International Experience in Business Processes Improving on the Base of Architectural Approach

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Abstract

Standardization is the pinnacle of the quality management instruments, which is vital for satisfying customer needs and ensuring sustainable development of business. The ISO 9001:2015 (Quality Management Systems, QMS) standard requires organizations to use the process approach. This paper proposes to use architectural approach for analysis and improvement of business processes for implementation of the ISO 9001:2015 standard.

Keywords: Business process, Enterprise architecture, Architectural approach, ISO 9001:2015, Quality management system, Standardization

1. Introduction

Modern trends in the development of industrial enterprises are characterized by changes in factors affecting their functioning: innovations and new technologies, increasing competition, changing customer requirements for product quality (the concept of product quality from the perspective of its compliance with customer requirements has developed in market economy).

Satisfying the needs of customers is the main objective of any enterprise. Product quality is one of the most important customer requirements, therefore, in order to ensure the successful development of an enterprise, it is necessary to manage the product quality, to evaluate and analyze relevant targets and predict the processes affecting it.

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Thus, the issue of quality management is of vital importance in this context. Quality management is an operational activity carried out by the managers and personnel of the enterprise, influencing the process of creating products in order to ensure its quality by performing the functions of quality planning and quality control, communication (information), developing and implementing measures and making decisions on quality.

There are various ways to solve this problem, one of which is standardization. This instrument represents the pinnacle of the evolution of quality management, therefore quality management is largely based on standardization in modern conditions. In other words, it's impossible to improve a process unless it isn't standardized [Imai, 1986].

Through formalization of business processes, development and implementation of norms and rules an enterprise can streamline its operations for the benefit and with participation of all stakeholders. The ISO 9000 standards are one of the most common and a special place among them is occupied by the ISO 9001:2015 "Quality Management Systems. Requirements" standard concerning the process of creation and implementation of the quality management systems. The use of this standard can be a strategic decision that allows to effectively manage the quality and get the following benefits from it [ISO, 2015]:

- to provide products that meet the customer requirements and create opportunities to improve customer satisfaction;
- to ensure sustainable development of an enterprise;
- to implement technological development of an enterprise in the framework of improving the business processes by focusing on modern information technologies;
- to eliminate inconsistencies and errors quickly;
- to provide products of better quality and reduce losses from inconsistencies;
- to take involvement of employees to a new level, which contributes to the improvement of internal business processes of an enterprise;
- to improve brand image and customers loyalty.

2. The Architectural Methodological Approach and its Application to QMS Field

The need to represent a holistic view of the enterprise is fulfilled by a concept of Enterprise Architecture (EA) which is defined as a set of models and definitions describing the structure of an enterprise, its subsystems and the relationships between them, terminology to employ and guiding principles for design and future evolution [Alaeddini M. et. al., 2016]. EA development is a continuous iterative process which may be approached using EA frameworks including tools, techniques, process model, artefacts descriptions and guidance for EA design.

EA frameworks implicitly ensure the achievement of a specific IT-business alignment level. However, they do not distinguish between different alignment perspectives: most of approaches claim that EA development must start with the business strategy and structure definition followed by supporting IT infrastructure and application portfolio design. Whereas diverse misalignment situations require different design approaches. And IT may and should be used in an innovative way as an enabler for renewed or even completely new business strategies, products and services, organization forms and processes.

The purpose of enterprise architecture is to optimize across the enterprise the often fragmented legacy of processes (both manual and automated) into an integrated environment that is responsive to change and supportive of the delivery of the business strategy.

Today's CEOs know that the effective management and exploitation of information through IT is a key factor to business success, and an indispensable means to achieving competitive advantage. An enterprise architecture addresses this need, by providing a strategic context for the evolution of the IT system in response to the constantly changing needs of the business environment [Tan F.B., Gallupe R.B., 2006].

Furthermore, a good enterprise architecture enables to achieve the right balance between IT efficiency and business innovation. It allows individual business units to innovate safely in their pursuit of competitive advantage. At the same time, it ensures the needs of the organization for an integrated IT strategy are met, permitting the closest possible synergy across the extended enterprise.

