

**VII INTERNATIONAL
CONFERENCE
QUALITY SYSTEM
CONDITION FOR
SUCCESSFUL BUSINESS
AND COMPETITIVENESS
PROCEEDINGS**



KOPAONIK, 27/11.-29/11/2019

**ASSOCIATION FOR QUALITY AND STANDARDIZATION OF
SERBIA**

VII INTERNATIONAL SCIENTIFIC CONFERENCE

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SUCCESSFUL BUSINESS AND
COMPETITIVENESS**

PROCEEDINGS

Kopaonik, 27/11 – 29/11/2019

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P R E F A C E

Dear Colleagues, Ladies and Gentlemen,

I take great pleasure in welcoming you to the 21st National and 7th International Scientific Conference on QUALITY SYSTEM CONDITION FOR SUCCESSFUL BUSINESS AND COMPETITIVENESS, organized by the Association for Quality and Standardization of Serbia.

We have entered our third decade and are proud of our commitment and successful performance in the field of quality in the Republic of Serbia and the region

We use our rich two-decade experience to further improve the quality status of Serbia in all spheres increasingly involving new actors in our work.

This year we are organizing the 21st National and 7th International Scientific Conference in cooperation with:

- Faculty of Veterinary Medicine, Belgrade University – co-organizer*
- Quality Centre, Faculty of Engineering Sciences, Kragujevac University*
- Quality Centre, Faculty of Mechanical Engineering, University of Montenegro, Podgorica*
- Middle and South East European Countries Quality Initiative*
- Technology College of Applied Studies, Krusevac,*

with the support of

- Ministry of Economy of the Republic of Serbia*
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- Accreditation Body of Serbia*
- Serbian Association of Employers*
- Serbian Chamber of Commerce*
- Chamber of Commerce and Industry of Serbia*
- Institute for Standardization of Serbia*

The large number of papers submitted for the presentation at the conference cover a wide range of topics: Quality system condition for successful business and competitiveness; Improving quality infrastructure; Management system: quality, environment, occupational health and safety, energy, food safety, information security...); Development and establishment of a management system (in theory and practice); Models of business excellence; Engineering and quality management; Knowledge management; Product and service quality; Audit and certification; Global quality; Quality culture; Management systems in the public sector; Quality, risks and opportunities; Information system in the function of management system development; Motivation and quality; Organizational behaviour, leadership and management; Quality – theory and practice; Quality and social responsibility; Innovations and quality; Measurement, control and quality in production; Quality improvement tools; Quality 4.0 and industry 4.0. After the conference, all papers will be submitted for indexing.

On this occasion, sticking to our roundtable tradition, we will organize discussions as follows:

- Development of Quality Infrastructure in Serbia - Risks and Opportunities, aimed at forming the Quality Infrastructure Council of the Republic of Serbia that would consist of experts on quality and represent an advisory body for state institutions in order to improve the current situation;*

- *Quality and crisis management, with the aim of preventing the emergence of a crisis by preventive actions, and if it does occur, to recognize and adequately and successfully manage it in a timely manner*
- *Food and beverage quality in Serbia, with special emphasis on the quality of wines and rakias on the Serbian market*

The Association for Quality and Standardization of Serbia strives to award its deserving members or organizations through the recognition criteria, but unfortunately, not always unmistakably.

This year, as well as every subsequent year, we will give recognition to those who have contributed to the success of the conference.

For the next year, we announce the award for those organizations with the most training hours per employee, since the success of an organization mostly depends on its knowledge. The award criteria will be published in a timely manner so that those interested can participate in the competition.

The success of a conference depends on all the participants, therefore, I take the opportunity to thank all the authors and co-authors of the papers, the co-organizer, those whose cooperation over many years has meant a lot to us, those who have given us support, the general sponsor – the Faculty of Business Studies and Law, Belgrade, other sponsors and donors, media patrons, as well as all the participants from Serbia and abroad.

I would like to wish us successful work and a good time at the largest gathering devoted to quality.

