SUPPLY CHAIN RESILIENCE BASED ON QUALITY MODELS

OTPORNOST LANACA OPSKRBE TEMELJENA NA MODELIMA KVALITETE

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ABSTRACT
Circumstances such as (1) the COVID-19 pandemic, (2) the blockade of the Suez Canal, and (3) the war in Ukraine have caused disruptions in supply chains. The purpose of this paper is to design three original models, the implementation of which should significantly reduce the damage caused by supply chain disruptions in future crises: (1) a model for organizations, (2) a national economy model, and (3) a global model. By applying scientific methods of cognition, the author comes to the research results, that by applying a quality model with four components (methods, measures, quality tools and indicators), the resilience of supply chains increases, which can significantly reduce damage in future crises and prevent a decline in the quality of life of everyone on the planet.

Keywords: supply chain, resilience, context, quality model.

REZIME
Okolnosti poput (1) pandemije COVID-19, (2) blokade Sueskog kanala i (3) rata u Ukrajini uzrokovale su poremećaje u lancima opskrbe. Svrha ovog rada je osmisliti tri originalna modela čija bi implementacija trebala značajno smanjiti štetu uzrokovanu poremećajima u lancima opskrbe u budućim krizama: (1) model za organizacije, (2) model nacionalnog gospodarstva i (3) globalni model. Primjenom znanstvenih metoda spoznaje, autor dolazi do rezultata istraživanja, da se primjenom modela kvalitete s četiri komponente (metode, mjere, alati za kvalitetu i indikatori), povećava otpornost lanaca opskrbe što može značajno smanjiti štetu u budućim krizama te spriječiti pad razine kvalitete života svih na planeti.

Ključne riječi: lanac opskrbe, otpornost, kontekst, model kvalitete.

1. INTRODUCTION

In recent decades, changes in the global context have been frequent [1]. There are many reasons for this: natural disasters, pandemics, terrorism, wars, cyber-attacks, etc. [2]. These circumstances change the context that affects disruptions and interruptions in the development of supply chains [1]. One of the circumstances that has changed the global context and caused disruptions and interruptions to global supply chains is the COVID-19 pandemic [3]. There has been a disruption and imbalance between global supply and demand, which has caused major financial losses. The supply chain crisis has been present for several years, since the beginning of the COVID-19 pandemic, and in parallel, the EU, as well as numerous other countries, are in an energy crisis that was largely caused by the start of the war in Ukraine in

2022. Food supply chains were also disrupted by the start of the war in Ukraine in 2022. It is known that Ukraine is the third largest producer and exporter of wheat in the world [4]. The subject of this paper is research and identification of ways to solve this problem and help global market participants prepare for future crisis situations that will certainly occur. As a result of this research, the author has built and propose the application of three models: 1) a model for individual organizations, 2) a model for national economies or countries and 3) a global model. The working hypothesis was set: "The full application of the model for preventing the impact of supply chain disruptions in future crises contributes to strengthening the resilience of individual organizations, states and the global community, reduces damage and contributes to preserving the quality of life of citizens."

2. METHODS

In conducting this research, scientific methods of cognition were applied. The analysis method was applied when analysing the context that in the recent past caused disruptions and interruptions in the development of supply chains, such as cases of the COVID-19 pandemic, stranding of the vessel Ever Given in the Suez Canal and war in Ukraine. The comparative method in the comparison of individual requirements in three different models that are researched in this paper. The synthesis method when drawing conclusions for each individual model. The induction method when developing the model, because the model is developed from an individual organization, through the national economy, that is, the state, to a global model. The models presented in the paper are the original work of the author.

3. SUPPLY CAHAIN DEFINITION – A MODERN APPROACH

There are many definitions of supply chain. Many of them are defined in international standards such as ISO – International Organization for Standardization, standards. In the following, there are performed supply chain information searches on tens of thousands of international standards. The topic of the supply chain is addressed in various aspects in a total of 2,062 standards. The concept of the supply chain is also defined in many standards. Many of them are case specific.

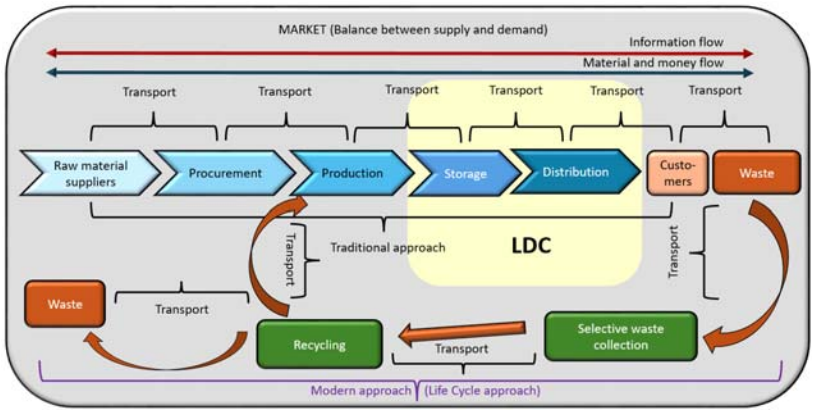

Figure 1. Supply Chain – modern approach.