The quality management system is both an instrument for improving the quality of an enterprise, a way of organizing business processes that ensures achievement of the planned goals through customers' satisfaction, and a specific model described in the ISO 9001:2015 standard. The introduction of a quality management system in accordance with the ISO 9001:2015 standard implies documented business architecture of an enterprise.

One of the examples of EA methodological frameworks is represented by a high-level approach The Open Group Architecture Framework (TOGAF) [The Open Group Architecture Framework (TOGAF Version 9.1)] to design an enterprise architecture. It provides an approach for designing, planning, implementing, and governing an enterprise information technology architecture in according to its business goals.

Business architecture is one of the elements of the EA – a comprehensive description (model) of all key elements and relationships between them (including business processes, technologies and information systems), as well as the process of supporting changes in the business processes of an enterprise on the part of information technology (Fig. 1).

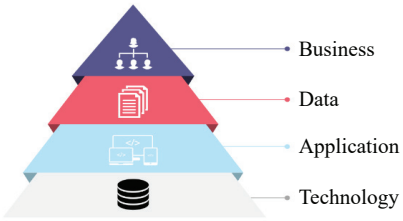

Figure 1. *Enterprise Architecture according to TOGAF framework [TOGAF].*

The objects of the enterprise architecture are the existing business processes and their supporting organizational, administrative and technical systems utilizing IT-technology. Thus, business processes are a central element of building both an enterprise architecture and quality management system, which allows us to conclude that the architectural approach to the problem under investigation is applicable [Kononov Yu., 2017].

The modeling of the enterprise architecture and the integration of the quality management system in it is aimed at improving business processes, which will ensure the quality of the enterprise as a whole – reliability, sustainability, technological leadership, investment attractiveness, innovation, employee satisfaction, financial stability. It shows a comprehensive description of the key elements and inter-elements relations.

Development of a quality management system demonstrates the importance of using the architectural approach (describing business architecture of the enterprise) as management instrument for a production enterprise [Peskov E., 2016]. The architectural approach implies clear objectives: company's goals, the specification of the organizational structure, the description and optimization of business processes, the development and distribution of documentation, the automation of processes and the implementation of a quality management system (Fig. 2).

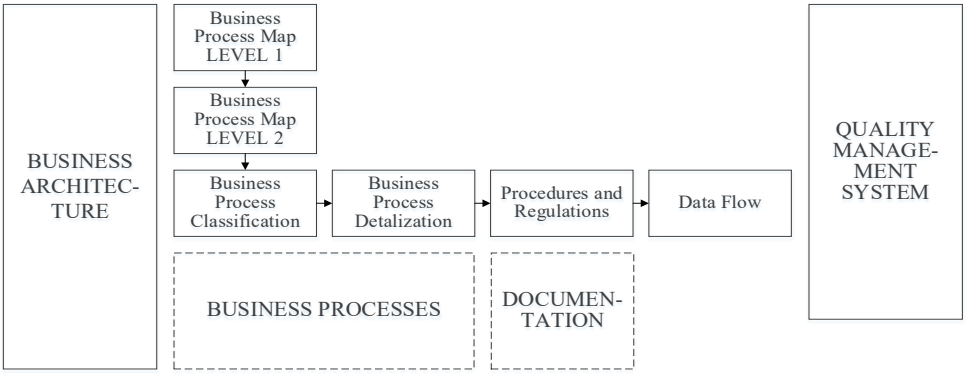

Figure 2. *Business architecture and QMS.*

Rationally organized and documented enterprise architecture allows to ensure compliance with the requirements of the international standard ISO 9001:2015 in the field of business processes identification and documentation. And vice versa, the need for a quality management system can direct attention to the initialization of the enterprise architecture development, paying attention to those processes and resources that are crucial for enterprise quality management.

Thus, quality management and enterprise architecture form a natural combination: the first is devoted to the development, documentation, control, measurement and improvement of business processes, and the latter determines how these processes will be organized and implemented.

3. Business Case Description: «AS-IS» Architectural State

Let us analyze how the architectural approach was implemented for transition to the standard ISO 9001:2015 on the example of an enterprise functioning in the field of manufacturing. The key goal is to describe the initial (AS-IS) and desired (TO-BE) states of the enterprise, conduct the gap-analysis and determine the scope of work that is required to make a transition to the desired state of the enterprise.