Yours sincerely,

***Professor Zoran Punoševac, PhD
Organizing Committee Chairman***

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METHODOLOGICAL APPROACH TO APPLICATION OF DMAIC METHOD ON IMPROVEMENT OF BUSINESS PROCESSES

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***Abstract:** The need to optimize business processes stems from the increasing demands of stakeholders as well as the turbulence of organizational environments. To meet the newly identified requirements, an organization must adapt and continuously improve its business processes, which is also one of the requirements of the ISO 9001:2015 standard highlighted in point 10. The organization for process improvement and optimization has a large number of tools, methods, and methodologies at its disposal. The method is also DMAIC. The DMAIC method is an acronym of five phases through which a process or project passes, namely the definition phase, the measurement phase, the analysis phase, the improvement phase and the control phase. During improvement and optimization, organizations face challenges related to employee resistance to improvement, as well as the duration of optimization that is determined by the complexity of the organizational system. But to improve business processes, they need to be identified, which is one of the challenges organizations face.*

***Keywords:** business processes, DMAIC, Lean, 6 sigma, optimization*

***JEL Klasifikacija:** L25*

1. INTRODUCTION

A constant process improvement is a requirement that arises from changes in organizational environments. However, changes in the environment are not the only reason for the continuous improvement of the process. The ISO 9001:2015 standard in point 10 as one of the requirements for the organization to put constant improvement of processes (Buntak, Kovačić, Mutavdžija, 2019). On the other hand, organizational growth and development in the organization accumulates business processes that can slow down the current way of functioning which occur the need for process optimization.

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In the 1990s, engineering of process emerged as a response to the need for redesigning and adapting to new conditions in organizational environments. Engineering of the process implied the externalization of all activities that are not part of the core process. Externalized processes are entrusted to external suppliers, i.e. service providers. Although the engineering process had several advantages, it also faced major challenges, such as the resistance of organizational employees to the rapid changes that are one of the characteristics of process engineering.

Drastic changes in the organization bring with them the risk of their disagreement, which has led to the need for a different way for improvement. The Japanese philosophy of quality through the Kaizen philosophy has enabled the constant, every day, improvements that involved and encouraged the proactive involvement of all organizational employees, which affected their additional motivation. By combining the Lean philosophy and the 6 sigma methodology, Lean 6 sigma methodology arises and includes all the benefits of Lean philosophy with the elimination of the variability of the process which significantly influenced the improvement of the performance.

In this secondary research, the main objective is to demonstrate the applicability of the DMAIC methodology in improving business process performance.

2. METHODS OF OPTIMIZATION AND IMPROVEMENT OF BUSINESS PROCESSES

To improve and optimize organizational processes, there are several tools available. The choice of the optimization approach depends primarily on the competence of organizational employees as well as on the awareness of organizational management about the needs for improvement (Buntak, Zlatić, Kovačić, 2018). A lean philosophy focuses on the elimination of process waste, which implies all activities that do not add value to the customer. Eliminating such activities increases the efficiency of the process, which reflects on overall organizational performance. On the other hand, the 6 sigma methodology is aimed at reducing the variability of the process, resulting in a lower probability of the production of a non-compliant product. In synergy, Lean and 6 sigma eliminate unnecessary activities in the process by increasing the number of manufactured co-products.

2.1. Lean philosophy

Lean philosophy is a part of TPS (Toyota production system) and is considered one of the most widely used, philosophies that shape the system of quality improvement. It contains a set of tools and methods that are directed towards improving the flow of resources through the process or increasing the efficiency and effectiveness of the process (Buntak, Kovačić, Mutavdžija, 2019). Process waste that lean try to eliminate from the process is MUDA (Japanese term for process waste), MURI (Japanese term for overburdening equipment) and MURA (Japanese term for unevenness in a process). However, the focus of organizations is primarily the elimination of MUDA which contains unwanted activities such as unnecessary movements, unnecessary transport, unnecessary processes, non-conforming products, unnecessary supplies, unnecessary waiting, and excessive production.

Organizations that adopt the Lean philosophy achieve several advantages such as reducing the production cycle time, reducing labor costs, and reducing the number of non-conforming products quoted by Leite and Vieira (2015) in their research (Leite, Vieira, 2015). Further, Lean's philosophy emphasizes the importance of timely planning, securing a safe working environment for all employees in the organization, as well as learning, ie educating all employees, reflecting organizational performance in the long run (Gupta, Kumar Jain, 2013).

The adoption of Lean philosophy is carried out in four steps. The first step in identification is process waste that reduces the efficiency of the process. Particular attention must be paid to hidden waste that can only be identified by a more detailed analysis of the process. In the second step, it is necessary to identify the cause of the process waste. Elimination of process waste as such will not result in performance improvement if the cause of its occurrence is not eliminated. The next step is identifying solutions that must prevent possible recurrence of process waste while the last step is to

implement the identified solution (Gupta, Kumar Jain, 2013). Improving the process and eliminating the causes of process waste can be accomplished using some of Lean's philosophy tools such as Just in Time, Poka Yoke, Jidoka, etc. The implementation of one of these solutions depends primarily on the context of the organization and the organizational process.