Based on them, it can be concluded that the supply chain is a complex system of integration of suppliers, manufacturers, distributors and wholesalers and retailers, for the purpose of production and distribution of goods/services with the aim of balancing supply and demand. While traditional logistics is based primarily on warehousing and transportation activities, the supply chain also involves the flow of information between numerous participants. To

understand the phenomenon of the supply chain as a complex structure, it is necessary to apply a modern approach to the supply chain, as shown in Fig. 1. Traditional models, processes, and practices are no longer fit for purpose and companies are re-examining the factors that enable supply chains: for example, business models, stakeholders' roles, technology and information systems, and complementary capabilities and processes [5]. From a business perspective, companies are increasingly held accountable for the sustainable performance of the whole supply chain, and it can be conceptualized as operating within economic and environmental contexts that must co-exist [6].

4. RESULTS

Disruptions and interruptions in supply chains cause problems at three levels: the micro level, or the level of an individual organization, the second is the level of the national economy or state and the third, highest level of the problem occurs at the global level.

4.1. Quality model for individual organizations

In the model for individual organizations, it is necessary, as shown in Fig. 2, fulfill the following requirements for the organization to gain resistance to disruptions in the development of supply chains, which will be caused by future crises:

Methods:

IMS – Integrated Management System – regardless of the level of management knowledge, each management system is structured in layers. This means that it contains elements of multiple management systems (quality, environment, safety, social responsibility, etc.). An integrated management system does not necessarily need to be certified as such. *HRM – Human Resource Management* – it is important that managers at all levels, are adequately trained in managing the IMS, as well as managing supply chains in conditions of disruption or interruption, i.e. in a crisis. *Simplify the business* – should be one of the fundamental principles of management at all levels of the organization. *Quality as a strategy* – strategy as the main plan, the main path to follow, the main method for achieving the vision and implementing the mission of the organization should be quality. This implies a higher degree of materialization of the principles of quality management [7].

Measures:

Alternative supply chain directions – it is necessary to continuously work on finding and establishing alternative routes of supply chains [8]. *Alternative suppliers* – it is necessary to continuously work on finding and establishing partnerships with multiple suppliers for the same product, if possible. This is because dominant dependence on a single supplier, especially when it comes to strategic products (food, medicines and medical equipment, energy sources), represents a great risk. *Alternative customers* – the same logic applies as with *Alternative suppliers*. *Alternative product design* – should strive to develop alternative production and products that the organization can continue to market in the event of a disruption or interruption of the supply chain for the usual dominant product. *Virtual logistics management* – a new approach to logistics management, the essence of which is that it is not necessary to have physically full warehouses of raw materials and semi-finished products to ensure production in case of disruptions or interruptions of supply chains. It is necessary to develop a system of information which should be regularly updated and available to decision makers in the organization.

Quality tools:

The problems that arise in business are complex and cannot be solved unambiguously. This is also the case with problems of disruption or interruption of supply chains. Since each

organization is a special entity and has some peculiarities, it is not appropriate to prescribe to the organization which and how many quality tools should be used in solving problems in the case of disruptions in the development of supply chains. It is left to the organization's management and experts to choose which and how many quality tools they will use in solving certain problems. That is why the "Quality toolbox" was formed, which contains 16 groups with a total of 65 quality tools. Quality toolbox consists of quality tools brought by the international standard ISO 10009:2024 Quality management – Guidance for quality tools and their application.

Indicators:
The "Indicators" are divided into three groups: 1) model indicators, characteristic of this model that refers to individual organizations, 2) natural indicators and 3) financial indicators. In each group of indicators, several indicators are listed, then the "Method of calculation", their "Interpretation" or meaning and the necessary "Reaction" of the organization's management now when a certain indicator reaches a certain value. By developing such a system of indicators, the organization is ready to react to mitigate the negative consequences of disruptions in the development of supply chains. Automation of action is achieved.

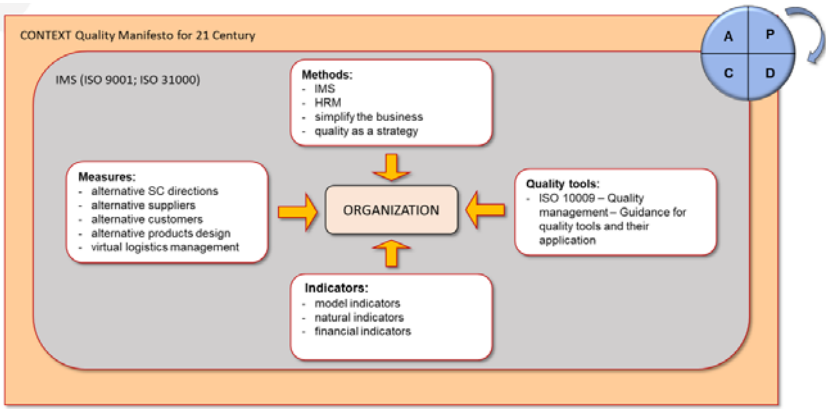

Figure 2. Model of prevention of damage from future crises due to disruption of supply chains (aspect of the individual organization).