In the view of the increasing production plan and the expansion of the product range, it becomes necessary to introduce a new approach to quality management. Thus, the company's management decided to implement the ISO 9001:2015 standard and get certified (conformity assessment).

ISO 9001:2015 is an international standard [ISO 9001:2015, Quality management systems – Requirements, 2015] that establishes requirements for quality management. Standard summarizes a global experience in the field of quality management and is applicable absolutely to any enterprise, regardless of the scope and size. According to the standard, the quality management system of an enterprise should be based on seven principles of quality management (Fig. 3).

Figure 3. *Quality management principles [ISO].*

The structure of ISO 9001:2015 can be displayed in a schematic representation of the process approach [ISO 9001:2015, Quality management systems – Requirements, 2015]. Such a representation shows the interconnection of all sections of the standard (Fig. 4).

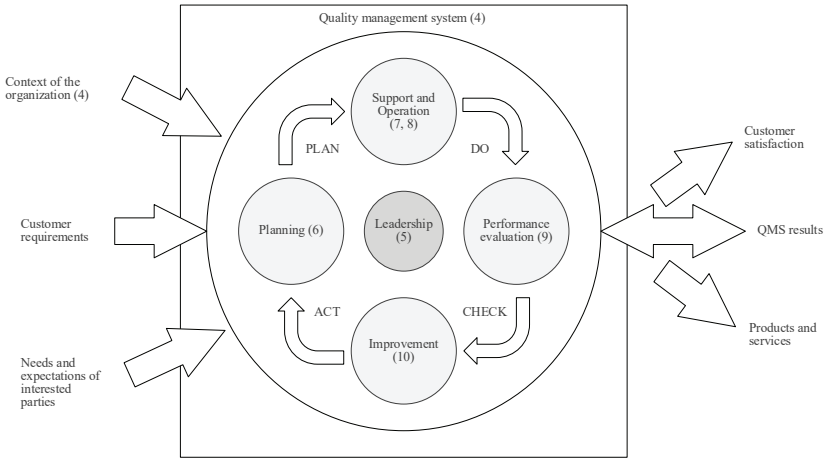

Figure 4. *The ISO 9001:2015 structure [ISO].*

The ISO 9001:2015 standard is a set of requirements that are necessary for the implementation and successful operation of the quality management system:

- adherence to the quality management principles established by the standard;
- use of the process approach (allows an enterprise to manage its processes and ensure their interaction);
- risk-oriented thinking (allows to identify risks that can lead to deviation from the planned results of processes and quality management system, develop and implement risk management measures to prevent and minimize the likelihood of risk realization);
- documenting processes and procedures, as well as managing documented information;
- conducting internal audits (allows to determine the compliance of the quality management system with the requirements of the standard and to analyze the effectiveness of its functioning).

The table below shows the initial state of the enterprise (AS-IS) at the level of the business architecture taking into account the analysis of the requirements of ISO 9001:2015 (Tab. 1):

Table 1

The Initial State of the Enterprise Business Architecture (AS-IS)

Architecture level	Scope	The initial state of the enterprise (AS-IS)
Business architecture	Goals	The company has set annual goals, which include the achievement of the following targets: volume of production, product quality, percentage of productivity of production personnel)
	Strategy	It was decided to implement the ISO 9001:2015 standard in order to perform quality management (implementation of a quality management system and certification for compliance with the ISO 9001:2015 standard)
	Implementation of ISO 9001:2015	
	QMS Documenta-tion	There is no documented first-level information necessary for the implementation and functioning of the quality management system (quality policy, quality objectives, quality manual). Existing documentation can be further developed for use in the quality management system.
	Risk management	Risk management process is developed insufficiently (there is no documented procedure for risk management, there is no documented information on risks and measures for their management)
	Internal audits	The implementation of the internal audit system is at an early stage. There is no documented procedure for conducting internal audits and developing and implementing corrective measures. There are no trained internal auditors
	Business processes	Situational (as problems are identified) approach to the development and description of business processes. Development of process management is at an early stage. Process performance targets are not defined
	Organizational structure	Organizational structure is defined
	Allocation of responsibilities	Every department has its responsibility distribution matrixe

