

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



25.11.-27.11.2020

**ASSOCIATION FOR QUALITY AND STANDARDIZATION OF
SERBIA**

VIII INTERNATIONAL SCIENTIFIC CONFERENCE

**QUALITY SYSTEM CONDITION FOR
SUCCESSFUL BUSINESS AND
COMPETITIVENESS**

PROCEEDINGS

25/11 – 27/11/2020

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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 22nd National and 8th International Scientific Conference on QUALITY SYSTEM CONDITION FOR SUCCESSFUL BUSINESS AND COMPETITIVENESS, organized by the Association for Quality and Standardization of Serbia.

In the past period, we have successfully organized 21 national and 7 international quality conferences where a large number of papers were published, with a large number of authors and co-authors and most importantly, with a large number of participants

This year, the organization of the conference got a completely different character due to the COVID-19 pandemic, so we organized the On line conference. The decision on the manner in which the conference will be organized was made only 15 days before the event, bearing in mind that at that time Government made a regulation to ban gatherings of more than 5 people indoors (in this case in the conference hall).

This year we are organizing the 22nd National and 8th 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*
- Shumadia Academy of professional studies,*

with the support of

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

The sponsor of the conference is Trayal Corporation from Kruševac

A number of papers have been submitted for this conference, which have been published in this proceedings, but the emphasis is on round tables, which are expected to be attended by a larger number of participants.

- THE FUTURE OF REMOTE AUDIT where the current practice and future directions of development of these new audit methods and techniques of verification would be pointed out.*
- CORONAVIRUS PANDEMIC AND CRISIS MANAGEMENT, with the main goal of understanding the aspects of crisis management in the context of a coronavirus pandemic, as well as the consequences of the pandemic on the economic and financial system*
- FOOD SUPPLY CHAIN IN THE CONDITIONS OF THE COVID-19 PANDEMIC, which will discuss the global food crisis in the world and its consequences, which were further deepened in 2020 by the SARS-Cov-2 pandemic (Covid-19) and finding possible solutions for the period ahead*
- FUTURE CONCEPTS OF STANDARDS FOR MANAGEMENT SYSTEMS with the aim of presenting the future concept of development of the ISO 9001 series of standards bearing in mind that the draft future concept of standards for management systems provides framework topics to be addressed in the future by ISO 9000 series standards and organizations applying standards for management systems.*

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

This year, as every next year, we will award prizes to deserving members for their contribution to the work of the Association as well as to the improvement of the quality infrastructure in Serbia

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, the general sponsor, 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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**QUALITY SYSTEM CONDITION FOR
SUCCESSFUL BUSINESS AND COMPETITIVENESS**

COMPARATIVE ANALYSIS OF 8D METHOD AND REQUIREMENTS OF QUALITY MANAGEMENT SYSTEM

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Abstract: *Nonconformity as such is a significant challenge for every organization because is the consequence of variability in the organizational process. Decreasing customer satisfaction could lead to a decreasing in organizational reputation which, in the long term, could be extremely dangerous for the organization. ISO 9001:2015 norm on the quality management system puts different kinds of requirements that are related to nonconformity management and which organization must involve in the decision when it comes to dealing whit nonconformity. Besides, ensuring accordance with such requirements could be a challenge for the organization because approach to the solving problem that is not systematic could lead to partial solutions. One of the ways for dealing nonconformities is the 8D method. In this paper, the authors compare requirements that ISO 9001:2015 puts on the organization when comes to nonconformity management and 8D method steps.*

Keywords: *non-conformities, complaints, analysis of the causes of the problem, quality management system*

JEL Classification: L29

1. INTERDUCTION

One of the requirements that ISO EN 9001:2015 puts on quality management systems is managing inconsistent outputs which are described in 8.7. point. Norm ISO 9001:2015 on the organizational management system puts also requirement related to describing how non-compliance appeared and also to describe actions related to the solving problem or root cause of the problem. Accordingly, to the requirement, the organization must define procedures that will be taken when non-compliance appeared and also procedures that will be taken when the customer reports non-compliance with the product or service that he bought.

Non-compliance in the process as the result may have a decrease in the efficiency and effectiveness of the process as well as decreasing in cost-effectiveness. Furthermore, one of the main reasons for decreasing effectiveness, efficiency, and cost-effectiveness of the process is the process instability.

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Process instability is the result of different kinds of variations that may appear in the process.⁴ Accordingly, the organization must investigate possible causes of the variations that result in non-compliance of the product or service, as well as an organization, must conduct a risk assessment that is related to the identifying all risks that may in future as the result have appearing of new non-compliances in the process. It should be highlighted that identifying the root cause of the problem and creating measures for future preventing of the incident in the process could lead to the development of the sustainable success of the organization.⁵

Reclamation that costumer have are one of opportunity for the organization to conduct improvements and also to discover places in the process and features that current product or service have that could be improved. Reclamation as such for the organization means that customer is not fully satisfied whit product or service so current satisfaction of costumer must be improved because there is the risk that customer will go to the competition.⁶

When non-compliance appears in the process this may lead to the appearance of cost for poor quality. Poor quality costs are all costs that organizations have and there are related whit dealing whit non-compliance of product or service that is delivered to the customer. In poor quality, the cost may be included costs that are related to the corrective actions that the organization is conducting because of the non-compliance.⁷ the organization places a larger amount of products on the market that have some kind of non-compliance there is also the possibility of endangering the health of the costumers that will buy such a product. Furthermore, there is also risk related to the increasing in poor quality costs because the organization must withdraw all non-compliance products from the market. So, because of the complexity of dealing whit non-compliances, there is a need of using a method that will be in accordance whit requirements of the ISO EN 9001:2015 and will result in dealing whit non-compliance products.

In this paper, the authors describe the 8D method for a scientific approach in non-compliance solving. In the paper, the authors find that the 8D method is following whit requirements that ISO 9001:2015 puts on the organizations.

2. METODOLOGY

For conducting research in this paper authors use secondary research in which they compare requirements that ISO EN 9001:2015 puts on the organizational quality management system and it's related to the dealing whit non-compliance and improvements in the process. After identifying all requirements of the ISO 9001:2015, whit secondary research authors identify all steps of the 8D method and compare them whit requirements of ISO 9001:2015. The main aim of the research is to show the importance of dealing with whit non-compliances and conducting continuous process improvements. Furthermore, the paper aims to compare the 8D method whit requirements of ISO 9001:2015 requirements.

⁴ Buntak, K., Sesar, V., & Kovačić, M. (2016). Bussness process controlling. XVII nacionalni i V međunarodni naučno stručni skup "Sistem kvaliteta uslov za uspešno poslovanje i konkurenntost".

⁵ Buntak, K., Kovačić, M., & Mutavdžija, M. (2019). Continuous process improvement as a foundation for sustainable organizational development. 20th International Symposium on Quality - QUALITY – YESTERDAY, TODAY, TOMORROW.

⁶ Tarí, J. J., & Sabater, V. (2004). Quality tools and techniques: are they necessary for quality management? International journal of production economics, str. 267-280.

⁷ Oppermann, M., Sauer, W., & Wohlrabe, H. (2004). Optimization of quality costs. Robotics and Computer-Integrated Manufacturing, str. 135-140.

3. NONCONFORMITY MANAGEMENT

Nonconformity is the product, service, or activity that has been conducted but that is not in accordance with what requirements that law or norm puts on that product, service, or activity. Furthermore, nonconformity in most cases is a result of process variations. According to the ISO EN 9000:2018 nonconformity is non-compliance with the requirements that are placed on the product or services. On the other hand, nonconformity showed also customer dissatisfaction with the product or service with product or service from the organization.⁸ So, nonconformity as the result has non-effectiveness because the organization is not conducted planned goal. With non-effectiveness and not meeting goals, the organization must invest more resources to meet planned goals that mean the organization is not efficient. With non-effective and non-efficiency, the organization is dealing with with decreasing cost-effectiveness.⁹

Nonconformity management is one of the main requirements that ISO 9001:2015 puts on the quality management system and its related to the root cause analysis of the problem that as result have nonconformity as well as the creating and conducting measures that are related to the improvement in the process to prevent future risks that may result in nonconformity.¹⁰ Furthermore, Nonconformity management is imperative because of fact that nonconformity as the result may have decreasing of organizational reputation as well as the possibility to customer substitute organizational products and services with products and services from the competitors.

In point 8.7.1. ISO 9001:2015 norm is highlighting that the organization must conduct all measures that are necessary for managing nonconformity. Furthermore, all measures must be aimed at the root cause of the problem so the problem will not appear in the future as well as conducting all measures that are related to the product recall.¹¹ So, it is necessary for the organization to create procedures for managing all nonconformity and also procedures that will be aimed at decreasing damage for all interested parties. All product recall for the organization may result in increased costs of poor quality that may endanger organizational success in the future.¹² After procedures that are aimed at product recall and decreasing damage to the customers has been conducted, the organization must conduct an analysis of root cause and also create measures that will result in decreasing damage. When conducting all measures, the organization must document every step that is made. Documenting of measures and their effectiveness and efficiency is one of the main requirements of ISO 9001:2015.¹³ For creating such measures and procedures, organizations can use a different kind of tools such as the Pareto diagram, Ishikawa diagram, brainstorming, control charts, etc.

The need for root cause analysis arises from the requirements that ISO 9001:2015 describe in point 10.2.1. in which is described that organization must create measures and procedures that are aimed at the supervision of the nonconformity and actions that are made for nonconformity management.¹⁴ In other words, the organization must identify all problems and consequences that arise from nonconformity and create measures for decreasing damage for the customer and all interested

⁸ ISO, S. 9000. (2018). Quality management systems. Fundamentals and vocabulary (ISO 9000: 2015). Brussels: European Committee for Standardization.

⁹ Buntak, K., Sesar, V., & Kovačić, M. (2016). Business process controlling. XVII nacionalni i V međunarodni naučno stručni skup "Sistem kvaliteta uslov za uspešno poslovanje i konkurentnost"

¹⁰ Percarpio, K. B., Watts, B. V., & Weeks, W. B. (2008). The effectiveness of root cause analysis: what does the literature tell us? The Joint Commission Journal on Quality and Patient Safety, str. 391-398

¹¹ ISO, E. N. 9001. (2015). Quality management systems. Requirements. Brussels: European Committee for Standardization.

¹² Magno, F. (2012). Managing product recalls: The effects of time, responsible vs. opportunistic recall management and blame on consumers' attitudes. Procedia-Social and Behavioral Sciences, str. 1309-1315

¹³ ISO, E. N. 9001. (2015). Quality management systems. Requirements. Brussels: European Committee for Standardization.

¹⁴ Ibid.

parties.¹⁵ For every identified problem, the organization must create corrective actions that will be aimed at solving problems and also improvement in the process. Every action that an organization is planning and conducting must be analyzed from the aspect of its efficiency and effectiveness.¹⁶

If organization identify the larger problem that may endanger business continuity, it is necessary to create procedures that will ensure business continuity and which will ensure all resources and measures that are important for ensuring recovery from the problem.¹⁷ It should be highlighted that every organization must put special attention to the risks and risk assessment that as the result could have nonconformity or decreasing in customer satisfaction. With this approach organization is preventing future problems that may result in creating nonconformity and also create an approach that is based on risk assessment. To additionally decrease the possibility of arising risks, it is recommended to involve interested parties in risk assessment and to look at risk from the aspect of the customer.¹⁸ Because of the requirements that ISO 9001:2015 puts on the quality management of the organization, it is necessary for the organization to create and implement a systematic approach to managing nonconformity and also for a system approach to the creating measures related to the decreasing damage to the customers and organization itself.

4. SYSTEM APPROACH TO THE NONCONFORMITY MANAGEMENT

System approach to the nonconformity management implies fulfillment of the requirements that ISO 9001:2015 puts on the organization, and are related to the communication with all interested parties which are affected with the problem or which reported nonconformity. One of the system-based approaches to the nonconformity root cause analysis is the 8D method. 8D method is an approach that is created during World War 2 within military norm 1520 – corrective actions and nonconformity. The method was first used in 1987. Within automobile organizations in the USA, and today is often used in the automobile industry.¹⁹ 8D is an acronym for eight disciplines that are incorporated within the method and which are described in Table 1.

Table 1: 8D method phases

Discipline	Description
D0 – planning	In this phase, the organization conduct preparation for the project of root cause analysis. So, in this phase, the organization defines all information that is important for the root cause analysis such as information from customer service, from customer and all interesting parties that are related to the nonconformity.
D1 - Team creation	In the first phase of the 8D project, the organization creates an 8D team that consists of different kinds of experts from different areas such as quality, customer service, manufacturing department in the organization, etc.
D2 – Problem definition	In the second phase of the project, the 8D team creates a definition of the problem that occurred in the organization. Problem definition is related to the creating problem statement that is in accordance with the nonconformity that the customer reported. The problem must be described as accurately as possible.

¹⁵ Gupta, P., & Varkey, P. (2009). Developing a tool for assessing competency in root cause analysis. The Joint Commission Journal on Quality and Patient Safety, str. 36-42.

¹⁶ ISO, E. N. 9001. (2015). Quality management systems. Requirements. Brussels: European Committee for Standardization

¹⁷ Buntak, K., Kovačić, M., & Sesar, V. (2019). The importance of identifying opportunities and risks in ensuring business continuity. 4th International Scientific Conference on Economic and Social Development "Sustainable Tourist Destinations".

¹⁸ Dănescu, T., Prozan, M., & Dănescu, A. C. (2014). Non-conformity risks—theoretical and practical connotations. Procedia Economics and Finance, str. 993-1001.

¹⁹ Biban, L. K., & Dhouchak, D. (2017). 8D Methodology and Its Application. JETIR.

