Zoran Rakićević[1], Ognjen Anđelić[1*], Goran Popović[2], Bojana Branković[3]
[1]University of Belgrade, Faculty of Organizational Sciences, Serbia
[2]Koncern Bambi a.d. Požarevac, Serbia
[3]Beorol d.o.o., Belgrade, Serbia

The influence of COVID-19 on production operations planning

DOI: 10.75995/management.fon.2022.0008

Abstract:

Research Question: This paper investigates the impact of the COVID-19 pandemic on production operations planning. **Motivation:** Due to the prevalence of the coronavirus pandemic, a disturbance has occurred in the global production and supply chain systems. By disturbing transportation and distribution mechanisms, the COVID-19 pandemic has directly influenced value chain participants, which makes the planning process more difficult. The current crisis caused by the virus has revealed the fragility, vulnerability and low resilience of systems that were previously considered to be best practices in global value chains. **Idea:** The paper provides new ideas to researchers and practitioners in the field of operations management, that can improve business practices in the current business environment caused by the COVID-19 pandemic. **Data:** In order to identify problems and expose potential solutions, we conduct a contemporary literature review combined with interviews with experts from supply chain operations. **Findings:** Experts from supply chain practice, as well as scholars and researchers identified mostly the same issues in planning business operations, that occur as a result of the COVID-19 pandemic disruption. **Contribution:** This paper outlines the main issues and challenges that arise as a result of the pandemic. The paper also provides guidance to improvements in operations planning with the purpose to increase sustainability and resilience in future emergencies.

Keywords: Production operations planning, COVID-19, supply chain, survey interview, literature review

JEL Classification: H12, M11, D20

1. Introduction

In recent decades, successful manufacturing companies in the most developed countries have focused on manufacturing products according to customer design, producing small volumes and high-value products. As a result, the production of large-scale standardized products with low sales margins has been relocated to countries with less developed economies and cheap production and labour costs. In this business model, long and complex value chains have been formed. In addition, the trend of globalization and outsourcing of business processes and activities has made value chains and their production and service operations more complex, and also more difficult to manage and monitor.

Uninterrupted processes and operations in supply chain systems are essential for firms to be successful in these highly competitive conditions (Shahed et al., 2021). However, these complex systems have become more susceptible to disturbances due to their increasingly difficult controllability. The application of Just-in-time production strategies and Lean methodology in complex value chains have led to significant cost reductions (Mclvor, 2001; Kannan & Tan, 2005). In addition, from the point of view of the global supply chain, manufacturing companies import most of the raw materials from China and other Asian countries. Large global supply chains, including those in manufacturing (e.g., automotive, electronics, pharmaceuticals, etc.) and service sectors (e.g., airlines, retail suppliers, transportation, etc.), have been significantly affected by their heavy dependence on China as a global partner in the supply chain in the last two decades (Belhadi et al., 2021). However, such value chains and their production strategies have shown weak resilience and high vulnerability to global disturbances arising in the circumstances of the pandemic (Govindan, Mina & Alavi, 2020; Spieske & Birkel, 2021). The disturbance has occurred in the global production and supply chain system due to the corona virus. The COVID-19 pandemic has severed most transportation links and distribution mechanisms between suppliers, manufacturing facilities and customers.

* Corresponding author: Ognjen Anđelić, e-mail: ognjen.andjelic@fon.bg.ac.rs

The current crisis caused by the COVID-19 virus has revealed the fragility, vulnerability, and low resilience of global supply chains. This unprecedented event has caused a problem that affects both supply and demand, making it difficult for companies to respond successfully to challenges that exist (Fonseca & Azevedo, 2020).