The system can be developed in a way that monitors the movement of each of these indicators, which is important for anticipatory crisis management because events are actively monitored, and the arrival of a crisis is predicted.

IMS – Integrated Management System
The IMS phenomenon has already been explained previously. In Fig. 2 is an example of the integration of ISO 9001 - *Quality management system - Requirements* and ISO 31000 - *Risk management - Guidelines*, but numerous other combinations and IMS structures are possible.

Quality Manifesto for 21st century
The wider context of the model shown in Fig. 2 presents the *Quality Manifesto for the 21st century*. It is a document adopted by IAQ – International Academy for Quality. Its acceptance is proof of commitment to "Leadership through Quality" at all governance levels.
PDCA
PDCA (Plan – Do – Check – Act) cycle or Deming circle, as shown in Fig. 2, represents one of the important management principles and it should be interpreted flexibly, in the correct

way. It is an integral part of all three models. Its application guarantees dynamism in management and is a prerequisite for the organization's proactive action. Application of the model shown in Fig. 2 is in the function of creating the resilience of the management system of an individual.

4.2. Quality model for national economy

In the model for national economies or states shown in Fig. 3, exist the same requirements, and some are differed from the model for individual organizations shown in Fig. 2, such as in Methods higher degree of self-sufficient and strategic alliances.#There is also a change in the Indicators module where macroeconomic indicators have been added.

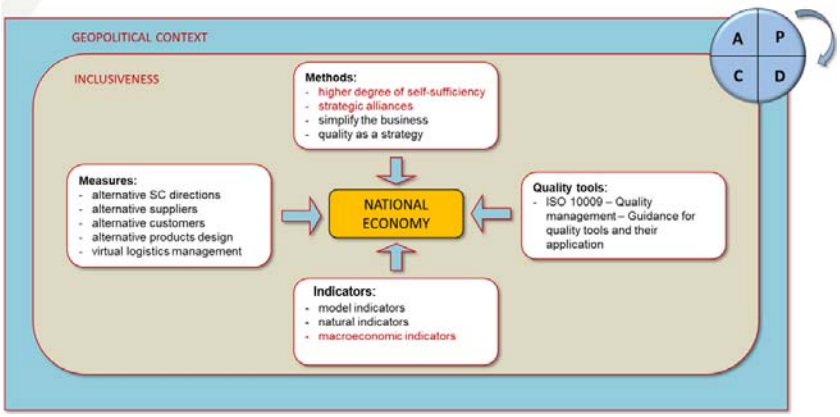

Figure 3. Model of prevention of damage from future crises due to disruption of supply chains (aspect of the national economy)

Inclusiveness

Inclusiveness in this model represents the inclusiveness of public administration bodies, that is, of state institutions that should serve citizens to a greater extent and be directed towards meeting the demands of citizens in solving their life situations, and of economic entities, to facilitate entrepreneurial activities.

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Geopolitical context

In this model, as a broader context than the impact on the national economy, or the state, the geopolitical context should be continuously monitored and understood.

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4.3. Global model

The Global Model (Fig. 4) contains the same requirements, and some are differed, from the previous two models shown in Fig. 2 and Fig. 3 such as: in Methods collaboration and international agreements, and in Indicators global macroeconomic indicators.

Quality of life

The global strategic goal should be "Quality of life" for all the inhabitants of planet Earth.
This is the narrower context of the global model.

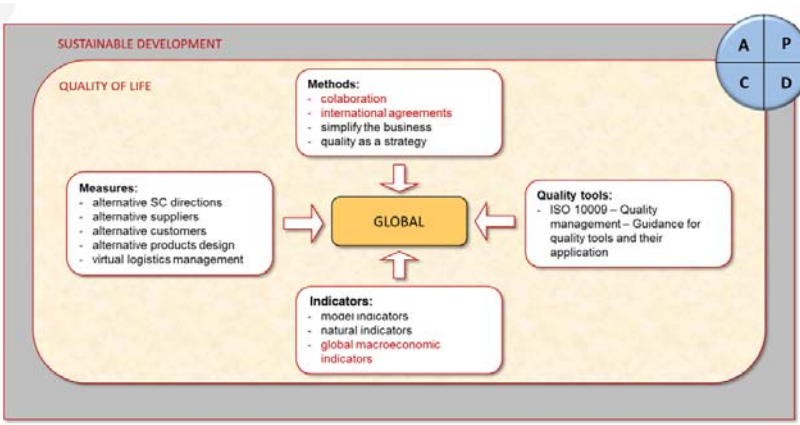

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Figure 4. Model of prevention of damage from future crises due to disruption of supply chains (global aspect)

Sustainable development

Sustainable development in the global model appears as a broader context. In addition to referring to the entire planet Earth, it also includes the part of the universe close to the Earth.

5. CONCLUSION

The full implementation of these models will make organizations, countries, and the global community more resilient to disruptions or interruptions in supply chains in future crises and will contribute to preserving the quality of life of citizens and aware of the approach of crises. Further research and development of the presented models should be continued in the direction of further development of methods, definition of additional measures and development of indicator systems.

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