Characteristics of the initial state of the enterprise (AS-IS) at the level of the information systems architecture (Tab. 2):

Table 2

The Initial State of the Enterprise Information Systems Architecture (AS-IS)

Architecture level	Scope	The initial state of the enterprise (AS-IS)	
Information systems architecture	Application architecture	Infor LN ERP	ERP-system, used to manage enterprise resources
		DIRECTUM	EDMS, used to manage electronic documentation
		MS Visio	Flowcharts and diagrams editor, used to detail business processes

4. "TO-BE" Architectural State Description: Migration Plan

The desired state of the enterprise (TO-BE) is an enterprise with an effectively functioning quality management system meeting the requirements of ISO 9001:2015 standard (Tab. 3, 4).

Table 3

The Desired State of the Enterprise Business Architecture (TO-BE):

Architecture level	Scope	The desired state of the enterprise (TO-BE)
Business architecture	Goals	The company has set quality goals in the framework of the quality management system
	Strategy	The quality management system is implemented and successfully functioning. The certificate of conformity to standard ISO 9001: 2015 is received
	Implementation of ISO 9001:2015	
	QMS Documentation	The first-level documentation for introduction and successful operation of the quality management system (quality policy, quality objectives, quality manual) has been developed. The second-level documentation has also been developed (procedures on document flow, regulatory documentation, risk analysis, supplier evaluation, management of non-conforming products, internal audits, corrective measures).
	Risk management	A risk management procedure has been developed, a risk register has been created (contains information on existing risks, their significance, responsibility distribution and risk management measures)
	Internal audits	Training of internal auditors was carried out. A system of internal audits has been implemented: procedure for conducting internal audits, developing and implementing corrective measures has been developed. Internal audits of all business processes were conducted.
	Business processes	Process management s implemented – business processes of the enterprise are considered as interrelated elements of the system: there is a map of the first level processes, a map of the second level processes, business processes were detailed. The targets and performance criteria of business processes are determined.

Table 4

The Desired State of the Enterprise Information Systems Architecture (TO-BE)

Architecture level	Scope	The desired state of the enterprise (TO-BE)	
Information systems architecture	Application architecture	Infor LN ERP	ERP-system, used to manage enterprise resources
		DIRECTUM	EDMS, used to manage electronic documentation
		BPMS iGrafx	Instrument for modeling, analysis and management of business processes

To determine the scope of work required for the transformation of the enterprise (AS-IS à TO-BE), management has appointed responsible employees and set up a working group. The next step was to create a work structure of the ISO 9001:2015 standard implementation (Fig. 5), as well as a project implementation plan (Tab. 5).

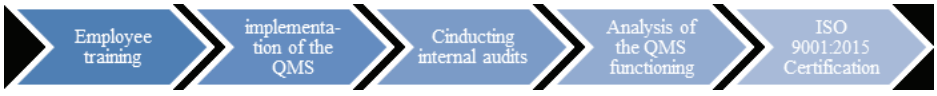

Figure 5. *Structure of work.*

Table 5

Project Implementation Plan

Stage	Description	2017				2018				
		WW4-34	WW35	WW36-45	WW43-51	WW3-4	WW5-9	WW10	WW10-12	WW13
1.	**Employees training**									
1.1.	Working group training (ISO 9001:2015)									
1.2.	Training "Business processes of the quality management system"									
1.3.	Internal audits training									
1.4.	Training for production masters (corrective measures)									
2.	**ISO 9001:2015 Implementation. Developing business processes and documentation**									
2.1.	Analysis of the requirements of the ISO 9001:2015 standard									
2.2.	Analysis of existing documentation									
2.3.	Analysis of existing process model and regulatory documentation, use of quality management system in existing process documentation									
2.4.	Discussing the QMS business processes and documentation. Conducting the gap-analysis									
2.5.	Creating documentation development plan. Developing the documentation according to the plan									
2.6.	Creating business processes development plan. Developing business processes									
3.	**Preparing for internal audits. Conducting internal audits**									
3.1.	Conducting internal audits									
3.2.	Preparing audit reports. Developing and implementing corrective measures									
4.	**The QMS performance analysis**									
4.1.	Conducting the QMS analysis									
4.2.	Preparing a performance report. Conducting management review									
5.	**Preparing for certification. Certification audit**									
5.1.	Preparing for the first stage of certification audit									
5.2.	Certification audit. Stage 1									
5.3.	Developing and implementing corrective measures according to the results of the certification audit (stage 1)									
5.4.	Conducting an internal audit. Developing and implementing corrective measures (if necessary)									
5.5.	Certification audit. Stage 2									