This, however, is not the first time value chains have experienced problems. Despite the specifics of the COVID-19 pandemic, global value chains have experienced disturbances in the past. According to Ivanov, Sokolov & Dolgui (2014), 85% of companies operating in the global value chain experience at least one disruption per year. The severity and impact of disruptions on the supply chain were more serious if the said disruptions were caused as a result of natural disasters. Some recent historical examples of natural disasters' impact on the global supply chain and operations of multinational companies have been (Ivanov, Sokolov & Dolgui, 2014): earthquakes and tsunami in Japan in 2011 caused Toyota to lose its leading position as the world's largest car manufacturer; the floods and earthquakes in Thailand in 2011 affected Intel's loss of $1 billion in missed sales of microchips for computers; the fires at the Philips plant in New Mexico affected Ericsson's $ 400 million operating loss as its main customer; hurricane Mitch affected the increase in the world price of coffee by 22%.

The paper aims to identify the main problems and challenges production and service organizations are facing, which arose in the circumstances of the COVID-19 pandemic. Also, appropriate strategies and activities regarding the planning process are considered, with the purpose of improving sustainability and resilience of the production system and the supply chain, thus making them more comprehensive. The paper provides an overview of important conclusions and recommendations for the topic of relevant literature, as well as a review of survey interviews conducted among managers of successful production and service organizations in the Republic of Serbia. Finally, potential research frameworks for addressing post-pandemic situations should also be provided.

The paper is organized as follows: After the introductory part, the second part of the paper presents a review of relevant literature about issues of planning production operations during the COVID-19 pandemic. The third section presents the survey on the impact of the pandemic on business and the challenges of planning production operations of several successful companies from different industries in the Republic of Serbia. Based on the presented research results, the last section brings the conclusion with the most important recommendations on operations planning in the circumstances of the COVID-19 pandemic. The conclusion also states future research ideas and intentions.

2. The Influence of COVID-19 on Planning Operations

The COVID-19 disease first appeared in the city of Wuhan in China and was caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). As a result of the rapid spread of the virus to other countries, in March 2020, the World Health Organization (WHO) declared COVID-19 a pandemic that caused a global health crisis. Most prominent economies around the world introduced a complete blockade and closure of economic and cultural life and the focus has since shifted to a jump in demand for basic products and services (Kumar et al., 2020). As a result of the spread of the virus, health and safety measures have been adopted worldwide that have affected all aspects of business and life in general (Kumar et al., 2020; Qin et al., 2021): Partial closure of factories, closure of borders, reduction and suspension of international and domestic air traffic, closure of shops, cafes and restaurants, suspension of tourist activities, transition to emergency remote teaching in schools and universities, reduction of a number of employees in the workplace, introduction of working from home, restrictions on the movement of the population, problems with provision of essential goods, but also lockdown and isolation. Factory lockdowns in some industries have caused problems in other industries and service sectors. Borders were closed and transport was reduced to a minimum, with simultaneous restrictions on the movement of the population and further restrictions of economic activities. The fact that since the World Health Organization (WHO) declared the COVID-19 virus a pandemic in March 2020, retailers across the United States have been forced to close their businesses for weeks or even months, addresses volumes about this problem. The retail sector revenue in the first quarter fell 57.7% compared to 2019 (Sulaiman et al., 2020). According to WTO data (2020), World trade has fallen by an average of 13 to 32% for various products. Decisions that led to the cessation of production activities had an impact on the global supply chain, reduced revenues and termination of cooperation, but also a partial blockade of production and supply of products (Grida, Mohamed, & Zaied, 2020).

For certain categories of products, the demand increased drastically, and the supply could not cope with that situation, hence the question of specific markets survival was raised. On the other hand, the demand for many other product categories has dropped dramatically at the same time. To avoid this situation,

manufacturing companies are taking steps to ensure business continuity. Measures include cross-functional controls and coordination at the global and regional levels, increased security stocks, improved customer support programmes, recovery measures to improve demand, and rapid responses to changing sources of demand to secure sources of revenue (Ivanov & Dolgui, 2020).