2.2. 6 sigma

The 6 sigma methodology was created in Motorola to reduce the number of nonconforming products that are the result of process variability. The 6 sigma process optimization and improvement is based on a team approach that seeks to identify stakeholder requirements and eliminate non-conformities from the process (Tjahjono et.al., 2010). The primary goal of the 6 sigma methodology is to reduce the variability in the process that is detrimental to its stability which affects the manageability and process capability. Furthermore, the main goal of applying the 6 sigma methodology is to bring the process up to 6 sigma level, which implies the occurrence of 3.4 nonconformities on a million produced products or services provided (Montgomery, Woodall, 2008).

The 6 sigma team consists of four specific roles that team members have; that is; a white belt, a green belt, a black belt, and a black master belt. The white belts are introduced to the 6 sigma methodology as well as to all the tools and methods used in it. The green belt is the backbone of the improvement project and it has a leadership role in the team. The black belt is normally the optimization manager and manages all the green belts in the organization, while the master black belt is the highest authority in the overall improvement project.

For the implementation and preparation of the 6 sigma project, the organization must provide the supreme management assurance as well as providing all the resources needed. In addition, the organization must provide competent employees who can contribute to optimizing and improving their processes through their knowledge and skills. The last component that needs to be provided is the infrastructure and superstructure in the organization (Gupta, Kumar Jain, 2013). The 6 sigma methodology is based on the DMAIC (acronym: Define, Measure, Analyse, Improve, Control) approach, which is the acronym described in Chapter 3. The DMAIC method itself contains a large number of different tools and methods that are used depending on the need and the project phase. In practice, decision-making tools are often used. Table 1 shows the sigma level of the process with the associated number of nonconforming products that are characteristic of the individual sigma process level. Additionally, the table also shows the yield percentage that depends on the process sigma.

Table 1: Sigma process level and number of nonconformities in the process

Sigma level	The number of non-conformities on the milk product / service	Yield
1	690,000	31
2	308,537	69
3	66,807	93.3
4	6,210	99.38
5	233	99.977
6	3.4	99.99966

Source: Authors according to Vivekananthamoorthy, N. and Sankar, S., 2011. Lean Six Sigma. In Six Sigma Projects and Personal Experiences. IntechOpen

2.3. Lean 6 sigma

The Lean 6 Sigma Approach to Process Improvement and Optimization emerged in the 1990s, it was identified that Lean Philosophy and 6 sigma methodology are complementary and how their joining results in significant effects in the context of improving organizational processes (Dave, et.al., 2015). The similarities between Lean philosophy and 6 Sigma methodology are shown in Table 2.

Table 1: The similarities between Lean philosophy and 6 Sigma methodology

Lean philosophy	6 sigma
Defining the methodology of improvement	Defining the methodology application policy
Focus on customer's request	Measurement of customer requirements
Understanding the Existing Situation	Discovery of knowledge
Documentation of the current course	Mapping the existing process
Evaluation of Opportunities	Analysis of causes and consequences
Collecting Product Data	Collecting Process Data
Reducing the cycle time, eliminating the possibility of failure of the equipment	Seven basic management tools, seven basic quality management tools, designing experiments

Source: Premužić, B. (2019). Metodološki pristup primjene DMAIC metode na poboljšanje poslovnih procesa. Diplomski rad. Sveučilište Sjever. Koprivnica

As can be seen in Table 2, Lean's philosophy is focused on customers and understanding of the existing state in the process before the start of the improvement project. Besides, Lean focuses on products as well as reducing process cycle time, while 6 sigma is focused on the process and the use of tools and methods for identifying the cause of non-compliance as well as identifying the place in the process where improvements can be made.

In other words, 6 sigma as a goal has reduced process variability as well as increased process robustness. Besides, the 6 sigma is directed to identifying optimal process conditions. On the other hand, Lean is focused on improving the flow of resources through the process. In synergy Lean and 6 sigma is aimed at eliminating all types of process waste as well as reducing the duration of activities that do not add value to the process and reduce the process cycle time (Snee, 2010).