The key areas of work are the development of quality management system documentation and the introduction of a process approach. In accordance with the requirements of the standard, documented information of the first and second levels is developed (Fig. 6):

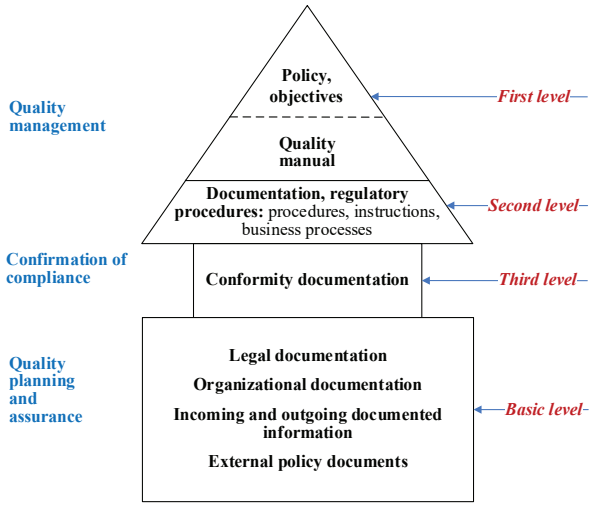

Figure 6. *Documented information structure.*

The introduction of process management within the framework of implementing the quality management system implies the consideration of all types of enterprise activities as a managed system of processes that is aimed at achieving its targets and meets the requirements of customers and other interested parties. All processes of the system are interrelated [Lapshin V., Yamashkin Y., 2015].

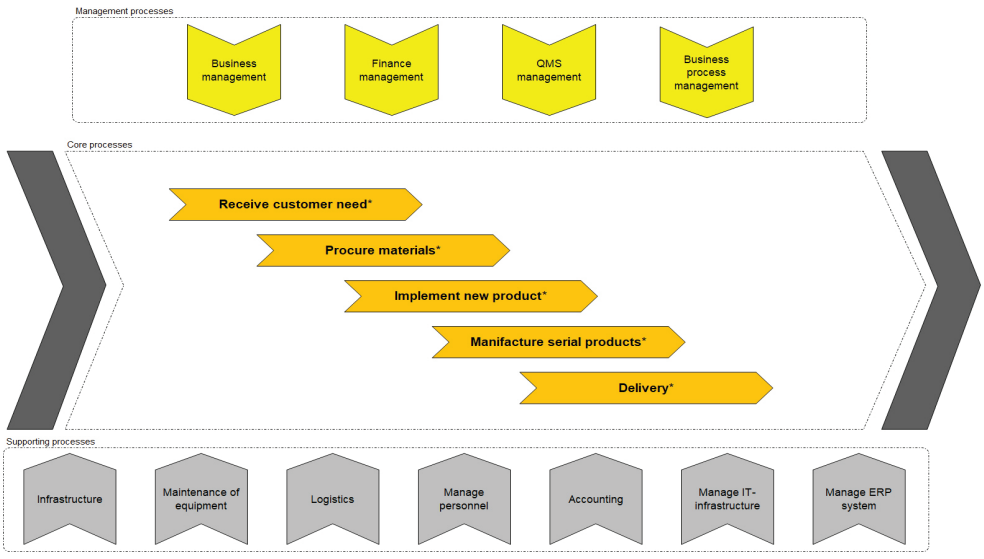

Figure 7. *Business process map (level 1).*

To implement the process approach, it is necessary to develop a complete model of the processes that create value for customers. This model can be represented as a top-level process map (Fig. 7). The second level of the process map and a plan for detailing business processes are also created. For each business process we defined:

- process owner;
- process boundaries and process goals;
- inputs and outputs;
- targets and performance criteria of the process.