Most organizations in the supply chain are struggling to predict the negative consequences caused by the COVID-19 pandemic. In general, the global supply chain and production network have found themselves in a very unstable and uncertain environment (Kumar et al., 2020; Alkahtani et al., 2021) with managers experiencing classic risks of supply, demand, and control in the supply chain at the same time (Remko, 2020). Recent events suggest that in the event of emergencies, supply chain resilience should be assessed taking into account its survival and sustainability to avoid collapses in both supply chains and markets, and to ensure the supply of goods and services (Ivanov & Dolgui, 2020). The COVID-19 virus is affecting production systems and trade nationally and even globally. The availability and production of many essential items, such as food, groceries, and pharmaceuticals, has been drastically reduced, and a large mismatch between supply and demand has been observed (Kumar et al., 2020). Despite all the above, some manufacturers have tried to find sustainable solutions to continue the economic activities of value creation, and contribute to maintaining the balance between supply and demand: teleworking, adapting workplaces to ensure the safety of employees, digitalization of business processes, e-service development for a relationship with customers and suppliers etc.

COVID-19 pandemic has caused value chain vulnerabilities in various industries and has negatively affected manufacturing and service operations around the world (Sahoo & Ashwani, 2020; Ardolino, Bacchetti & Ivanov, 2022). Supply chain managers have difficulty in operationalising the concepts of risk management and resilience, which highlights the need for empirical research in the field of managers' attitudes towards the challenges caused by the pandemic (El Baz & Ruel, 2021). Measures taken by various countries have led to a shortage of stocks and capacity, caused shutdowns of production facilities across the planet and suspended product delivery and sales. Global supply chains have failed to deliver the necessary goods, bringing their fragility and lack of operational agility to the fore. The Fortune 2020 magazine reported that over 94% of the companies on the list of the 1000 largest companies faced supply chain disruptions as a result of the Covid-19 pandemic (Sherman, 2020; Chowdhury et al., 2021). The network of value chains has shown weak resistance to a pandemic (Kumar et al., 2020). Also, Shokrani et al. (2020) state that almost 35% of manufacturers reported disruptions due to the global COVID-19 pandemic. According to a survey by auditing firm Ernst & Young Global Limited (2020) only 6% of companies are confident in their system and capabilities for E2E visibility in their value chain. In the context of the global disturbance caused by the pandemic, many operations managers sought management patterns that would adapt to the current situation in order to meet the needs and demands of end consumers.

Due to the current situation, globalization and efficiency based on lean principles are increasingly considered in a negative light, and currently, at least in the short term, there is a certain animosity, mistrust and doubt directed at these principles (Singh et al., 2021). In the United States and most European countries, major consequences have been observed in terms of the economic downturn that has led to serious losses of jobs, soon after the closure of various business facilities or the limitation of their working hours (Singh et al., 2021). At the same time, sustainability strategies and practices come to the fore, e.g., by encouraging more sustainable actions such as buying local products and building trust in local communities (Sarkis, 2020).

The COVID-19 pandemic also significantly affected operations through its impact on the workforce. Many employees are affected by low wages or loss of income. Sectors such as travel and tourism, food services, retail, manufacturing, and business and administrative activities are most at risk of unemployment and underemployment (Verma & Gustafsson, 2020). The COVID-19 pandemic increases the vulnerability of workers to find themselves in exploitative conditions and modern slavery as the most extreme form of labour exploitation (Trautrims et al., 2020). Although COVID-19 has caused serious job losses in global economies, the pandemic has also simultaneously led to labour shortages in industrial sectors with increased demand. The closure of borders has significantly affected the availability of migrant workers (Trautrims et al., 2020). For example, agriculture, as one of the most susceptible sectors, relies heavily on seasonal migrant workers, which calls into question what will happen if farmers cannot hire such workers. This means that some supply chains have consciously become much less transparent and that monitoring risky supplier behaviour, such as unauthorized subcontracting, has become more difficult due to resource constraints and mobility constraints caused by the aforementioned difficulties (Trautrims et al., 2020).