D3 – Actions for limitation of damage	The main goal of actions for limitation of damage is preventing further spreading of the problem to all other interested parties. Some of the examples of such actions is a product recall. Defined actions are in accordance with identified risk and identified risk should be a review after actions for damage prevention are done. Furthermore, it is necessary to establish communication with all interested parties and to communicate all defining measures that are aimed at decreasing damage.
D4 – Root cause analysis	In the fourth step in 8D, the team must analyze the root cause to identify possible causes of the problem. For root cause analysis the organization team can use different kinds of tools such as Pareto diagram, Ishikawa diagram, brainstorming, etc.
D5 – Validation of measures	In this phase, after the organization team recognizes root cause, corrective actions are defined. Before measures are implemented in the process it is necessary to validate such measures to ensure their efficiency and effectiveness.
D6 – Implementing measures	The sixth phase is related to the implementation of measures that are defined in the fifth phase. It should be highlighted that all implemented measures should be aimed at updating all procedures that are used in the process and also to educate all employees that are involved in the process. This approach will as the result have a decreasing risk of repetition of the problem in the future.
D7 – defining preventive actions	After corrective actions are deployed, the organization must create preventive actions to prevent future occurrences of similar problems in the process. All defined measures must be reviewed through the aspect of their effectiveness and efficiency.
D8 – Closing project	The last phase is related to the closing of the project and to rewarding all project members.

Source: Author

All steps that are described in Table 1 must be conducted with in accordance with step 1 to step 8. The organization team is not allowed to skip one of the steps because skipping will as the result have a partial solution to the problem. Furthermore, the organizational 8D team must document all steps and results of the step and in the last create an 8D report. It should be highlighted that 8D is a team approach to problem-solving and the organization must create and obtain synergy in the team as well as ensure management support.

ISO 9001:2015 norm on the organization puts a different kind of the requirements that are described in the third chapter. In accordance with that, the 8D method is one of the ways of problem-solving that is in accordance with described requirements. Furthermore, Table 2 is shown a comparison between requirements that ISO 9001:2015 puts on the quality management system of the organization and nonconformity management.

8D phase	ISO 9001:2015 point in which requirement is described	Short description
D0 – planning	8.2.1	In D0 phase of the 8D method problem solving in which organization collection all information related to the problem that customer report. This step is in accordance with point 8.2.1. of the ISO 9001:2015. Furthermore, in the mentioned point, ISO 9001:2015 on quality management system puts requirement that is related to the managing product that customer report as non-complained with the requirement as well as the places in which such product must be stored.

D1 – Team creation	7.2.	The team that the organization creates and will be in charge of problem-solving with the 8D method must have different competences and knowledge from different areas. Requirements that are related to the competence of the team and employees are described in point 7.2. Furthermore, the competence of the team and organization as a whole is one of the principles of the quality managed organization.
D2 – problem description	8.7.2, 7.4.,	In this step problem is precisely described which are the requirements that norm ISO 9001:2015 puts on the quality management system in point 8.7.2. The exact problem description is a precondition for a system approach to problem-solving as well as the nonconformity solving. Precise problem description often means good communication with the customers so customers can describe what is exactly wrong with the product or service. Furthermore, the organization must communicate problems with other interested parties with different media channels. This is a requirement that norm ISO 9001:2015 is describing in point 7.4.
D3 – actions for limitation of damage	10.1, 10.2.1	In this step are conducted risk assessment as well as the defining measures that will be aimed at decreasing damage to the problem that is occurred. ISO 9001:2015 norm in point 10.2.1. describes the requirement that is related to conducting all measures that are important for damage limitation. In point 10.1. ISO 9001:2015 norm defines requirement related to the correcting, preventing, and decreasing of unwanted repercussions of the problem. So, D3 is in accordance with the described requirement.
D4 – root cause analysis	10.1, 10.2.1	In this step, the organization is providing root cause analysis. Requirements that norm puts on the organizational quality management system are described in point 10.1. of ISO 9001:2015 norm in which is described that the organization must analyze the root cause of the problem as well as all unwanted repercussions. Furthermore, in point 10.2.1. are described requirements that are related to the measures for supervision of conducted steps for analyses of the problem.
D5 – validation of the measures	10.2.1,	ISO 9001:2015 norm in point 10.2.1. on the quality management system of the organization puts requirement related to the evaluating of all measures that are created for problem-solving i.e. corrective actions.

D6 – implementing measures	9.1.1, 9.1.3, 10.2.2.	In this step, the organization is implementing steps that are created in D5. This is related to creating control points in the process that will be used for the monitoring of the efficiency and effectiveness of the implemented measures. Furthermore, in point 9.1.3. ISO 9001:2015 norm on the organizational quality management system puts requirements related to the imperative of identification are defined measures good i.e. does measures as the result have improvements. In point 10.2.2. ISO 9001:2015 norm puts requirements related to the monitoring of the conducted corrective measures. So, D6 is in the accordance whit requirements of the ISO 9001:2015.
D7 – defining preventive measures	10.1,	Quality management system based on the ISO 9001:2015 norm is based on the risk approach which means that organization must provide risk assessment and to create and conduct all measures that are appropriated and in correlation whit the risk level. ISO 9001:2015 norm in point 10.1. on organization puts requirements related to the improvement's so in the future, there is significantly lower risk and the possibility of occurrence of the problem. So, an organization in D7 create preventive measures based on the risks and risk evaluation and created measures are related to the decreasing possibility of occurrence of new problems.

Source: Author

It should be highlighted that D8 of the 8D discipline is not described in Table 2 because motivation and human potential management policies are defined by every organization itself. So, ISO 9001:2015 is not explicitly defining requirements related to the rewarding of the employees.

5. CONCLUSION

This paper is based on secondary research and within it is conducted a comparative analysis between requirements that ISO 9001:2015 puts on the quality management system in the organization and phases i.e. 8D disciplines. In research, authors find accordance with 8D whit requirements of ISO 9001:2015 norm in points that are aimed at requirements for nonconformity management. Nonconformity management is one of the main requirements that ISO 9001:2015 highlights and it is especially important for obtaining relations whit costumers and obtain the reputation that organizations have on the market. Furthermore, 8D is one method that an organization can use for the non-compliance management and for analyzing root cause that as the result have lower satisfaction of the customer.

Managing nonconformities is important because nonconformity products as the result may have to decrease in the satisfaction of the costumers and also the possibility of endangering their quality of life and life as such. Furthermore, nonconformity is the possibility to improve product or service and also to make products or services better. Through secondary research, authors find that man papers are describing methods for nonconformity management and for root cause analysis but there is a lack of papers that highlight possibilities of using the 8D method for nonconformity management and solving costumer's problem. Also, many papers are describing individual tools.

Usage of individual tools for root cause analysis could lead to partial solutions and partial solutions mean the possibility of a new occurrence of the nonconformity in the process.

So, all organizations that have a quality management system that is certificated whit ISO 9001:2015 norm are advised to use the 8D method as the scientifically and systematic approach for nonconformity management. Usage of 8D is in accordance with whit requirements that ISO 9001:2015 norm puts on the quality management system and also summarizes that requirements in a methodological and logical approach.

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**QUALITY SYSTEM CONDITION FOR
SUCCESSFUL BUSINESS AND COMPETITIVENESS**

CONCEPTUAL MODEL OF QUALITY FLEET MANAGEMENT

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Rezime: *Kvalitetno upravljanje voznim parkom podrazumijeva osiguranje sljedivosti s načelima kvalitetnog*

Abstract: *Quality fleet management implies ensuring traceability with the principles of quality management and designing a fleet management system. Organization should define quality fleet management and vehicle procurement based on analysis of stakeholder requirements and analysis of organization needs, because vehicle fleet can be a source of competitive advantage or competitive weakness. Furthermore, quality fleet management should also based on the analysis of current performance. This paper presents a conceptual model of fleet management based on the principles and characteristics of quality management.*

Keywords: *fleet management, principles of quality management, conceptual model, quality management;;*

JEL Classification: *R40*

1. INTRODUCTION

The vehicle fleet of the organization consists of vehicles of different operational properties. The organization's fleet can be a component of the support process as the organization can use the fleet as a mechanism in the process to carry out the transformation. If the maintenance of the vehicle is insufficient, reliability of the vehicles can be decreased, which can result in higher costs due to poor quality.

The imperative of sustainability and growth should be replacing vehicles that use fossil fuels with electric vehicles, i.e. vehicles that use alternative energy sources. This is based on ~~for movement,~~ ~~emphasizes~~ the analysis of the cost-effectiveness of substituting fossil fuel vehicles with vehicles that use alternative energy sources.⁴ Besides cost-effectiveness, the use of ~~such~~ electric vehicles brings more benefits in long terms, such as reducing the negative impact on the environment or reducing the need for energy.

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However, regardless of what kind of vehicles are included in the organization's fleet, the organization should systematically approach their management, i.e. manage the fleet based on the principles of quality management contained in the ISO 9001: 2015 standard.⁵ In other words, this approach based on the PDCA (Plan-do-check-act) cycle can result in continuous improvement of the fleet management cycle.

Paper indicates the importance of a systematic approach to fleet management that is based on the principles of quality management of the organization. The paper is based on the conducted secondary research as well as on the development of a conceptual model of fleet management that will be in accordance with the PDCA and the principles defined by the ISO 9001: 2015 standard.

2. QUALITY MANAGEMENT

The ISO 9001: 2015 standard considers seven basic management principles of quality management of an organization: customer focus, leadership, people involvement, process approach, improvement, evidence-based decision making, and relationship management.⁶ In addition to the principles defined by the ISO 9001: 2015 standard, quality management of the organization implies characteristics of a well-managed organization: documentation, manageability and competence.

In other words, quality management of the organization involves primarily the analysis of the current state of the organization using different tools and methods, which depends on the segment of the organization, or organizational environment that is being analyzed. After gathering evidence, i.e. facts about the current situation in the organization, the evaluation of the identified situation can create a basis for management to make decisions about possible changes, or choices. Decisions can be further analyzed using scenario analysis, which will result in the ability to select the decision that will be optimal.

Furthermore, the organization can collect suggestions for improvements from employees that are directly connected to the specific situation, which may lead to identifying places for improvement. Besides that, the principle of relationship management refers to the analysis of stakeholder requirements as well as the care of the relationship between suppliers, customers and all other stakeholders.⁷ In other words, it also means customer focus, because the organization adjusts its business and activities based on customer requirements analysis.

When it comes to the link between quality management and the characteristics of a quality-managed organization, ISO 9001:2015 standard requires some specific documentation. Those are the terms of proving that the organization has carried out activities aimed at for ensuring traceability with the requirements defined by the standard. Documentation itself is a proof that management manages organizational processes as well as the entire organization as defined through quality management system standard. On the other hand, competence is also related to quality management since the ISO 9001: 2015 standard itself requires the organization to ensure competent employees as well as the competence of the entire organizational system. Competence can refer to four levels of competence: technical competence, technological competence, structural competence and human resource competence, which in synergy also mean quality management of the organization.⁸

3. FLEET MANAGEMENT

Fleet management involves a series of activities aimed to the correctness of vehicles, scheduling vehicles according to the needs of the organization, etc. Fleet management, in addition to containing

⁵ ISO 9001:2015 quality management system – requirements.

⁶ Ibid.

⁷ Chattergoon, S., Darling, S., Devitt, R., & Klassen, W. (2014, April). Creating and sustaining value: Building a culture of continuous improvement. In *Healthcare management forum* (Vol. 27, No. 1, pp. 5-9). Sage CA: Los Angeles, CA: SAGE Publications.

⁸ Buntak, K., Adelsberger, Z., & Adelsberger, D. (2011). Kompetentnost-ključna karakteristika organizacije upravljane na načelima kvalitete. *Kvalitet*, 7-8.

a technical aspect related to the correctness of the fleet and increasing the reliability of the fleet, also contains the economic aspect, i.e. the managerial aspect.⁹ The managerial aspect is focused on maintenance costs and the point at which the decision is made on the need to purchase new vehicles that will replace existing vehicles in the fleet.

Managerial aspect of fleet management also refers to the use of various tools based on operational research, such as the use of methods to solve the transport problem, or allocation problems. The application of such methods can optimize driving schedule of vehicles on different routes since each route has different costs.

Characteristics of the fleet directly determinate the costs of a fleet management. For example, homogeneous vehicle fleet has significantly lower costs compared to a non-homogeneous vehicle fleet. Homogeneous vehicle fleet consists of vehicles that have same characteristics, while non-homogeneous vehicle fleet consists of vehicles that are significantly different. Differences in vehicles can result in high spare parts ordering costs as well as high maintenance costs. Furthermore, the different operating characteristics that are characteristic of a non-homogeneous vehicle fleet imply different load capacity, i.e. different fuel consumption, which can significantly affect the total cost of fleet management.¹⁰

3.1. Fleet efficiency indicators

The organization itself can define its fleet efficiency indicators that will be used to analyze the effectiveness of fleet management. However, basic indicators are shown in Table 1.

Table 1: Fleet management performance indicators

Indicator	Expression	Description
Repair costs	$\frac{\text{repair costs}}{\text{total fleet costs}} \times 100 \%$	This indicator is used to analyze the share of repair costs in total fleet management costs.
Fuel costs	$\frac{\text{fuel costs}}{\text{total fleet costs}} \times 100 \%$	Indicates the total share of costs the organization incurs for fuel
Number of empty runs	$\frac{\text{Number of empty runs}}{\text{total number of rides per year}} \times 100 \%$	Indicates the proportion of empty runs that vehicles in the fleet have per a year.
Revenue per unit of fleet	$\frac{\text{total driving income}}{\text{Number of vehicles in the fleet}}$	Indicates the total income that the organization generates, given the number of vehicles in the fleet.
Number of failures per unit	$\frac{\text{number of unit failures}}{\text{total number of failures}} \times 100 \%$	Indicates the number of failures that the fleet unit has in the total number of failures.

Source: The table is the work of the author

⁹ Monnerat, F., Dias, J., & Alves, M. J. (2019). Fleet management: A vehicle and driver assignment model. *European Journal of Operational Research*, 278(1), 64-75.

¹⁰ Moutaoukil, A., Neubert, G., & Derrouiche, R. (2014, September). A comparison of homogeneous and heterogeneous vehicle fleet size in green vehicle routing problem. In *IFIP International Conference on Advances in Production Management Systems* (pp. 450-457). Springer, Berlin, Heidelberg.