3. USE AND APPLICABILITY OF LEAN 6 SIGMA METHODOLOGY IN PRACTICE

There is a large number of professional and scientific researches on the benefits of using the Lean 6 sigma methodology to improve and optimize the process. Antony et al (2007) study the benefits that Lean 6 sigma methodology uses in the service sector. Furthermore, Antony et al. identify that the application of the said methodology in practice in an unpublished health organization resulted in a reduction in radiology costs by 22% or a 33% increase in resource flow through the radiological process. The same author for the Lean 6 Sigma methodology in the banking sector cites a significant increase in the satisfaction of clients using bank services, reducing the process cycle time, as well as increasing the efficiency of the process (Antony et.al., 2007).

Pinjari (2017) in his research speaks of the benefits that the manufacturing organizations have been using through the Lean 6 sigma methodology. In its research, it presents a case study that outlines the range of benefits the automotive industry achieve by using Lean 6 sigma methodology, which are reflected in increasing employee productivity, as well as reducing inventories of raw materials and materials that the organization uses in their manufacturing processes (Pinjari et.al., 2017).

Further, there are a number of other examples of good practices describing the benefits of Lean 6 sigma methodology implementation. One such example is mentioned in the research Oguz (2012), referring to the application of the said methodology in the production of concrete products and the reduction of the variability in the production process (Oguz et.al., 2012).

Challenges that facing organizations when using Lean 6 sigma relate to the huge resistance from employees who do not want to change the way they are doing the job. In addition to resistance, organizations face the challenge of carrying out education or investing in the development of human resources that are necessary to make improvements. Furthermore, there is a need for financial investments aimed at implementing one of the identified improvements in the process. As a rule, it can be said that the challenges the organization face depend on its context and the state of affairs in the process.

4. DMAIC

The DMAIC method is used within the Lean 6 sigma methodology for improving and optimizing the process. The method is actually an acronym for process improvement phases, namely the defining phase, measurement phase, phase of analysis, phase of improvement and phase of control. Each phase must be closed before it commences with the next phase, and each delivery of a particular stage must be presented and approved by the management.

The DMAIC method is applicable in all organizations because of the fact that it is a generic approach to improving and optimizing the process. Speaking about professional and scientific papers, DMAIC has been studied and investigated in the manufacturing sector in most cases (Srinivasan et.al., 2016). However, Lean 6 sigma in practice has shown particularly good results in the healthcare sector, which, by applying the same, increases the quality of life by reducing waiting lists due to the inefficiency and efficiency of the process (Buntak, Zlatić, Kovačić, 2018).

Before starting to improve and optimize the process, it is necessary to identify problems in the process from which the project will be created. Brainstorm is commonly used to identify problems as well as the weighting of generating ideas to initiate improvements. However, this is not the only prerequisite for improvement, given the fact that it is necessary to provide competent employees who will be members of the improvement team.

4.1. Define phase

The Phase of Defining is the first phase of the DMAIC in which is investigating existing states in organizational processes. An organization creates a project charter that contains all the information needed to carry out the project. In addition, it is approaching defining the requirements of the interested parties that are leading to improving and optimizing the process in order to increase the satisfaction of the interested parties. Furthermore, the existing state of the process is created using the SIPOC (Supplier, input, process, output, costumer) diagram as well as the creation of a CTQ (Critical to Quality) diagram in which a metric defines the performance, ie the failure to improve and optimize the business process. At this stage, you are also approaching and defining teams.

When creating teams it is important to emphasize that team members are limited to a maximum of 7. In addition, the team leader must have the competencies that enable team management as well as organizational skills, the ability to delegate tasks and find out about the stage in which the team is located. Each team goes through 5 phases, the stage of formation, the intensification phase between employees where conflicts often occur, the stage of standardization in which each of the team members accepts its role, the stage of performing in which the harmony prevails co-operation between team members and the ending phase in which the team is disbanded and each of the team members is awarded a suitable prize that depends on his involvement in the team (Manges, 2015).

It is important to note that all data defined in the project charter can be changed during the project if necessary. The same goes for team members who can also be replaced if it is identified that their

competencies are not good enough, that is, they do not contribute to generating and finding a solution to the problem.

4.2. Measuring phase

The measurement phase is focused on identifying the existing performance of the process. At this stage, measurements are made on previously defined measurement points in the process, but also through the extraction of information from the organization's information system. All collected data must be statistically processed using basic statistical budgets ie descriptive statistics. At this stage, a process stability analysis is also developed, which is the basis for identifying possible problems in the process that result in the production of a non-conforming product.