To implement the principles of the process approach, the company implements the iGrafx BPM system. The system allows to model and analyze business processes, as well as manage them. The introduction of iGrafx helps to accelerate the creation of a graphical representation of processes (process detailing is carried out in BPMN notation) and to manage the life cycle of business processes. Let us take a look at the the main process "Serial production" (Tab. 6). It includes three second-level processes, which have their subprocesses (detailing).

Table 6

Serial Production Process

Level 1		Level 2		Detailing	
Code	**Title**	**Code**	**Title**	**Code**	**Title**
CP4	Serial production	CP4_1	Planning and production	CP4_1_1	Planning of details
				CP4_1_2	Production of details
				CP4_1_3	Planning of assembly groups
				CP4_1_4	Production of assembly groups
				CP4_1_5	Painting
		CP4_2	Ensuring the production process	CP4_2_1	Management of techonogical documentation
				CP4_2_2	Changing route time
				CP4_2_3	Management of techonogical process
				CP4_2_4	Confirmation of orders and changes in delivery dates
				CP4_2_5	Ensuring the safety of materials, parts and products
		CP4_3	Production equipment	CP4_3_1	Management of technological equipment
				CP4_3_2	Replacement and repair of broken instruments
				CP4_3_3	Replacement of consumables
				CP4_3_4	Metrological support of production

5. Results and Discussion

The paper addresses the issue of quality management system development on the base of enterprise architecture approach. It was proposed as an attempt to align a practical business case with the requirements of ISO standard. When estimating the required investments in the

quality management system implementation (achieving compliance with the ISO 9001:2015 standard), several types of costs are defined - implementation costs and operating costs. The first type of costs can be divided into two groups: the costs of direct implementation and the cost of certification. Operating costs are understood as costs for maintaining the quality management system and its improvement. The cost model for the implementation of the management system is shown in Fig. 8:

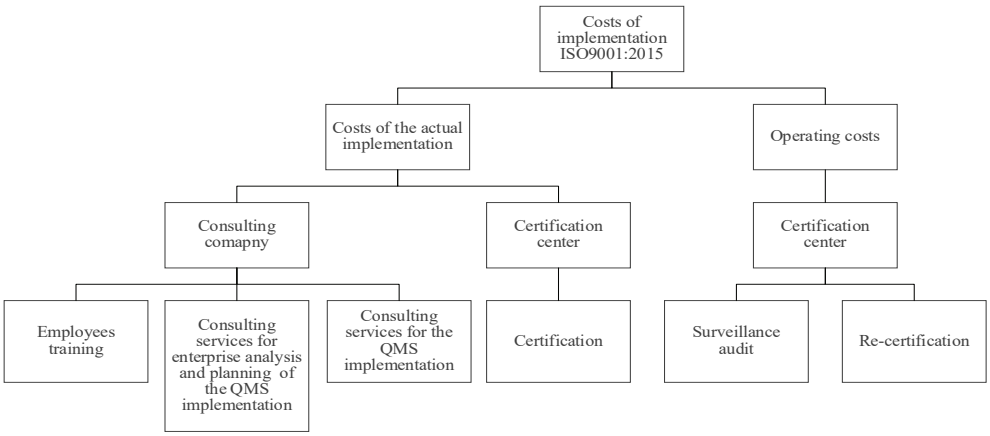

Figure 8. *Cost model of the implementation of the QMS.*

Another important task is to assess the benefits of implementing the ISO 9001:2015 standard. Advantages can be quantifiable and non-quantifiable, the model is shown in Fig. 9:

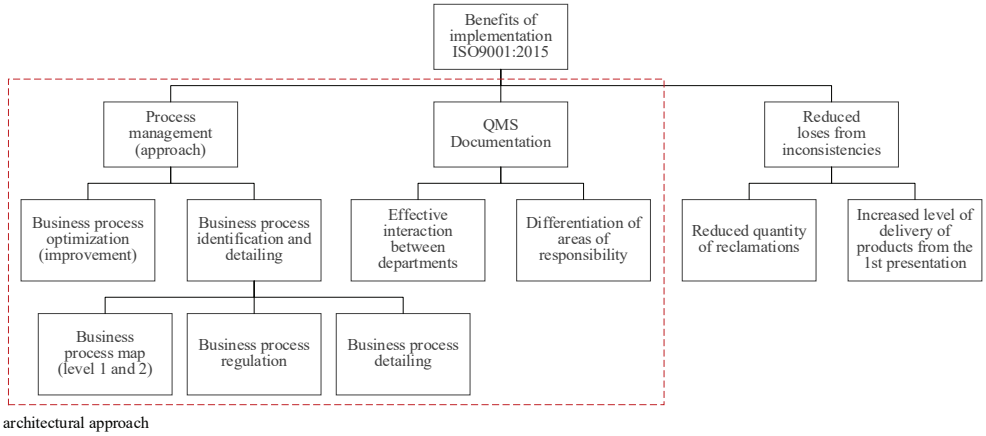

Figure 9. *Benefits of implementing the ISO 9001:2015.*

Fig. 10 reflects the quantifiable effect of the implementation of the quality management system - the statistics on received complaints (reclamations) from customers (the introduction of the management system started in May 2017):

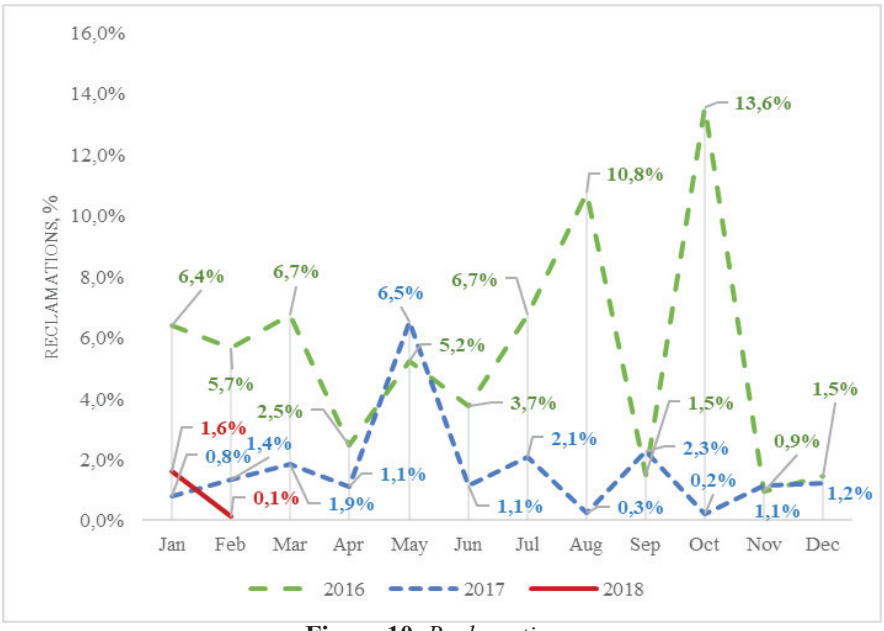

Figure 10. *Reclamations.*

As a result of the formation of the business process architecture based on the international standard ISO 9001:2015, and the analysis of the results obtained, it is possible to draw a conclusion on the effectiveness of applying the architectural approach to improving business processes of the enterprise. The architectural approach provides continuous management at the interface of single processes within the system, as well as their combination and interaction. Understanding the cause-and-effect relationships between system factors, processes and results allows us to find levers for managing business processes, i.e. develop, manage and improve business processes in order to create added value for customers and other interested parties.

Further research activities follow but are not limited to the following branches:

1. extending the research onto the usage of other architectural approaches and tools (Archimate, BPMN etc.);
2. a deeper specification of each TOGAF phase for different QMS adoption steps;
3. formalization of the model for the resulting EA evaluation;
4. practical application of the proposed framework taking into account such business factors as industry sector, organizational size and type of strategic positioning.

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