future is not updated, not automatically linked to key performance indicators, goals, performers and owners.

This situation gives rise to another unpleasant problem. Regulatory documentation is also written on paper and may not correspond to the relevant process and, naturally, it is not relevant at the time of its creation. Paper regulatory documents can be “revitalized” only through its automatic generation based on current processes, thus ensuring its relevance and simplicity of modification when changing processes.
Monitoring processes and individual indicators, as well as the analysis of the data obtained, is very difficult due to its labor intensity and low efficiency, since the monitoring data are mostly collected by the quality officers of the units, and only part of these data are exported from the existing information systems. At the same time, visualization of monitoring results is not usually implemented. And this ultimately leads to the impossibility of applying Deming's cycle to the management of the processes, which leads to ignoring one of the main principles of the QMS - the principle of constant improvement.

Implementation of the QMS on paper, its isolation from the information environment of the enterprise do not ensure the transparency and accessibility of relevant data for management, which excludes the possibility of serious analysis and efficient managerial influences. For the same reasons, it is impossible to implement executable processes (BPM-systems).

### 3. Results and Discussion

Before automating processes, they must be formed taking into account the mission, policy and strategic goal using a strategic map that provides a description of the strategy in the form of a set of sub-goals and causal relationships between them. At the same time, the relationship of sub-goals to indicators is realized graphically, which determines the degree of their achievement.

The strategic map is implemented on the basis of a balanced score card that reflects all aspects of the enterprise's activities, both financial and non-financial.

The application of the balanced scorecard ensures the implementation of the organization's strategy through its decomposition to the level of operational management and control of the desired values of indicators. This approach turns the strategy into a continuous process and brings the strategy to each member of the team, involving it in the implementation of the strategy through daily functional duties. It should be noted that implementation of a number of sub-objectives requires the development of new processes, which together with existing processes form the “TO BE” model process register, which may have a hierarchical structure.

The implementation of the processes is performed on the basis of the Russian “Business Studio” or “Elma” packages, and at the lower levels of the hierarchy it is recommended to use the BPMN notation. The capabilities of the packages allow you to implement a “linking” to the processes of their characteristics - the corresponding indicators, performers, owners and storing them in the knowledge base, providing immediate access to historical and real-time data. In other words, all the information contained in information cards and documented procedures is present in the knowledge base and can be used if there are appropriate access rights for analysis, managerial influences and automatically generate relevant regulatory documents.

The boundaries of permissible and critical values are established for each indicator, specified in strategic map. Opportunity used software tools allow graphically and in various colors to display planned and actual values of indicators in the form of indicator rulers. Visualization is carried out with the help of three color zones: the green zone means the conformity to the planned indicator value, the yellow area - the approach to the planned value and the red zone - the critical not match planned value indicator. Visualizing indicators are useful for management of the engineering enterprise on the basis of the Deming’s cycle, because the database stores not only the dynamics of values, their target date and target values, but also belonging to a concrete process, the performer and the owner.

Thanks to this set of data in the knowledge base of each process for employees, we formed a clear presentation of the limits of their rights and responsibilities. On the one hand, this eliminates the duplication of functions, and on the other - the desire to shift the problem on the shoulders of other colleagues. The administration of enterprise is provided, in addition, by the transparency and accessibility of relevant data for monitoring processes, including remote access through a web-portal “Business Studio”.

### 4. Solutions and recommendations
As a result, the knowledge base has current processes with a complete set of historical and current information about their characteristics, automatically generating on their basis current regulatory documents (job descriptions, process regulations, department regulations, responsibility matrices for any process hierarchy level). Such conditions allows one to manage processes in an automated mode, using Deming’s cycle, regularly to carry out monitoring indicators and processes, to perform prompt solutions on the basis of quantititative and relevant data. The success is mainly determined by the extent to which performers and owners of processes will perform position descriptions.

To exclude the human factor, it is not enough to describe the processes and manage their execution according to the regulations, it is necessary to automatically track their execution. To accomplish this task, it is necessary to use one of the most modern and powerful means of automation of the quality management system - BPMS (Business Process Management System) or BPM-system that is an extension of the workflow class system and enable to implement of a high-performance tool quality management. The BPM-systems complete workflow-systems with the means of the transition from a modeling stage to the implementation stage, reverse engineering tools for updating the process model after its implementation, as well as evaluation of staff performance.

The implementation of the process management system (BPM-system) is based on a simple idea: the processes of the enterprise are modeled during the development phase of the QMS, using diagrams in BPMN notation. Then the process diagram is downloaded in business-modeling package Elma, where the process becomes executable. As a result, the BPM-system allows you to track and monitor the execution of the process in on-line mode, maximizing the actual execution of processes to obtain their ideal model, which was originally developed.

The performer can set the time quota for each action in the executable process, allowing the system to keep a record of the executive discipline. At the time when there is a delay in the work execution, this fact is recorded in the log records of delinquency and it automatically affects the coefficient of performance discipline. The availability of such mechanism allows you to create flexible motivation systems for the performers and owners of the processes. The BPM-system easily tracks movement of the object in its process: the object is moving or the object “is detained” and then, who “detained” its. In fact, BPM-system implements the strict control of the execution of the job description by the performers and the owners of the process. It is recommended to choose only the most important processes as executable processes due to considerable laboriousness in the exploitation of BPM-systems.

5. Conclusion
The result of the work is the development of the concept of regulation and automation of the process approach in the quality management system. This makes it possible to eliminate some shortcomings of the typical model of the quality management system. The effect of automation consists in the fact that the knowledge base contains actual “live” processes with “tied” to their characteristics, including an archive of planned and actual values of indicators. It allows one to visualize the indicators values for any time interval, to generate automatically the actual regulated documentation, to generate the executable processes (BPM-systems), allowing you to monitor the execution of processes strictly in the corresponding with job descriptions.

The proposed concept of regulation and automation of QMS processes provides an increase in the effectiveness of the work of mechanical engineering enterprises through the possibility of analyzing processes. Processes need to be evaluated by the values of the relevant indicators by monitoring the dynamics of their changes and identifying places where inconsistencies arise in accordance with the Deming cycle.

The proposed concept of the process approach automation in the QMS is applicable to organizations and enterprises of any type, including integrated corporate structures. The complete list of works on regulation and automation of the quality management system processes has been implemented as a pilot project in several units of the enterprise.
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