The indicators described in Table 1 can serve as a base for making decisions related to improvement of fleet management. If an indicator, such as the cost of repairs, indicates the high costs that the fleet has per unit of the vehicle, or if the total costs of a fleet management is very high, the need to invest in new vehicles can be identified to increase their reliability. Furthermore, the fuel cost indicator may indicate the use of vehicles for private purposes if the fuel cost exceeds the planned values as well as may indicate insufficient optimization of vehicle movement routes as different movement routes have different costs.

In terms of the number of empty runs, each empty run for the organization can mean an insufficiently well-optimized transport process, which can mean the occurrence of high costs due to the empty runs that vehicles have. Revenue per unit of fleet refers to the revenue that the organization has. The lower the revenue per unit of the vehicle, the more it may indicate the need to reduce the number of vehicles in the fleet as the organization has more capacity than required. The last indicator that an organization can use, that is listed in Table 1, is the number of failures per unit of a vehicle. The higher the number of failures, the greater the need to invest in the modernization of the vehicle fleet. This may indicate that organizational management does not manage preventive maintenance of the vehicle fleet well enough, which results in increased fleet management costs due to the number of failures. There are two ways to observe the number of failures. For example, there is a possibility to compare a cumulative number of failures for this year with a cumulative number of failures of the previous year, or to compare cumulatively number of failures of one unit of vehicle fleet in relation to the number of failures in the current year.

3.2. Fleet characteristics

Most important characteristics of the fleet are:

- Reliability: reliability implies the property of a system to satisfy its fundamental function at a given time in defined modes of operation.¹¹
- Efficiency: it can refer to the total utilization of an individual unit of the vehicle fleet, i.e. and it can also refer to the utilization of all vehicles in the vehicle fleet.¹²
- Cost-effectiveness: can refer to the costs that the organization faces, which are related to fleet management as well as the revenues that the organization generates.¹³
- Competence: the competence of the vehicle fleet refers to the ability of the organization to meet the requirements of stakeholders, i.e. the requirements that it has in terms of transport and the possibility of using vehicles in the fleet to perform activities.

Fleet characteristics are related to indicators for fleet management performance analysis as characteristics, such as reliability, directly correlate the individual indicator defined in Table 1. Furthermore, when talking about fleet competence, it is necessary to determine the capacity of vehicles in the fleet to meet the requirements of stakeholders as well as capability and knowledge of the employees which to drive and use vehicles.

4. CONCEPTUAL MODEL OF FLEET MANAGEMENT

The vehicle fleet can be the foundation for creating a competitive advantage, for an organization, but it can also be a factor that will distort the competitiveness of the organization. To avoid this, it is necessary to develop a conceptual model that will enable organizations to manage fleet quality in a way that vehicles in the fleet are reliable. In this way, vehicles will always be available with a high factor of security of transport service. The safety factor of fulfilling the transport service refers to the probability that the vehicle in the fleet will be in order and be able to fulfil the assigned task.

¹¹ Fosgerau, M., & Karlström, A. (2010). The value of reliability. *Transportation Research Part B: Methodological*, 44(1), 38-49.

¹² Vujanović, D., Mijailović, R., Momčilović, V., & Papić, V. (2010). Energy efficiency as a criterion in the vehicle fleet management process. *Thermal Science*, 14(4), 865-878.

¹³ Shukri, F. A. A., Jusoh, R. M., Ramlan, A., & Anuar, M. S. M. (2002). *An Overview of Fleet Maintenance and Operating Cost: Key Components and Methods*.

The need to develop a model of quality fleet management is based on the fact that the fleet should be in the service of meeting the requirements of stakeholders together with the organization, since it be a mechanism within the organization. This is especially important for logistics and transport organizations.

The conceptual model of fleet management is shown in Figure 1. First step of the model is to analyze the current needs of the organization. This implies an analysis of the requirements that stakeholders have, as well as the needs of the organization that can be determined by the requirements of stakeholders or the core business of the organization. Based on the identified requirements, the organization can plan the shape and appearance of the vehicles needed to meet the requirements of the stakeholders. This can also mean selecting the vehicle according the terrain on which the vehicle will operate, selecting the vehicle capacity, vehicle brand, energy source for starting the vehicle, etc. The first step is also in accordance with the first phase of the PDCA cycle, so called *planning*.

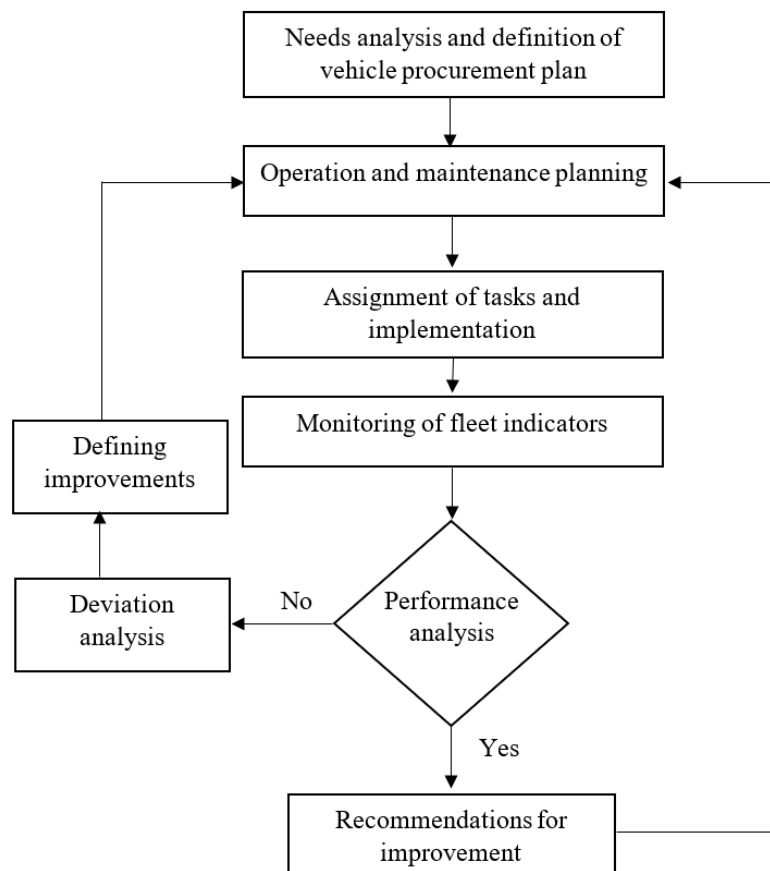


Figure 1: Conceptual model of quality fleet management
Source: Autor

After analyzing the needs of the organization for vehicles, their procurement and after maintenance and operation plan is defined, vehicles are assigned to duties in the fleet. The maintenance plan is of very important because as insufficient maintenance of the vehicle fleet can result in higher costs. Also, the goal of maintenance is to reduce the possibility of the vehicle breaking down when performing a defined task, because a malfunction on a vehicle located outside of the organization base may mean generating new costs related to towing vehicle to the base.

The step of planning the operation and maintenance includes the allocation of vehicles to employees in the organization who will oversee both the use of the vehicle and its daily maintenance. Employees should be as competent to use the vehicle and educated about the procedures if they recognize a potential risk of the cargo on the environment.

In accordance with the defined plan, the assignment of tasks should be in accordance with the needs of both the organization and the identified requirements of stakeholders. When assigning tasks and performing the transport function itself, it is necessary to focus on the indicators of vehicle use in the vehicle fleet, and the use itself should be designed so that the vehicle fleet is optimally used.

In the next phase, of the model is the analysis of fleet management efficiency based on the analysis of indicators. In addition to the indicators proposed in Table 1, the organization can define the indicators that are in accordance with the needs of the organization and with the properties of the fleet itself and the vehicles in the fleet. If analysis shows a deviation from the planned values, it is necessary to conduct an analysis to identify the reason of deviation and required measures that will annul the deviation. This may include improvement of the route planning in transport, more frequent preventive vehicle inspections, etc.

However, even though the vehicle in the fleet fulfils the defined task, an analysis of the effectiveness of fleet management is ~~definitely~~ recommended in order to identify points as well as indicators that can be improved.

The model shown in Figure 1 is in accordance with the PDCA principle and the requirements that the ISO 9001: 2015 standard imposes on the organization from the aspect of quality organization management. It means that the standard defines the importance of ensuring competence, the need to analyze the requirements of stakeholders and shape the organization's business in accordance with the requirements and the analysis of performance management. Based on the results it is possible to create an improvement for next process cycle.

The organization should be obligated to document everything related to the vehicle fleet and create all the records needed to prove compliance with the requirements defined by the standard.

When it comes to the sustainability and feasibility of using electric vehicles, based on the first step of analysis of the model shown in Figure 1, organization identifies, whether the requirements can be met by electric vehicles, because they have certain limitations, such as carrying capacity and autonomy.

In conclusion, if based on the monitoring of fleet performance is recognized that maintenance costs, as well as fleet efficiency in general, are such that it does not meet organizational needs, i.e. that the fleet is no longer competent, the organization restarts the analysis of stakeholder requirements. It also initiates the procurement of vehicles so that the vehicles in the fleet can meet the identified requirements.

5. CONCLUSION

This paper presents a conceptual model of fleet management according to the principles of continuous improvement, i.e. the principles of quality management. The conceptual model incorporates the requirements that the ISO 9001: 2015 standard set for organizational system of quality management, such as ensuring competence, documentation, continuous improvement and analysis of stakeholder requirements.

The model shows principles of planning organization's fleet. While planning it, organization should consider the needs of stakeholders that defines characteristics of vehicles that are part of the fleet. Emphasis should be on defining indicators like those shown in Table 1 and possibility of constant application of the model shown in Figure 1. It is also recommended that organizations have proactive approach to vehicle maintenance, to ensure their optimal level of reliability and the ability to meet the requirements that stakeholders and organizations set.

This paper shows theoretical approach in defining the model, but the model has not been tested in practice. Therefore, future researchers in this field are recommended to test and upgrade this model in accordance with the results of the test.

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**QUALITY SYSTEM CONDITION FOR
SUCCESSFUL BUSINESS AND COMPETITIVENESS**

METHODOLOGICAL APPROACH ENSURING BUSINESS CONTINUITY BASED ON INFORMATIONAL RISK ASSESSMENT

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Abstract: With increasing turbulency in the organizational environment, there is an increasing challenge related to creating and ensuring business continuity of the organization. One of the especially important areas that determine business continuity is information security. Information security is particularly endangered because of the digitalization of the business system and digital transformation. One of the risks that are related to the digital transformation and translation of the business to the digital sphere is the threat of access to information from third parties that may misuse such information. Accordingly, there is a need for creating a conceptual model for ensuring the security of the information in the organization as well as the way of creating businesses continuity plans

Keywords: business continuity, risk approach, corporate safety, information safety;

JEL Klasifikacija: L21

1. INTRODUCTION

With the development of Industry 4.0 there is a need for all organizations to conduct digital transformation. Digital transformation for the organization means the possibility of increasing efficiency and effectiveness but on the other hand, there is also a challenge that is related to the managing of new risks that are arising through the usage of new technology. One of the most pronounced risks is an informational risk that is related to the leaking of information to the public or risk that third parties can access organizational information. With arising risk of information security as well as the endangering organizational information there is also a risk of endangering

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organizational corporate safety.⁴ Information risk is endangering corporate safety because corporate safety is made from different kinds of fields and one of the fields is an information security and risk management. So, when endangering information security there is also an increased risk of endangering corporate safety which can lead to the decreasing possibility of the organization to continue doing business. In other words, corporate safety determines the business continuity of the organization because the information that are stored in the organization are important for normal functioning of the organization.⁵ Furthermore, digitalization also means translation specific information that is stored in physical documents in the organization to the cloud and virtual sphere. Virtualization and digitalization of the information create a new risk that is related to the possibility of leaking such information to the public. There is also a risk of cyber-attacks that will as the result have stolen information or publishing some of the information to the public. To decrease such risks, an organization must create and conduct a risk assessment. Furthermore, after risk assessment, the organization must create plans for ensuring business continuity as well as the plan for increasing corporate safety. Every risk that an organization identifies must be analyzed and for every risk, an organization must create measures for decreasing identified risk. This approach results in increasing corporate safety. There is also a risk that business secrets that organizations have and it is related to the business models can leak to the public and also endanger business continuity.⁶ When increasing the importance of the information that is stored in the organization, as well as the increasing of the vulnerability of the information that is the risk of disruption of business continuity higher. Because of that, the organization must conduct risk assessment with different kinds of methods and tools that are described in different kinds of norms such as ISO EN 30001:2018 and ISO/IEC 31010:20019. Furthermore, there is also a need for the creation of the concept that will help the organization in creating plans based on conducted risk assessment.

The main aim of this paper is to create a methodological approach that will become one of the steps in creating business continuity plans. Furthermore, the aim of this paper is also to show importance of the information security and its relations to the business continuity and competitive advantage of the organization.

2. RISK AND IMPACT OF RISK ON THE BUSINESS

Risk as such can be defined as the impact of the insecurity on the goals. In other words, the development of risk can impact the achieving of defined goals in the organizational plans.⁷ Impossibility of the organization of achievement its own goals can result in a decrease in the effectiveness and efficiency of the organization because efficiency is related to the resources that an organization must invest in the process of achieving goals. So, decreasing inefficiency is leading to a decreasing in effectiveness because organizations do not achieve planned goals related to the using of resources. The impact of the risk to the organization is determined with the type of risk.

Risk can be divided into:

- Financial risk: financial risks are related to the uncertainty of financing as well as the changes in financial markets that can significantly impact the ability of the organization to achieve goals. Some of the examples of the financial risks are changes in the interest rates, changes in the availability of financial resources, etc.

⁴ Wijnia, Y., & Nikolic, I. (2007). Assessing business continuity risks in IT. *IEEE International Conference on Systems, Man and Cybernetics*, str. 3547-3553.

⁵ Cioc, M., & Ursacescu, M. (2012). Information systems' risk management—an empirical research in romanian companies. *AMIS*.

⁶ Vlachos, T. (2018). Certifiable Risk Management & Business Continuity approach in mining industry. *World Congress on Mechanical, Chemical, and Material Engineering*.