Another problem caused by the current pandemic is the problem of the bullwhip effect. One of the driving factors of the bullwhip effect is ordering oversized and unnecessary quantities due to the assumption of limited supply, sometimes referred to as shortage gaming (Seifert & Markoff, 2020). In this regard, and for these products such as respirators, the ideal method of allocating products with limited stocks should be

based on relative demand rather than actual demand quantities. Hospitals across the country are expected to order more stock based on perceived supply chain problems and imputed future demand. This type of order is precisely the mechanism behind the bullwhip effect and leads to delays and inefficiencies of producers, as well as limited access in areas with the greatest need (Patrinley et al., 2020).

The COVID-19 pandemic has had an enormous effect on all aspects and parts of the value chain, as well as its management worldwide, from the procurement of raw materials to the delivery of finished products. Based on the literature research, Table 1 presents a current overview of the impact of the COVID-19 pandemic on disruptions and changes in the value creation process and its influencing factors.

Table 1: Influence of the COVID-19 pandemic on different operations planning factors

Factors	Disruptions	Changes
Work force	Unemployment and underemployment in industries that have suspended their operations (Hobbs, 2020; Verma & Gustafsson, 2020; Belhadi et al., 2021; Farooq et al., 2021); Quarantine restrictions on movement caused by the spread of the pandemic (Sulaiman et al., 2020; Sharma et al., 2020; Trautrims et al., 2020; Nagurney, 2021); Lack of labour in industries where there has been an increase in demand (Xu et al., 2020; Hobbs, 2020; Sharma et al., 2020; Singh et al., 2021, del Rio-Chanona et al., 2020; Nagurney, 2021); Reduced supply of migrant labour due to border closures (Trautrims et al., 2020); Some activities cannot function through teleworking.	Development of digital competencies of employees (Sulaiman et al., 2020; van Hoek, Gibson & Johnson, 2020; Farooq et al., 2021); digitization of work procedures; teleworking; virtual collaboration between employees (*MS Teams, Zoom, Google Meet*); Employees health and safety as a primary goal. Maximum dedication of workers to one production line; Changing working methods to limit contact between workers; Issuing instructions online and avoiding personal contact; Establishing physical barriers between workstation on the production line; Shift handover meetings conducted remotely using technology.
Materials and components	Lack of raw materials and supplies (Xu et al., 2020; Fonseca & Azevedo, 2020; Kumar et al., 2020; Paul & Chowdhury, 2020; Belhadi et al., 2021); Disturbances in the raw materials market due to restrictions in transport and trade (Belhadi et al., 2021); Uncertainty in supply; Lack of stocks of finished goods (Ketchen and Craighead, 2020).	Alternative supply strategies (Xu et al., 2020; Fonseca & Azevedo, 2020; Remko, 2020, Ivanov & Dolgui, 2020; Steingberg, 2021); Development of local alternative suppliers (Fonseca & Azevedo, 2020; Sarkis, 2020; Paul & Chowdhury, 2020; Steingberg, 2021); Maintaining a higher security level of stocks of raw materials and necessary components (Ketchen and Craighead, 2020; Hobbs, 2020); Diversification of supplier base; Development of alternative components (development of digital twin technology) (Sarkis, 2020; Ivanov & Dolgui, 2020; Kumar et al., 2020).
Production process	Suspension of production activities (Xu et al., 2020; Ivanov & Dolgui, 2020; Paul & Chowdhury, 2020; El Baz & Ruel, 2021; Farooq et al., 2021); Changes in standard operating procedures at the workplace (Paul & Chowdhury, 2020; Farooq et al., 2021); Adaptation of production facilities, barriers to maintaining social distance; Reducing the productivity of the production process (worker safety as the primary goal); Longer production cycles; Vulnerability of just-in-time production and delivery system (Sarkis et al., 2020; Hobbs, 2020; Fonseca & Azevedo, 2020).	Transformation of the production process for social needs (Fonseca & Azevedo, 2020); Development of flexible and resilient production systems for rapid product changes (Ivanov & Dolgui, 2020; Paul & Chowdhury, 2020; Fonseca & Azevedo, 2020; Sharma, Adhikari & Borah, 2020); Digitization and robotization of production processes (Fonseca & Azevedo, 2020; Kumar et al., 2020; Ivanov & Das, 2020); Redesign of the premises and restructuring so that the workers could be at the appropriate distance from each other (such a decision required a smaller number of workers, longer production time, longer delivery time); Reconsideration of the prevailing system of globally dislocated production; Complete value chain transformation from rigid and linear to networked ecosystems.