Analyzing the collected data identifies the sigma process level, a map of the existing process is created, which is the basis for the later phase of the analysis. It is important to emphasize that the organizational team working on the improvement project must define the data form to be collected as well as the data collection plan that the operators performing the measurements must adhere to. All measuring instruments used in the measurement must be moderate in order for the data to be obtained to be relevant and to be used in the improvement project.

4.3. Analysis phase

In the analysis phase of the approach, analyzing the collected data and identifying the causes of deviation, ie non-compliance. To identify the causes of nonconformity, the organizational team can use quality management tools such as Ishikawa Diagram, 5 why, Control - Impact Matrix, Affinity Diagram, Force Field, etc. The number of tools the organization will use depends on the complexity of the problem and the process being analyzed. In addition, at this stage, the DMAIC method performs a flow analysis of the value that is the basis for identifying all activities in the value-added process as well as for defining ways by which the identified activities, ie process waste, will be eliminated from the process or reduced time to maximize the efficiency of the process.

4.4. Improvement phase

The improvement phase implies identifying and evaluating possible alternatives by trying to eliminate the identified nonconformity from the process. At this stage, tools and methods developed in Lean philosophy, such as Just in time, Just in sequence, Jidok, Poka Yoke, 5S, etc. can be used. The choice of tools to be used for improvement depends on the context of the organization as well as the context process. For creating improvements, most commonly used brainstorming ideas are generated by ideas that are then evaluated using some of the methods such as the Walt Disney method, the world cafe method, etc. In addition, at this stage, an analysis of the desired state of the process is carried out in order to the future appearance of the process was identified. The organizational team must identify all the risks and identify the extent to which it will cancel for the identified risk. The cost-benefit analysis identifies cost-effectiveness improvements, identifies tangible and inexhaustible benefits, and makes a decision about the proposed alternative of improvements to be implemented in the process.

4.5. Control phase

During the control phase the implemented improvements are controlled, the project closes, and the process is submitted to the process owner who becomes responsible for process management as well as for corrective action if discrepancies occur. In addition, access to updating of all documentation defining new processes as well as performing all the activities in the process.

When a team is disbanded, it is appropriate to reward each member of the team, depending on his engagement in the project. Awarding and fostering relationships with employees is of crucial importance for their motivation as well as for their later proactive participation in monitoring and defining suggestions for improvement.

5. CONCLUSION

Continuous process improvement is a requirement that stems from the ISO 9001:2015 standard, but also from the increasing and turbulent changes from organizational environments. In order to be able to adapt to market trends, the organization implements a process approach that makes it more flexible and enables it to adapt more easily and quickly to new conditions. However, in practice, organizations cannot and do not know how to recognize processes and do not properly transform their existing structure to process-oriented structure. As a consequence, there are challenges related to a lack of understanding of the role that employees have in the process and a lack of understanding of the process approach as such.

Furthermore, the growth and development of an organization bring with it an increase in the complexity of the organizational system, which can affect its manageability. Fewer manageability results in non-compliance products and services, less efficient, less efficiency, but also less cost-effectiveness. Accordingly, there is a need to optimize business processes, and one method that can be used for optimization is DMAIC.

The paper describes each of the stages of the DMAIC method as well as the benefits of applying the method. It is important to note that different tools are applied within the improvement project as well as in each of the DMAIC stages, depending on the problem being solved. Each identified problem must be analyzed and its cause must be identified in order to define measures to address it.

DMAIC, furthermore, takes a team approach to improving and solving problems, addresses issues of non-compliance, less flow of resources through the process, which affects the efficiency and effectiveness of the process. Furthermore, the project optimization process and transformation of the organization into process-oriented, in case the organization is not process-oriented, the process documentation is created based on the identified processes in the organization.

The benefits of applying the DMAIC method are evident through the reduction of process cycle times, increased efficiency and effectiveness, greater customer satisfaction, cost reductions, etc. On the other hand, the challenges of implementing the method are manifested through the resistance that organizational employees can provide to optimizing and changing their present tasks in the process as well as the duration of optimization that is determined by the complexity of the organizational system.

In practice, the application of the DMAIC methodology has proven to be very successful. On a business example (company name information available to authors and not disclosed because of data protection) on the day the optimization and improvement project begins, the current state of the product launch process, which is undergoing optimization, since the adoption of the portfolio decision, there have been an average of 384 calendar days on 47 new products. After improving the process and eliminating the key causes of the problem, the duration of the process is 163 days on average. During the optimization, we noticed 4 spin off projects that will be optimized separately. The financial impact is a 1.2% increase in the company's revenue for 2019.

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