⁷ Renault, B. Y., Agumba, J. N., & Ansary, N. (2016). A theoretical review of risk identification: perspective of construction industry. *ARCA*, str. 773-782.

- Infrastructure risks: infrastructure risk is related to all events that can impact infrastructure such as the disruption in the telecommunication infrastructure, natural disasters that can impact infrastructure and possibility of using infrastructure for organization needs,
- Market risks: market risks are related to the market trends and developments on the market such as economic crisis, competition moves that can result in developing crisis in the organization or decreasing demand for the goods and services,
- Reputation risk: that is related to the corporate social responsibility, perception of the buyers that are building based on the decision of the management.⁸

Risks have a fundamental property that is related to the impossibility of their prediction. In other words, the uncertainty of risk is related to the impossibility of the organization to assess all risks as well as the possibility to analyze all risks for all sources.⁹ That impossibility in first place sources from large financial resources that the organization must invest in the risk assessment and creating measures for decreasing risk. Furthermore, impossibility is related also to the unpredictability of the organizational environment. Changes in the organizational environment can lead to the development of the new risks than can as the result have to endanger organizational business continuity or competitiveness.

Risks have a high impact on the entire organization as well as all functions and departments in the organization. They can lead to the creating of costs because of the need for remediation of consequences of the development risk. Because of the areas from which risk can be developed such as the management, human resources, market, etc., there is a need and imperative for risk assessment and developing measures for decreasing identified risk to prevent disruption of the business continuity.

It should be highlighted that impact of the risk on the organization is determined through the resistance of the organization. With the increasing resistance that is related to the possibility of an organization dealing with crisis and risk, that is the impact of the risk on the organization smaller. Furthermore, increasing of the organizational resistance is determined through corporate safety because corporate safety encompasses almost all risks and areas from which risk can arise.¹⁰

2.1. Information risks

Information risk may be related to the unauthorized access to the information that is stored in different databases as well as they are documented in the organization. Such databases may be protected in different ways such as protection with usage of firewall that is protecting data from unauthorized access. Furthermore, databases that are used for the storage of the organizational information can be protected with different encryption techniques. Such encryption techniques are used for the coding of information so third parties cannot access or understand encrypted data. When encrypted, information must be decrypted with special software. Such software can be implemented in the computer systems in the organization and only computers that have such software can show information that is encrypted. This kind of encryption is often used in a financial organization to protect customer data and transactions from the costumers.¹¹ Depend on data and its sensitivity depends the encryption technique that is used for encryption. So, there is a significant difference between encryption techniques that are used to protect cells or the entire database. Furthermore, the encryption technique that will be used for the protection of data is determined with programming language that is used for the programming database.

⁸ Živko, I., Marijanović, Z., & Grbavac, J. (2015). Rizici u poslovanju - Upravljanje pristupom financija i računovodstva. *Zbornik radova Ekonomskog fakulteta Sveučilišta u Mostaru, No. Posebno izdanje 2015*, str. 401-412.

⁹ Toma, S. V., Chiriță, M., & Șarpe, D. (2012). Risk and uncertainty. *Procedia Economics and Finance*, str. 975-980.

¹⁰ Vogus, T. J., & Sutcliffe, K. M. (2007). Organizational resilience: towards a theory and research agenda. *IEEE International Conference on Systems, Man and Cybernetics*, str. 3418-3422.

¹¹ Sesay, S., Yang, Z., Chen, J., & Xu, D. (2005). A secure database encryption scheme. *Second IEEE Consumer Communications and Networking Conference*, str. 49-53.

Except for unauthorized usage of data stored in the database, there is also a list of different kinds of risks that are related to the information that is documented in offices in the organization. Employees that do not have authorization for access such information can through insight in the document and its content endanger business secret and all other information that are related to the organization and way of doing business. Besides, one of the most significant risks is cyber-attacks that can be performed by third parties. Cyber-attacks can endanger information that organizations have and can endanger the business continuity of the organization. Such information may be related to the data of employees, data of customer, etc.¹² It should be highlighted that there is also a possibility for the organization employees, because they may be malicious, to seek for the protected data and to forward such data to the third parties and what that endanger organization business continuity.

2. BUSINESS CONTINUITY MANAGEMENT

Business continuity management is a process of development plans and defining measures that will be aimed at creating a strategy for continuing of doing business after incidents occur and to ensure the safety of the organization.¹³ In other words, business continuity management is based on prevention and its aimed at the timely identification of risks to avoid interruption of the business continuity.

Business continuity management consists of activities such as risk management, crisis management, and all other activities that can disrupt business continuity. Furthermore, business continuity management is based on different kinds of plans:

- Recovery plan: in recovery plan organization is defining and allocating all resources that are needed for recovering business after occurring an incident or other unwanted event. In other words, the recovery plan may within it consist of procedures that will be activated after an incident occurs, and is aimed at the communication with different stakeholders, etc.,
- Response to an incident plan: this kind of plan consists of procedures that must be activated to decrease the impact of the incident on the organization activities. So, this plan consists of different kinds of standard operating procedures that are activated after the incident has occurred in the organization.¹⁴

The core business of the organization determine recovery plan and also a business continuity plan. Organizations like healthcare organizations that are especially important for normal functioning of the society must have developed plans that will ensure business continuity management because interruptions in the activities of such organizations can as result have the decreasing quality of life of all society as well as the occurring different kind of new diseases.

When it comes to the business continuity management and recovery plans, it should be highlighted that the recovery plan as well as the business continuity plan must be implemented in the organizational processes through procedures. What procedures can be defined what activities will be activated if there is a threat of interruption of the business. Furthermore, when it comes to business continuity management, it should be highlighted that there is also a need for implementing measures for ensuring the safety of the information. Within defined procedures, organizations must define measures that will take place if there is a risk of endangering organizational information.

¹² Sek Seong Lim, M. (2017). Business Continuity Management and Cybersecurity. *The Cyber Risk Handbook: Creating and Measuring Effective Cybersecurity Capabilities*, str. 185-192.

¹³ Costello, T. (2012). Business continuity: Beyond disaster recovery. *IT Professional*, str. 64-64.

¹⁴ Herbane, B., Elliott, D., & Swartz, E. M. (2004). Business continuity management: time for a strategic role? *Long Range Planning*, str. 435-457.

3. CORPORATIVE SAFETY

Corporative safety is related to the care of the different areas within the organization as well as the performing different kind of activities that are aimed at increasing safety in the organization.¹⁵ In other words, corporative safety within it consists of different kind of activities such as:

- Fire protection: that is related to the planning of measures related to the fire extinguishing as well as the ensuring normal functioning of the equipment that is used for the fire extinguishing,
- Protection of property and people: that is related to the protection of people that are working in the organization as well as the technical protection such as installing a different kind of security cameras to protect the property of the organization,
- Safety at work: that is aimed at protection and prevention of injury that employees can suffer when they performing their activities. Furthermore, implies also to the education of all employees for performing activities on safety way,
- Data protection: is related to the analyzing of risk related to the possibility of leaking information from the organization and unauthorized access of third parties to the organization information,
- Business intelligence: is related to the intelligence work related to the market and environment in which organizations exist. Furthermore, business intelligence is related to the analysis of data as well as all information that can be used by the organizational competition in the market and also protect the usage of information by the employees that are not authorized for it.

Within corporative safety, information security has a special role because information has an important role in the normal functioning of the organization. Information safety is related to the all information and data that are stored in the organization and that are related to the organizational employees, business results, plans of the organization, risks that may treat organization, information about suppliers, etc. Furthermore, one of the most important areas of corporate security is intellectual property. Intellectual property is related to the new patents and innovations that are developed by organizational employees and such innovations may become one of the competitive advantages of the organization.

3.1. Informational security

When it comes to the information security it should be highlighted that informational security is in the Republic of Croatia determined whit legislative such as:

- Law of protection of personal data,
- Law of informational security,
- Law of security of data,
- Law of the electronic document,
- Law on the Security and Intelligence System of the Republic of Croatia

All mentioned lows are base for the normal functioning of the system of protection of information in every system besides if is a business system or all other types of the system. Furthermore, besides Laws, an organization can implement norms such as ISO EN 27001:2018 norm that shapes the information security management system.

Furthermore, informational security in an organization is related to the protection of all information that is related to the organizational employees, patents, innovations, dana related to the suppliers

¹⁵ Huang, Y. H., Chen, P. Y., Krauss, A. D., & Rogers, D. A. (2004). Quality of the execution of corporate safety policies and employee safety outcomes: assessing the moderating role of supervisor safety support and the mediating role of employee safety control. *Journal of Business and Psychology*, str. 483-506.

and buyers, etc. It should be highlighted that informational security is determined through different kinds of elements of corporative security such as business intelligence, technical protection, etc.¹⁶

4. METHODOLOGICAL APPROACH ENSURING BUSINESS CONTINUITY BASED ON INFORMATIONAL RISK ASSESSMENT

Since organization exists in the environment that is turbulent, fast changes in the environment as a result have new risks. New risks in a significant way can endanger business continuity of the organization as well as corporative safety if the organization on time does not identify risks and create measures for risk decreasing and decreasing consequence of the risk. In other words, risks can endanger the continuity of the organization that can be determined with corporative safety. Furthermore, one of the most important components that can determine the business continuity of the organization is information safety. The information system of the organization meets different kinds of risks and challenges because of digital transformation and virtualization of the data. With digitalization of the data, data can be easily accessed through Internet so third parties that can be malicious can access and stole data stored in the databases. Furthermore, there is also the risk of cyber-attacks that can be also aimed at the misuse of the information. Accordingly, it is necessary to identify all risks that could endanger information that is stored in the databases in the organization as well as all documents that are stored in offices in the organization that could be endangered by unauthorized views.

One of the ways for dealing with risks and ensuring business continuity is implementing the business continuity management system and to certificate it with norm ISO EN 22301:2019 as well as the implement risk management system that is shaped through ISO EN 31000:2018. It should be highlighted that implementing such a system is only a base for ensuring business continuity of the organization and organizations must ensure also different kinds of activities that will support such systems i.e. provide risk assessments, etc.

All changes in the market must be accompanied by a with new risk assessment. In other words, risk management is a continuous process that is made in different iterations. The time within which the organization will repeat risk assessment related to the new condition in the market depends on the type of business that takes place in the organization as well as on the decision of management. Furthermore, how the organization will deal with risk depends on the risk policy and policy of ensuring business continuity that is created by the management of the organization.¹⁷ Accordingly, Figure 1 shown steps when an organization is creating plans for ensuring business continuity. As shown in Figure 1, the first step is risk analysis. Organizations must analyze all risks that can appear from organizational environments such as the internal environment and general environment. In other words, organizations analyze risk through the frequency of risk, high impact, and high consequences. Organizations should analyze such risk with methods such as FMEA that is an acronym for Failure Mode and Effects Analysis. FMEA method is based on the analysis of the area from which risk can appear. After defining area, all risks that can appear are identified and for each risk is analyzed the impact of the risk, consequences of the risk as well as the frequency of the risk. This is based on the creating measures and procedures that will be activated if an incident occurs. Furthermore, if information safety is considered, an organization must analyze all risks that can endanger the safety of the information. Also, the organization can perform penetration tests related to the possibility of third parties to penetrate databases and to steal information from it.

Except for penetration tests of databases, it is necessary to analyze the possibility that third parties could access information that is stored in offices in the organization. Such information can be stored

¹⁶ Mishra, S., & Chasalow, L. (2011). Information security effectiveness: A research framework. *Issues in Information Systems*, str. 246-255.

¹⁷ Aven, T. (2016). Risk assessment and risk management: Review of recent advances on their foundation. *European Journal of Operational Research*, str. 1-13.

in offices and different parties could access information and steal it. Furthermore, it is also recommended to test the possibility of eavesdropping as well as usage telecommunication equipment for the personal purpose of the employees. Such behavior can result in the misuse of the equipment and the possibility of leaking information. Furthermore, an organization can test the possibility of the organizational employees to copy files that are stored on their computers and to take that information to the house.

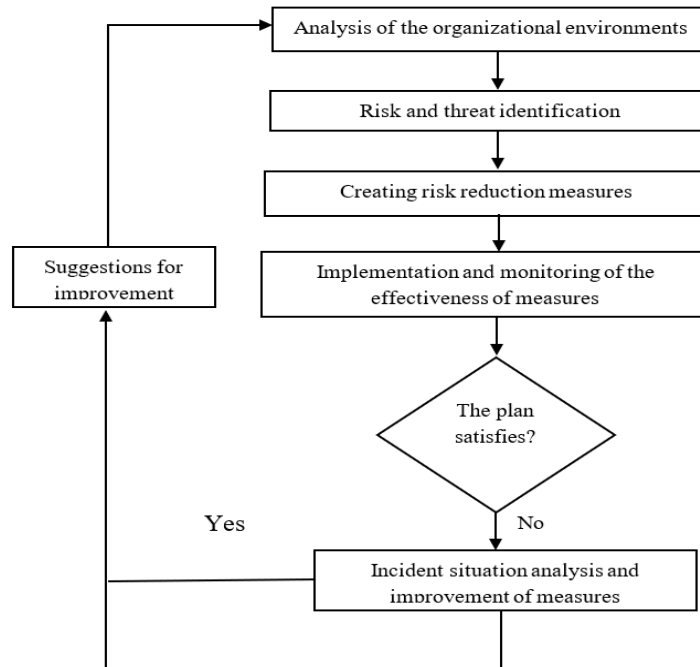


Figure 1. Diagram flow of the creating information security and business continuity plan

Source: Author work

After the organization identifies threats and weaknesses, it should define measures that will be used for risk reduction and decreasing risk of information leaking. Such measures must be implemented in the organizational plan of ensuring business continuity as well as the plan for ensuring corporative safety because of the fact that such a plan consists of different kinds of areas such as informational safety, fire protection, etc. After defining measures, an organization must conduct tests for identifying efficiency and effectiveness of created measures as well as the education of the employees so employees will be in the possibility to answer if in the organization occurs incident.

One of the recommendations when it comes to ensuring business continuity is to implement a process approach and to defined so-called KPI (Key Performance Indicators) that will be used for the tracking indicators of informational safety. KPIs can be implemented in the processes where is a possibility and risk for unauthorized access to the information. These kinds of indicators must be included in the business continuity plans as well as the plans for ensuring corporative safety.

If an incident occurs in the organization that is related to the informational security, it is necessary to analyze the root cause of the incident as well as to conduct all measures that will decrease the consequences of the incidents. Furthermore, the organization must define measures to prevent the occurrence of such risks in the future and such measures must be implemented to the new plans.

5. CONCLUSION

This paper is describing the methodological approach to ensuring business continuity based on ensuring informational safety and risk assessment. It should be highlighted that the development of the informational safety plan as well as the corporative safety plan is part of creating a business continuity strategy. In other words, the organization must repeat analysis for all segments of the business and then integrate them into one plan.

Corporate safety is based on creating a business continuity plan for the organization. For creating such a plan, the organization must conduct a risk assessment as well as provide analysis of all areas that can be affected by whit the risks. Whit the identification of those areas it is necessary to define measures for the decreasing of the risk as well as to conduct the education of the organizational employees.

Through the digitalization of the organization and an increasing number of risks that are arising from changes in organizational environments, the organization must pay special attention to informational security. Informational security is related to all information that is stored within the organization and is related to all types of misuse of the information that can come from organizational employees as well as third parties.

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**QUALITY SYSTEM CONDITION FOR
SUCCESSFUL BUSINESS AND COMPETITIVENESS**

THE IMPORTANCE OF IDENTIFYING AND MANAGING RISK IN ENSURING THE CONTINUITY OF A HEALTH CARE ORGANIZATION

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Abstract: Ensuring the continuity of healthcare organizations is crucial for the normal functioning of today's society. Without health services or health care as a whole, society would be exposed to a high level of risk associated with the occurrence and spread of epidemics. Recent developments in the SARS CoV - 2 epidemics have highlighted a number of shortcomings and failures in the health care system as well as in the overall functioning of the system. In order to prevent similar occurrences in the future, it is necessary to develop a model that will underpin the development of a continuity strategy. However, a continuity strategy cannot be developed without adequate risk analysis. This paper presents a conceptual model of business continuity assurance based on risk identification.

Keywords: risk management, business continuity, healthcare, pandemic;

JEL Classification: I19

1. INTRODUCTION

Rapid and turbulent changes in the environment in which today's society exists can result in crises. Crises may occur with the emergence of new outbreaks, the disappearance of resources for the process, etc. Such crisis conditions require an appropriate risk assessment and defining measures for decrease identified risk. One of the cases that should be mentioned, when it comes to the imperative of improving the risk management and ensuring business continuity in hospital organizations, is the SARS CoV - 2 virus that began to spread in the 2019 year in a high-density urban area. The emergence of the SARS CoV - 2 result in a crisis that has been spread to the surrounding areas, and also globally. The emergence of viruses on healthcare organizations, but also on the entire medical supply chain, places high demands related to ensuring all medical products that will be used in handling patient's with virus. Besides hospitals, this crisis may affect almost all segments of the economy that may result in the risk of ensuring business continuity. Healthcare as such is geared towards considering the quality of life and providing medical assistance in situations like an

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epidemic outbreak. Because of that fact, it is necessary to ensure business continuity of healthcare organizations, otherwise, disruption in business continuity as a consequence may have the emergence of new crises and also in increasing the level of the existing crisis.⁴

Business continuity means creating ways continuing of the health care process and based on pre-defined contingency plans. The contingency plan consists of several plans that relocate organizational resources and also relocate available capacities of the organization to ensure continuity. Furthermore, each organization can define an associated recovery plan that will be used to reorganizing resources so the organization can continue to provide services.⁵ Furthermore, it is necessary to highlight the need to identify risks associated with the organizational process, since the occurrence of the new risks may increase the existing crisis level.⁶ All risks should be documented and for each risk, the organization should define measures related to decreasing the possibility of its occurrence since its complete exclusion requires a large number of financial and other resources. Furthermore, risk management through process approach in practice shown especially good result because of KPI (Key Performance Indicators) that are one of the fundamentals of business processes. KPIs are used for measuring the execution of processes and also for tracking possible risks related to the processes. If a high level of risk is identified in one of KPI, that KPI becomes a critical performance indicator, namely CSF.⁷ To identify and document risk at KPIs in the process, an organization can use several different approaches such as FMEA (Failure Modes and Effect Analysis). FMEA is used for creating a risk map that defines which risk the organization should concentrate on. With the higher probability of risk occurrence it is higher imperative for the organization to concentrate on defining measures to reduce identified risks.⁸ When it comes to risk in healthcare organizations, based on the conducted research, it was identified that an insufficient number of authors spoke about the need of consideration of creating business continuity plan in healthcare organizations which is why the topic of continuity assurance in such organizations is particularly important.⁹ Moreover, thought conducted research authors identified that an insufficient number of papers spoke about the possibility of reducing the risk with Industry 4.0 technologies in healthcare organizations. Besides, the topic of information security in healthcare organizations is of particular importance, since almost all communication technologies use an Internet connection for their normal functionality. The exposure of information related to healthcare users to third parties may not only impair the privacy of the user but also his security and dignity.

Given the lack of conceptual models related to ensuring the continuity of the healthcare process, this paper aims to give an overview of existing insights regarding the business continuity in healthcare organizations. Also, this paper aims to show the importance of the identification of risks and risk management.

2. BUSINESS CONTINUITY

The need for developing a business continuity assurance model for organizations grows with increasing risks arising from organizational environments. The higher risk may also result in a greater possibility of continuity interruption, which may also have challenges associated with the

⁴ Rogers, C. B., & Sathyavagiswaran, L. (2018). Business Continuity Planning for the Medical Examiner. *Multidisciplinary Medico-Legal Death Investigation*, str. 353-364.

⁵ Gibb, F., & Buchanan, S. (2006). A framework for business continuity management. *International journal of information management*, str. 128-141.

⁶ Cagliano, A. C., Grimaldi, S., & Rafele, C. (2011). A systemic methodology for risk management in healthcare sector. *Safety Science*, str. 695-708.

⁷ Poon, P., & Wagner, C. (2001). Critical success factors revisited: success and failure cases of information systems for senior executives. *Decision support systems*, str. 393-418.

⁸ Raz, T., & Michael, E. (2001). Use and benefits of tools for project risk management. *International journal of project management*, str. 9-17.

⁹ Aven, T. (2016). Risk assessment and risk management: Review of recent advances on their foundation. *European Journal of Operational Research*, str. 1-13.

normal functioning of social and other processes.¹⁰ Risk, as such, can be defined as a lack of knowledge about a particular phenomenon.¹¹ Lack of knowledge can result in decisions that may result in unacceptable events, such as a crisis. Besides, a lack of knowledge about an unusual event in the context of healthcare may also mean a dilemma about the measures that need to be taken to reduce an unusual event. In other words, if a healthcare organization has little information or knowledge about a particular virus outbreak, it cannot define the steps for preventing the virus from further spreading. This can also have a detrimental effect on society as a whole, and in particular on certain economic sectors such as tourism, since one of the first measures taken in the event of a pandemic is tighter travel control. Business continuity can be defined as the ability of an organization to continue its business after a particular risk has occurred.¹²

Impairment of organizational subsystem functionality may result in impairment of the functionality of the entire organization as a system since the organization as such should be viewed through the context of system theory. System theory emphasizes that all components in the system are interconnected and that changes in one of the components effect changes in all other components and even cancellation of their function.¹³ In regard, health care organizations should pay particular attention to ensuring business continuity, since their role in society is of particular importance and has the primary task of reducing the spread of epidemic diseases or taking measures to assist in the outbreak.¹⁴ Moreover, it should be highlighted that healthcare organizations should also consider scenarios that may arise if appear specific requirement such as a lack of particular resources, for example, lack of blood supplies. The lack of such resources may result in impaired continuity in service provision, which is why it is necessary to define measures on the basis of which such events can be annulled. It should be highlighted that numerous studies show that organizations pay insufficient attention to business continuity planning, which causes additional risk associated with the termination of their business due to the achievement of some of the risks.¹⁵ Another challenge that the authors talk about is the hospital organization's information system, which can be exposed to a number of different risks that can result in the disruption of business continuity. This is also one of the fundamental reasons why an organization needs to create a recovery plan.¹⁶ A recovery plan involves ensuring organizational capacity so that organizations can continue to provide services, i.e. produce products shortly after an organization crisis or incident occur.¹⁷ To manage risk and crisis an organization can implement a risk management system based on the ISO 31000 standard. Furthermore, organization can create an integrated risk management system that will include business continuity and risk management systems, employee health and safety management systems, etc. All these systems in synergy can have an impact on reducing the risk in the organization, which is the basis for achieving business continuity.

¹⁰ Baba, H., Watanabe, T., Nagaishi, M., & Matsumoto, H. (2014). Area business continuity management, a new opportunity for building economic resilience. *Procedia Economics and Finance*

¹¹ Renault, B. Y., Agumba, J. N., & Ansary, N. (2016). A theoretical review of risk identification: perspective of construction industry. *Procs 5th Applied Research Conference in Africa*, str. 773-782.

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¹³ Caddy, I. N., & Helou, M. M. (2007). Supply chains and their management: Application of general systems theory. *Journal of Retailing and Consumer Services*, str. 319-327

¹⁴ Turner, A. M., Reeder, B., & Wallace, J. C. (2013). A resource management tool for public health continuity of operations during disasters. *Disaster medicine and public health preparedness*, str. 146-152

¹⁵ Rebmann, T., Wang, J., Swick, Z., Reddick, D., & delRosario Jr, J. L. (2013). Business continuity and pandemic preparedness: US health care versus non-health care agencies. *American journal of infection control*.

¹⁶ Payne, T. (2008). Introduction and overview of clinical computing systems within a medical center. *Practical Guide to Clinical Computing Systems*, str. 1-9

¹⁷ Guide Jr, V. D., Jayaraman, V., & Linton, J. D. (2003). Building contingency planning for closed-loop supply chains with product recovery. *Journal of operations Management*, str. 259-279

2.1. Crisis and risk management in the organization and ISO 31000 standard

An organization crisis can arise as a result of an unplanned event, or an insufficient willingness of the organization to respond to particular events. Therefore, it can be said that the crisis in the organization is a consequence of the lack of a contingency plan as well as a lack of knowledge about a particular phenomenon. After the crisis occurs, each organization adapts to the new conditions that have resulted in the crisis.¹⁸ The crisis is particularly problematic in the context of healthcare organizations because it may result in the inadequate quality of the health care services provided. Therefore, the healthcare organization should pay special attention to identifying the possible risks that could result in a crisis. The organization needs to define the mechanisms which are directed towards managing the crisis. Failure to define crisis management mechanisms can result in an additional increase in the crisis and the possibility of interrupting business continuity. Besides, the emergence of a crisis in an organization and inadequate management of the crisis can result in a decline of the organization's reputation as well as a decline of the customer or customer's trust.¹⁹ For crisis management as well as risk identification, the organization should define a risk management policy and procedures related to the decreasing risks. It should be highlighted that the acceptable level of risk for the organization is depending on the risk management policy. Some organizations may be more tolerant and readier to risk occurrence than others. Accordingly, risk management policy depends on the organization's readiness and also resistance to the risks. Furthermore, risk management policies can be significantly different in manufacturing organizations and organizations that are providing services. An optimal way to manage risks in the organization is to implement a process approach based on measuring points i.e. KPI. All identified deviations in KPIs should be analyzed with root cause tools. After identification of root cause, the organization should create a mechanism for preventing risk occurrence in the future. As mentioned before, in all measuring points where is the high level of risk organization must defined measures for reducing identified risks because such points can endanger the entire transformation undertaken in the process. An organization can set up a risk management system based on ISO 31000, which can serve as a basis for preventing the achievement of specific risks. ISO 31000 can be adapted to any organization which means that the standard is also applicable in the healthcare system. Furthermore, since the standard is Annex SL compliant, it can be integrated with other management systems.²⁰ ISO 31000 risk management emphasizes the importance of understanding the context of an organization as well as the importance of organizational management's commitment to identifying possible crisis situations and defining roles, responsibilities associated with risk reduction measures. Likewise, it is necessary to evaluate and analyze all identified risks and also to evaluate the efficiency of created measures for risk annulation in order to define measures to reduce them.²¹

2.2. Business continuity management according to ISO 22301

To show its commitment to quality management, an organization may, in addition to the ISO 9001 standard, implement a business continuity management system and certified it with the ISO 22301:2019 standard. According to ISO 22301:2019 standard, any organization that has a business continuity management system in place should develop processes to ensure business continuity as well as implement individual activities into processes to reduce the likelihood of business

¹⁸ Sarkar, S., & Osiyevskyy, O. (2018). Organizational change and rigidity during crisis: A review of the paradox. *European Management Journal*, str. 47-58.

¹⁹ Šontaitė-Petkevičienė, M. (2014). Crisis management to avoid damage for corporate reputation: the case of retail chain crisis in the Baltic countries. *Procedia-Social and Behavioral Sciences*, str. 452-457

²⁰ Brocal, F., González-Gaya, C., Reniers, G., & Paltrinieri, N. (2019). Emerging risk management versus traditional risk: differences and challenges in the context of occupational health and safety. *Proceedings of the 29th European Safety and Reliability Conference/Beer, M*, str. 3895-3903

²¹ Oehmen, J., Ben-Daya, M., Seering, W., & Al-Salamah, M. (2010). Risk management in product design: Current state, conceptual model and future research. *ASME 2010 International Design Engineering Technical Conferences and Computers and Information in Engineering Conference*, str. 1033-1041.

interruption if any of the identified risks have occurred. Likewise, ISO 22301:2019 standard requires that the organization must define the scope of application of the standard, define all internal and external risks, and define measures to reduce identified risks. Moreover, the standard highlights that every organization should consider the creation of business continuity plans and goals when planning business.²² In point 8.2, ISO 22301: 2019 defines the need for each organization to analyze the impact of the risk as well as the need to document all identified risks. It also defines the need to analyze the potential impact that risks could have on an organization. Based on the analysis of the organizational environment, a strategy for achieving business continuity is defined. In the strategy, it is necessary to define all resources such as people, information and data, finances, partnerships, etc. for ensuring business continuity. All the described resources will be used in case of a crisis in the organization. For each crisis, the organization should define procedures that declare the communication protocol, precisely describe the specific steps that the organization needs to take to reduce the crisis, etc. So, plan for ensuring business continuity describe the exact roles that each individual has. It should be emphasized that the organization should conduct testing and appropriate training aimed at increasing the competency of the organizational team, to increase the readiness to respond to an individual crisis in the organization.²³

3. CONCEPTUAL MODEL OF CONTINUITY MANAGEMENT IN CRISIS SITUATIONS IN HEALTH HOSPITAL ORGANIZATION

The importance of managing risks and ensuring business continuity in healthcare organizations arises from the number of outbreaks or crises that occur in the healthcare system. The goal of any healthcare organization, or health system as a whole, is to prevent outbreaks of epidemics and crises of any kind, based on the identification of possible risks and on the definition of preventive actions that will prevent the occurrence and rapid spread of a crisis or epidemic. For prevention, it is necessary to properly educate the staff of the healthcare organizations as well as to define the protocols that will be triggered in the event of an epidemic or crisis. Regarding this, each healthcare organization should identify the risk points in its processes and define in each of the processes the mechanisms that will allow timely monitoring of anomalies. Furthermore, it should be emphasized that healthcare organizations should not focus only on health risks, but also focus on the risks arising from the application of certain technologies such as those of Industry 4.0. If the organization does not define the mechanisms for block the unauthorized use of some of the technologies, such as the Internet of Things (IoT), Big Data, etc., a third party may take control of such technologies, that will result in the exposure of healthcare users to risks of their information being made available to third parties. Such risks organizations should recognize and consider when creating a business continuity plan. To identify risks, an organization can perform risk mapping, using several different tools. One tools for risk mapping and managing is FMEA method, which defines the need to identify all critical parts in process or and to identify possible risks. One example, in the context of a healthcare organization, is the possibility for an organization to encounter a lack of capacity to accommodate health care users after an epidemic or pandemic occurs. This is one of the problems faced by the health system of the country in which the SARS Cov - 2 virus has appeared, which is why construction begun construction of a new hospital with facilities to accommodate infected persons. The same can be applied to other matters such as lack of blood supply of a particular blood type, lack of medical staff specialized in a particular medical procedure, etc. It should be emphasized that this is also one of the reasons and basis for the development of medical logistics that serves for the allocation and provision of all necessary resources for the normal functioning of the health process.²⁴ Moreover, when identifying risks, an organization creates a so-called a risk

²² ISO 22301. (2012). ISO 2012 Societal security — Business continuity management systems — Requirements. ISO organization

²³ Ibid.

²⁴ Buntak, K., Kovačić, M., & M. I. (2019). Impact of medical logistic on the quality of life of healthcare users. str. 1025-1032.

map defining all risks that are of particular importance to the organization and the organization should address such risks to reduce the likelihood of their occurrence. An example of a risk map is shown in Figure 1. To evaluate the likelihood of a risk occurrence, an organization may use number 1 through 5 where is number 1 the least likely risk and the weighting 5 is a risk that will almost certainly be realized. Furthermore, for an impact assessment, an organization may use weights 1 through 5 where weighting 1 is the smallest risk impact and weighting 5 is the largest risk impact on organizational business.

All identified risks can be further analyzed using the FMEA method shown in Figure 2. As seen in the figure, the FMEA requires the definition of a risk level for each item by weighting 1 to 5 for the probability of occurrence, 1 to 5 for detection probability and weights 1 to 5 for influencing the organization. Weighting 1 indicates the least likely risk, while weighting 5 indicates the most likely risk. Furthermore, in assessing the likelihood of detection, the weighting 1 shows the risk that will be detected while weighting 5 shows the risk that is unlikely to detect. In assessing strength or impact level, weighting 1 indicates a risk that will not significantly affect the organization, while weighting 5 indicates the risk that will result in disruption to the normal functioning of the organization. Furthermore, it should be emphasized that for all identified risks an organization should check whether controls exist or not. If it is identified that controls do not exist, they should be defined in the same way as it is necessary to define responsible persons who will take care of the proper implementation of the proposed measures, ie who will consider the individual risk identified in the process. It should be reiterated that the level of risk depends on the organization's risk management policy and the organization's willingness to respond to the identified risk by applying the procedure. When referring to possible items that can be analyzed using the FMEA, in the context of the healthcare organization, it should be noted that it can be, for example, interruption of the supply of electricity or other energy, delays in the supply of some of the resources necessary for the normal operation of the provisioning process. health services etc. Risk identification is the basis for developing procedures to ensure business continuity.

Probability of occurrence	Very high	5	10	15	20	25
	High	4	8	12	16	20
	Medium	3	6	9	12	15
	Low	2	4	6	8	10
	Insignificant	1	2	3	4	5
		Very small	Small	Medium	High	Very High
		Impact				

Figure 1: Risk map

Source: Author

Besides, for each identified risk, the organization should conduct a stress test to identify how an organization is well prepared with its existing capacity to respond to the occurrence of the identified risk. It should be highlighted; the organization should create recovery plans within defines how it will allocate its resources to continue whit providing services or to continue whit production after an incident occurs. Figure 3 shows a conceptual model of business continuity. The conceptual model is based on the identification of stakeholder requirements by creating an organizational context. Based on the organization's context, the organization begins to the identification of risks that could jeopardize the continuity of the organization's operations. All identified risks should be analyzed and documented as described at the beginning of this chapter, using tools and methods such as FMEA, or a risk map. It is necessary to evaluate whether all the risks have been identified since the organization may mistakenly overlook some of the risks. If it is identified that there are

other risks that the organization did not consider when creating the organizational context, it is necessary to conduct the analysis again. On the other hand, if all the risks are identified, the organization begins to create a business continuity strategy, which involves defining the responsibility for implementing the measures for risk reduction, identifying all the resources needed to re-establish the service delivery process if its interruption occurs. etc.

An essential component of the model is employee education and testing of all measures defined in the strategy to identify whether the proposed strategies and measures are sufficiently effective or not. If it is identified that they are not, they need to be improved or redefined in order to allow the defined measures to continue in business, i.e. to provide the service. On the other hand, if an incident or risk has occurred, the organization activates the protocol that is defined in the strategy

The protocol may include activities such as communicating relevant information to all stakeholders, activating suppliers to provide additional resources, expanding the existing capacities of the organization, etc. Therefore, the protocol is related to risk and the analysis of existing capacities available to the organization. The organization must check competences and knowledge of all employees on a regular basis so that they can readily respond to any threats to business continuity. Within the health care system of the Republic of Croatia, all institutions have continuous training of staff which they provide through competent chambers, which is a condition for maintaining licenses for independent work.

Once the protocol has been activated, the organization should monitor whether the defined protocol is enough effective and efficient to ensure business continuity. If this is not the case, there is a need to identify areas for improvement and suggested improvements should to be implemented in a new cycle of organizational environment analysis and planning. All procedures that an organization creates should be documented and accessible to employees, i.e. employees need to know where to find a particular procedure for a particular risk, i.e. crisis in an organization, and how they should be able to apply the procedure.

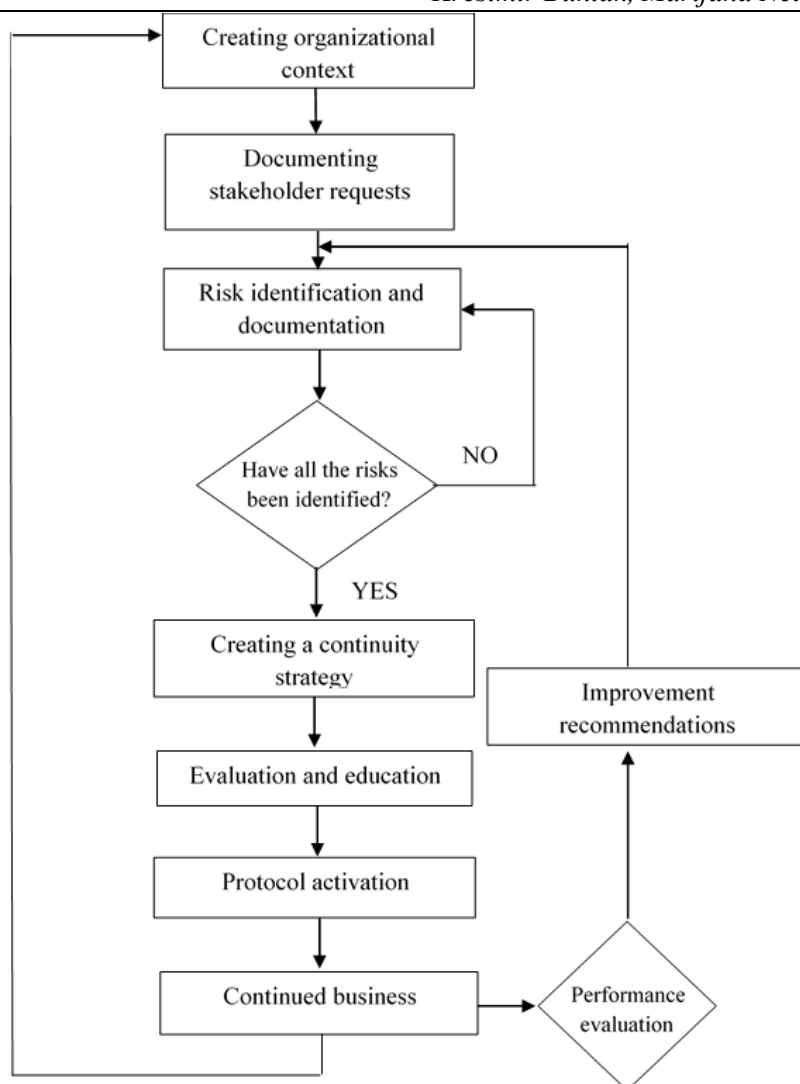


Figure 2: Conceptual framework of creating business continuity based on risk identification

Source: Autor

Activation of the business continuity assurance protocol results in the continuation of the organization's operations if the organization has identified and defined a strategy following the proposed conceptual model.

4. CONCLUSION

This paper is based on the conducted secondary research. As result of conducted research conceptual model was developed. The conceptual model is based on the need of healthcare hospital organizations to continue service delivery after a crisis, i.e. a single risk, is occurred in the organizational system. Achieving business continuity is imperative for any healthcare organization, since healthcare is a sector in which termination of service may result in decreased quality of life or fatal outcomes. To create business continuity, an organization needs to develop capacities that can be linked to several different factors, one of which is the information system, through which an organization can communicate its resource needs on time.²⁵ Some authors emphasize that the development of a business continuity assurance strategy has the potential to increase the performance of an organization, which additionally highlights the importance of each organization

²⁵ Bakar, Z. A., & Udin, Z. M. (2015). Business Continuity Management Factors and Organizational Performance: A study on the Moderating Role of it Capability. *Journal of Management Info*, str. 12-39.

to develop a business continuity insurance plan.²⁶ Furthermore, the increasing number of different threats coming from different domains of organizational environments that may be related to pandemic threats, epidemics, terrorist attacks, power outages, cyber-attacks on the information system, etc. may result in interruption of continuity. business organization These are some of the reasons why a healthcare organization needs to ensure continuity in the provision of health care services to its users. The proposed model is theoretical nature, which is one of the limitations of this research. However, given the lack of authors dealing with the topic of business continuity of healthcare organizations, there is a need to create such conceptual models that will serve as a basis for upgrading and which will incite consideration of the need to create business continuity models of healthcare organizations. Creating such models as well as testing the same are suggestions for future researchers in the field. As there is an increased risk of the rapid spread of viruses and diseases due to the high degree of urbanization, it is necessary to reflect on the emergence of the crisis as well as the risks associated with the occurrence of such conditions.

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²⁶ Sawalha, I. H. (2013). Organisational performance and business continuity management: a theoretical perspective and a case study. *Journal of business continuity & emergency planning*, str. 360-373.

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QUALITY SYSTEM CONDITION FOR SUCCESSFUL BUSINESS AND COMPETITIVENESS

THE ROLE OF NEW TECHNOLOGIES IN SMART CITY MANAGEMENT

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Abstract: Smart cities consist of a number of components and technologies, one of which is IoT. However, IoT as such can be contained in other components of the city such as transport, logistics, construction, etc. Many new technologies are present in smart cities and are used to better manage and run the city. In addition to the link between IoT and Smart City, the aim of this paper is to show the connection of a smart city with other technologies, such as big data and blockchain technologies, which are increasingly emphasized in the context of this concept. The existing technology, mentioned through this paper, will find its expanded application and will undoubtedly be further improved with the proposed model. The proposed model supports the use of artificial intelligence, because through the dimension of AI it is possible to collect data obtained from different urban components in one central location and in that way improve smart city management.

Keywords: Smart Cities, Smart Management, Internet Of Things, Big Data, Blockchain Technology, Artificial Intelligence

JEL Klasifikacija: O18 Urban, Rural, Regional, and Transportation Analysis

1. INTRODUCTION

The concept of a smart city is a concept of the cities of the future. Just as organizations need to monitor changes in the environment and adapt to new demands, so must urban areas. There are more and more inhabitants in urban areas and new requirements are being placed on the management of urban areas. Smart cities consist of a number of components and technologies, one of which is IoT. However, IoT as such can be contained in other components of the city such as transport, logistics, construction, etc. Many new technologies are present in smart cities and are used to better manage and run the city. In addition to the link between IoT and Smart City, the aim of this paper is to show the connection of a smart city with other technologies, such as big data and blockchain technologies, which are increasingly emphasized in the context of this concept.

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The components of a smart city can be divided into; smart healthcare, smart environment, smart energy, smart security, smart management, smart traffic, smart industry, etc. (Gaur et al, 2015). Each of the components of a smart city can be developed on its own, but it can also be developed in parallel with the development of other components. However, different authors list different components of smart cities. In addition to the above, Bosha, Liezel, and Stephen (2017) list three basic components of each smart city; people, technology and institutions. However, they mention the internet of people, internet of things, internet of services and internet of data as the four main components of any smart city (Sadiku et al, 2016).

Regardless of the difference in views on the components of a smart city, one can induce the conclusion that a smart city consists of electronic devices as well as connecting physical infrastructure to a network that allows easier and simpler monitoring or management of processes taking place within the city that has this concept implemented. Technology as such plays a key role in guiding the development of a smart city and helping to manage the city as well as make better, fact-based decisions.

2. SMART CITY - APPROACH TO DEVELOPMENT AND OPPORTUNITIES

The development and emphasis on the development of smart cities begins with the process of urbanization. Urbanization means the process by which traditional settlements are transformed into urban environments under the influence of technological and other achievements. Accordingly, there are challenges related to development and life in a created urban environment. The challenges associated with the development of modern urban environments are the foundation for the development of the smart city concept. Different authors have different views on the aspects and scope of development of such cities, but all aspects are reduced to the development of a smart society, which implies the use of technological advances that allow urban population to interact with implemented infrastructure and superstructure (Repko and DeBroux, 2012). However, with the development of technology and industry, there are challenges related to increased emissions of harmful gases as well as negative impacts on the ecological aspect of the urban environment. Accordingly, states are beginning to develop programs based on which they seek to reduce the negative impact that the growth and development of the urban environment have on the environment. Emphasizing the development of smart cities has resulted in different approaches to the implementation and introduction, ie the transformation of traditional cities into smart cities. Different approaches emphasize different aspects that need to be addressed. The concepts of smart city development can be divided into five basic categories, and they are; experimental mode of development, ubiquity as a mode of development, corporate concept of development, European concept of development and holistic, complete concept of development (Mora and others, 2018).

Each development concept advocates a different way of implementing smart solutions, ie the transformation of traditional cities into smart cities, which depends on the needs that are identified as key. In addition to the mentioned strategies, one can also identify the approach to implementation obtained by conducting research on best practices of implementation and development in the European Union. The approach emphasizes a technologically driven way of development, a top-down approach and a monodimensional approach (Mora and others, 2018). In addition to theoretical approaches and development models, an example of good development practice is the city of Barcelona, which has undergone its transformation into a smart city in four phases; the initial phase in which ideas were collected and the current situation analyzed, the planning phase in which, based on the identified development opportunities, development methods and approaches were planned, the project development phase in which the identified projects were implemented in practice and the last phase, the control phase in to which the implemented solutions were controlled to ensure their sustainability (Bolic and Mora, 2016).

Regardless of which approach and model of implementation, ie smart city development was used, it is necessary to provide three basic components that determine the success of implementation; collective leadership, strategic management and learning organization. Collective leadership is

directed towards collective management, which will enable the implementation of a once defined solution. Strategic management is aimed at defining goals that will enable the sustainability and future development of the smart city. Finally, the learning organization enables collective learning and the improvement of a once-designed solution (Radecki and others, 2017). Residents, ie citizens, have the most important role in the entire process of development, implementation, but also acceptance of a once implemented project. This is particularly evident in creating their influence towards other people to embrace new technologies, such as the example of the acceptance of electric vehicles (Vassileva and others, 2016).

Once adopted and implemented, the smart city project must be managed to ensure its sustainability. Sustainability implies synergy between all components of the sustainability triangle - environmental, social and economic components. Therefore, development must be directed so as to reduce the environmental negative impact, while ensuring sufficient financial resources as well as the involvement of all city residents, ie ensuring population growth, keeping in mind other components of sustainability (Trinidade and others, 2017).

3. SMART CITY AND INTERNET OF THINGS

Growth and development as well as the emergence of the smart city concept can be linked to information and communication technology. As already pointed out at the beginning of this paper, the smart city concept is based on the use of sensors that collect data from a variety of sources. This data is then stored in dedicated databases, ie used for decision making. One of the technologies driven by the development of the Internet that helps manage the smart city concept is IoT which is an acronym for the Internet of Things. Connecting sensors and IoT devices enables real-time monitoring and control of urban processes (Zanella and others, 2014).

The implementation and application of IoT in the smart city concept enables efficient management of complex systems, such as the transport system, ie transport infrastructure for which man becomes less and less competent and capable due to increasing demands and rapid changes in processes taking place within such system. Thus, IoT provides and is the foundation used to transform classical, ie traditional processes that take place in cities into digital, ie smart processes (Mijac and others, 2017). IoT technology in practice is a technology that supports the development and transformation of a traditional city into a smart city. The applicability and possibility of applying such technology is determined by the infrastructure and superstructure that the city has at its disposal. It should be noted that the IoT is only one of the aspects and components of a smart city, but its application and the opportunities it opens up affect the simpler ability to manage a city. The authors Arasteh et al (2016) provide an overview of the actual applicability of IoT technologies in smart cities, which are shown in the following table.

Table 1 The main application of IoT in Smart Cities

Application of IoT	Description
Smart homes	Houses can have sensors that will monitor the situation in the house using the collected data. In this way, pollution and other pre-defined variables can be measured.
Smart parking lots	Smart parking lots should be designed to control the number of cars in each city zone. In areas where a large number of cars move, it is necessary to establish new parking lots. The collected data can be used for the purpose of improving the lives of citizens, but also better accessibility of economic entities.
Weather and water systems	Information such as temperature, rain, wind speed, pressure, etc. is provided, which can contribute to increasing the efficiency of smart cities.

Vehicular traffic	Citizens could use traffic data to determine the time of arrival at the destination. Traffic-related data can be used for different levels of traffic planning in the city.
Environmental pollution	The use of sensors to control air quality is crucial for the quality of life of citizens, especially those who have certain health problems. By monitoring environmental variables, it is possible to alert citizens and provide information on air quality.
Surveillance systems	Security is one of the key components of a smart city. By using technology, it is possible to monitor certain parts of the city and act to increase the safety of residents.

Source: Authors according to Arasteh, H., Hosseinneshad, V., Loia, V., Tommasetti, A., Troisi, O., Shafie-khah, M., & Siano, P. (2016). Iot-based smart cities: A survey. 2016 IEEE 16th International Conference on Environment and Electrical Engineering (EEEIC).

A key setting for IoT is to use sensors to identify, locate, track, monitor, and control. Sensors are a source of numerous data that can be used to better manage a smart city in order to achieve city sustainability. By using IoT, it is possible to improve the safety, economy and lifestyle of the citizens of an urban area.

4. THE ROLE OF BIG DATA IN SMART CITIES

Big data refers to all data and the integration of all technologies used in the modern world. These may include mobile technology, sensors, social networks and other available technology. As the name suggests, big data refers to the multitude of data that users receive through such technology. Osman (2018) emphasizes that the big data encompasses four elements, or four characteristics:

1. Volume - refers to a large volume of data, which exceeds typical values such as gigabytes or terabytes
2. Velocity - refers to the movement of data. The technology allows us to provide insight into the actual figures related to the data used.
3. Variety - refers to the complexity of the data structure used.
4. Veracity - refers to the credibility of the data.

Big data is used in Smart cities in different areas, which are mostly very similar to the areas of application of IoT or any other technology, and this mainly applies to all areas defined by the concept of smart cities. All smart cities capture a large amount of data, because using sensors collects a large amount of data, but you need to know how to manipulate that data. Authors Doku and Rawat (2019) point out that by creating smart cities, smart devices and applications create huge data, but collecting that huge data can pose security threats that, unattended, can lead to data misuse or cybercrime. The authors recommend that Smart City needs proper testing of data and their validity and in-depth testing of the processes involved in data collection for all applications and their performance.

Authors Hashem et al (2016) best explained the application of Big Data in Smart cities to several examples shown in the following table.

Table 2 The main application of IoT in Smart Cities

Application of Big Data	Description
Smart grid	Using Big Data in the context of a Smart Grid can help make decisions related to the level of electricity supply, which are in line with customer requirements. Also the data can be used to predict the need for power in the future.

Smart healthcare	Using analytical tools, health professionals can analyze patient data, which can then be used by insurance companies or other administrative organizations. Also, using the data collected can help predict epidemics, treat disease, and improve quality of life.
Smart transportation	Through obtaining data from the field of traffic, it is possible to improve traffic systems by minimizing traffic congestion and providing alternative routes. By analyzing the history of accidents, it is also possible to reduce the number of accidents or help optimize movement.
Smart governance	The use of Big Data is crucial for governments in establishing and implementing satisfactory policies. By analyzing such data, it is possible to reduce unemployment and influence other needs that arise among the population.

Source: Authors according to Hashem, I. A. T., Chang, V., Anuar, N. B., Adewole, K., Yaqoob, I., Gani, A., Chiroma, H. (2016). The role of big data in smart city. International Journal of Information Management, 36(5), 748–758.

Big data is a technology compatible with IoT, because IoT is used to collect data that is later widely used in the functioning and management of Smart Cities. The use of this form of technology helps to identify the needs of the population and increase the overall quality of life, as well as to achieve the sustainability of the system.

5. SMART CITIES AND BLOCKCHAIN TECHNOLOGY

Authors Zheg et al (2017) explain Blockchain as a Blockchain public ledger in which all transactions made are stored in a list of blocks. That chain grows as new blocks are continuously added to it. Blockchain technology generally has the key characteristics of decentralization, persistence, anonymity, and audibility. This makes it possible to save a lot of costs and improve efficiency. Furthermore, authors Yli-Huumo et al (2016) explain how Blockchain is a decentralized transaction and data management technology developed first for cryptocurrencies Bitcoin. The authors believe that the reasons for interest in Blockchain are its central attributes that provide security, anonymity, and data integrity without any third party controlling the transactions.

Authors Biswas and Muthukkumarasamy (2016) believe that Blockchain technology can protect smart city data and propose a four-level smart city protection model. On the other hand, the authors Rivera et al (2017) believe that using Blockchain technology, a digital identity of citizens can be established. There are numerous advantages of using this technology in smart cities, and the authors Xie, J., Tang, H., Huang, T., Yu, FR, Xie, R., Liu, J., Liu, Y. (2019) define some key, which are shown in the following table.

Table 3 The main application of Blockchain Technology in Smart Cities

Application of Blockchain Technology	Description
Smart Citizens	Analyzing citizens' personal data has a number of benefits, such as providing personalized services, accelerating innovation and economic growth, predicting future market trends, and optimizing an organization's decision-making process. Blockchain is a technology that allows citizens to collect, store and control access to their personal data.
Smart Healthcare	The use of blockchain in smart healthcare has several advantages. For example, medical data can be stored in a blockchain in a secure, immutable way. Patients can

	control the use of their medical data and flexibly manage access to their data.
Smart Grid	Blockchain technology not only promotes the realization of a reliable and efficient decentralized power grid system, but also increases the stability and data security of smart grid systems.
Smart Transportation	The distributed nature of blockchain technology can improve the robustness of smart transportation and improve in-vehicle communication management and information exchange. With the help of blockchain, a decentralized, reliable and secure smart transport system can be established.
Supply Chain Management	In supply chain management, a blockchain can be used to track detailed product information and prevent counterfeit products from being placed on the market. Furthermore, the blockchain can also be used to exchange business information between entities in supply chains. Based on shared business data, entities can optimize their decision-making process.

Source: Authors according to Xie, J., Tang, H., Huang, T., Yu, F. R., Xie, R., Liu, J., & Liu, Y. (2019). A Survey of Blockchain Technology Applied to Smart Cities: Research Issues and Challenges. IEEE Communications Surveys & Tutorials, 1–1.

Blockchain technology increases the security component in smart cities and finds its application in all parts of the smart city. The greatest emphasis of using this type of technology is the satisfaction and safety of its users. By using blockchain technology, people can protect their data, but also use it when it is needed to make certain decisions.

6. THE NEXT TECHNOLOGICAL PHASE IN SMART CITIES

The modern world is marked by constant change and technology is constantly evolving. The existing technology, mentioned through this paper, will find its expanded application in the coming years and will undoubtedly be further improved. Authors Arasteh et al (2016) predict how collective intelligence will improve decision-making processes and empower citizens. The authors emphasize that the ability to monitor and manage electrical devices can improve the participation of active customers in the operation of a system known as the response to demand. Authors Allam and Dhunny (2019) propose a model for integrating IoT and Big Data, through the use of artificial intelligence.

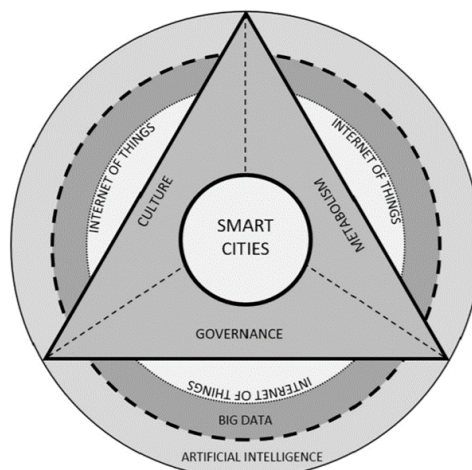


Figure 1. A proposed framework for the integration of AI and big data in smart cities

Source: Allam, Z., & Dhunny, Z. A. (2019). On big data, artificial intelligence and smart cities. Cities, 89, 80–91.

By ensuring a focus on the life dimension through the dimensions of culture, metabolism and governance, the proposed framework provides a focus on smarter and healthier cities from the economic and social levels. Authors Allam and Dhunny (2019) suggest that technology be the core of smart cities where big data can emerge via IoT across different domains, and then artificial intelligence is proposed as a core feature that can process, analyze, and interpret generated data. The proposed model supports the use of artificial intelligence, because through this dimension it is possible to collect data obtained from different urban components in one central location. This is possible due to the interconnection of different services made possible by the availability of a number of smart devices. With this big data, city managers, governments, companies and other stakeholders have the ability to tailor services accordingly.

Although artificial intelligence is a key technology in the next technological phase of smart city management, the proposed model suggests that technology is the core of smart city, which is not the case. Technology should assist in decision making, but management of the smart city has to be the core of every smart city. To measure and compare its progress, each smart city can use ISO 37120. ISO 37120 certificate, or Smart City certificate, helps cities measure progress, with the goal of improving the quality of life in the city. The standards are developed by the leading experts of ISO Technical Committee on Sustainable Development (ISO / TC 286), using the knowledge and experience of 250 cities (Buntak et al, 2019.). ISO 37120 is divided into 17 areas, ie parts of an urban area, which are: economy, education, energy, environment, finance, fire and emergency response, governance, health, shelter, recreation, safety, solid waste, telecommunication and innovation, transportation, urban planning, wastewater and water and sanitation.

In that case, the core of smart cities should be smart management that uses technology for making smarter decisions. New proposed framework can use ISO 37120 for smart city planning and for measuring the improvement, and new technologies, such as IoT, Blockchain, Big Thata and AI, should be used as a support for smart city management.

7. CONCLUSION

In this paper, the emphasis was on three core technologies that are emerging in today's smart cities, and are interconnected. These technologies are IoT, Big Data and Blockchain. Despite the fact that these technologies are different, they have something in common, and that is improving the quality of life and protection of citizens. Each of these technologies, together with its sub-technologies and the components of which they are composed, works towards data collection, data analysis and the use of data to improve the lives of residents and make better decisions. The goal of all technologies in smart cities is to enable the sustainability of the city as a system and the protection of its citizens and all parts of that city.

IoT uses a number of different modern technologies that citizens and government use for easier and simpler management, monitoring and other activities in the city. IoT is closely linked to Big Data, which without IoT and data collection technologies cannot function. Big Data as a cloud of large amounts of data allows the use of this data to improve and enhance the quality of life. Blockchain, as a supporting technology, enables the creation of protection for this data and provides security to all residents of a smart city.

Certainly, in the further development of smart cities, artificial intelligence should be taken into account, which is still in the stage of development, but has enabled great shifts in society. Artificial intelligence is the next technological step towards the development of smart cities. With the help of artificial intelligence it is possible to simulate and choose the best decision based on all available information.

To conclude, smart cities should invest in new technologies in order to gain competitiveness, but new technologies should serve as a support for decision making process and for smart city management. For further research, it is suggested to review all ISO standards that can help in

developing, implementing and improving Smart City concept, and that can be used to propose a new smart city management framework.

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QUALITY SYSTEM CONDITION FOR SUCCESSFUL BUSINESS AND COMPETITIVENESS

QA MATRIX AS QUALITY TOOL IN AUTOMOTIVE INDUSTRY

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Abstract: Quality control is important in nearly every industry. It ensures that each product leaving the factory is of the highest quality and the same as all those items that came before it. One industry where quality control is especially vital is the automotive industry.

Within the quality control principles, the characteristics of product that are perceived as “Quality” by the market are logically and strictly related to material specifications, production methods, manpower knowledge and machine / process characteristics (4M). These correlations generate a group of conditions associated to process and its environment to avoid Non-Conformities.

QA Matrix (“Quality Assurance” or “Assure Quality”) is a tool which is used to Identify relationships in place among quality problems and the phase of the process in which the problem arise. QA matrix must collect defects reporting main non-conformities coming from all indicators specifying frequency, costs, seriousness, in order to define priorities.

Keywords: QA matrix, automotive industry, 4M, Kaizen, WCM;

JEL Classification System: L15

1. INTRODUCTION – WHAT IS WCM?

WCM is a systematic way to improve continuously manufacturing competence by specially focusing on the followings:

- Substantial quality improvement to satisfy customers
- Cost competitiveness based on elaborate cost deployment
- Short lead time to serve customers better than competitors

Follow WCM way means: from a fire fighting approach to a systematic step by step improvement approach:

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1. Identify What problems need to be addressed
2. Detect Where they are
3. Prioritize them
4. Analyse them and choose right methods
5. Estimate how much they cost to be solved
6. Implement solutions with rigor
7. Evaluate the achieved results against the original objective

2. QC IN AUTOMOTIVE INDUSTRY

Quality Control is a group of activities that define process conditions so as to prevent the generation of non-conformities; maintain previously defined conditions over time to ensure a perfectly conforming production. Mission of Quality Control is to ensure quality products to customers at minimum costs; to define production system conditions in order to prevent non-conformities; to define production system conditions in order to prevent non-conformities; to maintain defined conditions to ensure conformity over time; and to increase skills of operators on the solution of quality problems.

Within the Quality Control principles, the characteristics of product that are perceived as “Quality” by the market are logically and strictly related to material specifications, production methods, manpower knowledge and machine/process characteristics (4M).

These correlations generate a group of conditions associated to process and its environment to avoid Non-Conformities.

Often, in the plant just a few product characteristics are measures (e.g. dimensional parameters, noise, fluid losses, missing parts, etc.); however, in order to be excellent and competitive, product check logics must be changed to suit process conditions in order to be excellent and competitive.

2.1. Non conformity

A “Non Conformity” is produced when a component/finished product is not as per associated specifications. This means that, in order to detect the Non-Conformities, the product or component specific characteristics must be clearly defined.

Non-conformities detected in the in-house process:

- detected on process where it is generated
- detected on a process downstream of the process where it is generated
- detected at in-house process final inspection

Non-Conformity detected by final customer

- detected during the in-house process and received by final customer
- not detected during the in-house process and directly received by final customer

3. QA MATRIX

QA Matrix ("Quality Assurance" or "Assure Quality") is a tool which is used to identify relationships in place among quality problems and the phase of the process in which the problem arise. QA matrix must collect defects reporting main non conformities coming from all indicators specifying frequency, costs, seriousness, in order to define priorities (Figure 1).

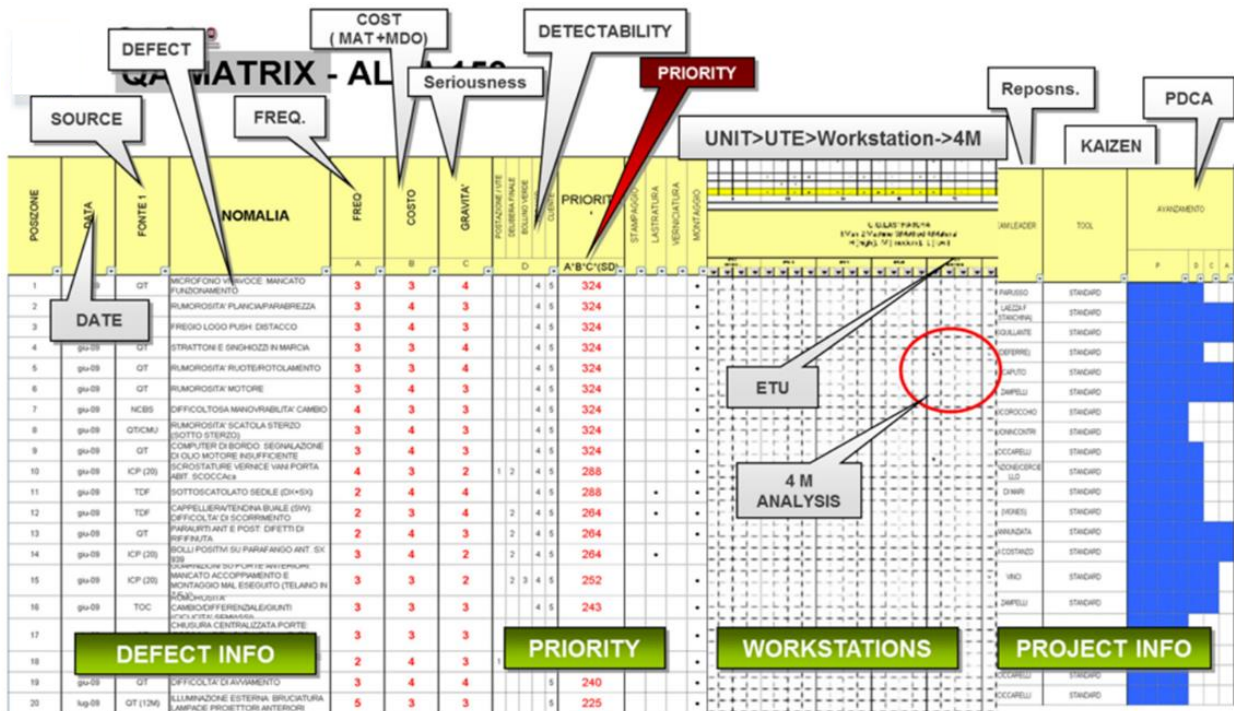


Figure 1. QA Matrix

Source: Internal documentation

Main information required are:

- Date
- Source
- Defect description
- Priority index
- Index of critical issues that will be attributed to the multiplication of the indicators

Collect plant non conformities, coming from external indicators (example: NCBS, QT, CMU, MAPS) and internal indicators (example: TOC, ICP, FTQ, reworks, final quality control).

Each line correspond to each non conformity and proper.

3.1.Frequency

Frequency for each specific defect can be an integer number in the range 1 (min) – 5 (max). For each plant, it can be determined based on the table below. If the defect is present in more than one quality indicator, then put the highest value for the frequency of that indicator (Table 1).

Table 1. Frequency

Frequency	Score	For frequency between
	=1	>0% and <=1%
	=2	>1% and <=3%
	=3	>3% and <=10%
	=4	>10% and <=30%
	=5	>30%

Source: Internal documentation

3.2.Costs

For each defect, the related manpower and material costs have to be evaluated. Cost for each specific defect can be a integer number in the range 1 (min) – 5 (max). For each plant it can be determined based on the table below.

Table 2. Cost

Frequency	Score	For frequency between
	=1	<=10 EUR
	=2	>10 EUR and <=30 EUR
	=3	>30 EUR and <=50 EUR
	=4	>50 EUR and <=200 EUR
	=5	>200 EUR

Source: Internal documentation

3.3.Seriousness

Seriousness for each specific defect can be an integer number in the range 1 (min) – 5 (max). Seriousness is determined based on the following:

- Defect is not perceived by the customer;
- Dissatisfaction and a slight complaint for the customer due to the defect (i.e. the defect has been fixed during the MOT);
- Defect causes a strong dissatisfaction to the customer (the defect has to be fixed asap);
- Defect is reducing the correct use of the car (immediate repair is necessary) and undermines the customer loyalty;
- Defect causes the car stop or it is related to safety issues o it makes the customer reject the car.

3.4.Detection

The more the defect is detected downstream in the process, the more its seriousness increases. Detection for each specific defect can be a integer number in the range 1 (min) – 5 (max). It is necessary to consider the seriousness value in each process area, including customers claims whose value should 5 or even more (10....). Process stages where the defect can be detected are:

- Workstation / ETU;
- Final quality control;
- ICP/TOC/Dynamic functional test;
- Final customer.

3.5.Priority index

- Priority index is defined as:

$$A \times B \times C \times \Sigma D,$$

where are:

A – Frequency; B – Cost; C – Seriousness; D – Σ areas in which the defect is detected

In the end, operator has arrange, in ascending order, all defects in QA Matrix; and define top priorities for the plant and critical processes, based on priority index. Analyze the causes starting from a 4M analysis (1=Machine; 2=Method; 3=Man; 4=Material) and estimate correlations (high/medium/low) between 4M and defects

4. QA MATRIX: RESULTS

Developed in this way, the QA matrix allows to obtain (Figure 2):

- List of Prioritized defects: focused approach
- List of critical processes: systematic approach
- Vision of the root cause of the 4M that generates most critical

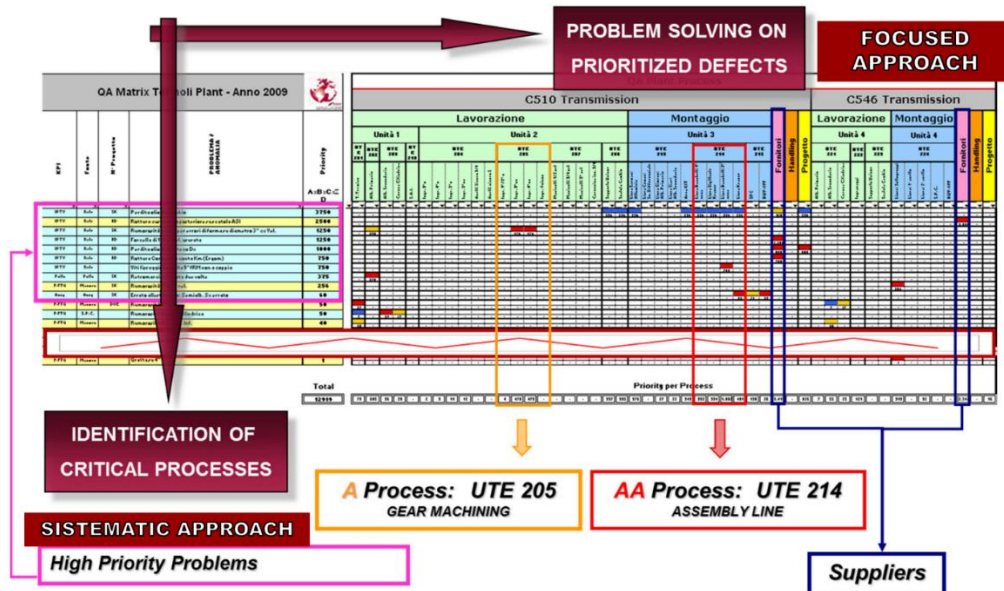


Figure 22. QA Matrix example

Source: Internal documentation

5. CONCLUSION

In automotive industry where you produce expensive product whose many elements can affect safety problems we have to manage with defects in very seriously way. On of very effective tool is QA matrix which provide good overview of defects and monitoring of project for problem resolving. Future activities will be developing of electronic QA matrix to simplify way of input data and filling QA matrix.

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Faculty of Veterinary Medicine University of Belgrade (FVMUB) was founded upon the Declaration of the Ministry of Education Act No 30281/36 in 1936.

FVMUB is an educational and research institution. Dean of the Faculty is Prof Dr Vlado Teodorović.

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- ✓ Doctoral Academic Studies (20 students/year):

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