Factors	Disruptions	Changes
Services	Suspension of numerous services; Tourism affected by travel restrictions (Xu et al., 2020); Demand for air transport industry services is minimal (Xu et al., 2020; Fonseca & Azevedo, 2020; del Rio-Chanona et al., 2020); Endangered hospitality and entertainment industry (Sulaiman et al., 2020; del Rio-Chanona et al., 2020).	Changes in service delivery (Hobbs, 2020; Paul & Chowdhury, 2020), safety and health in focus; Digitization of the public services sector (Hobbs, 2020) and services in general (Farooq et al., 2021).
Transport	Transport restrictions (both on the import and export side) due to border closures (Ivanov & Dolgui, 2020; Hobbs, 2020; Sharma et al., 2020; Belhadi et al., 2021); Reduction of logistics and distribution operations (Hobbs, 2020; Singh et al., 2021); Disorders in the delivery of products due to the lack of finished products and raw materials as well as the appearance of bottlenecks.	New modes of transport in the world (i.e., drones) (Kumar et al., 2020); Safety monitoring in the flow of goods; Diversification of 3PL/4PL service providers (Sarkis, 2020).
Supply	The reduction of supply due to factories lockdown and production with reduced capacity (Patrinley et al., 2020; Sharma et al., 2020); Redistribution of capacity to meet increased demand of essential and deficit products (Sharma et al., 2020; Paul & Chowdhury, 2020). Occurrence of shortage in groceries.	Offering new innovative products; Home delivery; intensive internet offers and sales.
Demand	Intensive retail activities, Increased demand for PPE equipment (masks, gloves, face shields, overalls and suits) and medicines, supplements, essential food categories, disinfectants, bicycles (Xu et al., 2020; Hobbs, 2020; Ivanov & Dolgui, 2020; Trautrims et al., 2020; Ketchen and Craighead, 2020; del Rio-Chanona et al., 2020; Singh et al., 2021; Farooq et al., 2021; Nagurney, 2021); Inability to meet demand by companies due to shortages of raw materials and fragile value chains (Patrinley et al., 2020); Falling demand for services, cars, clothing and fashion products, textiles, public transport services, entertainment services, sports and recreation, hospitality, etc. (Hobbs, 2020; Ivanov & Dolgui, 2020; Sharma, Adhikari & Borah, 2020; Farooq et al., 2021).	Internet sales, increasing demand for digital products and services (Sarkis, 2020).
Planning and management	Problems in current models (Patrinley et al., 2020): just-in-time (Ketchen and Craighead, 2020; Hobbs, 2020; Fonseca & Azevedo, 2020; Sarkis et al., 2020; Steingberg, 2021), zero inventory (Ketchen and Craighead, 2020).	Application of advanced analysis (Sharma et al., 2020), fast data processing, fast scenario analysis, optimization (Sharma, Adhikari & Borah, 2020); Use of AI-based techniques (Sharma, Adhikari & Borah, 2020; Sarkis et al., 2020); Development of advanced decision support systems; Mitigation strategies: delivery delay, definition of strategic stocks (Paul & Chowdhury, 2020; Steingberg, 2021), flexible supplier base, flexible transport, dynamic assortment planning; Industry 4.0 (IoT, AI, 3D, Robots; RFID, blockchain) (Xu et al., 2020; Sarkis, 2020; Sarkis et al., 2020); Implementation of the control tower which monitors E2E visibility in the supply chain and performs disturbance prevention.
Environment	People health and safety, social distancing (Sulaiman et al., 2020; Sarkis, 2020; Farooq et al., 2021), desocialization, lockdown (Sulaiman et al., 2020), restriction of movement (Trautrims et al., 2020).	Reducing global CO2 emissions, improving sustainability.

3. The Survey of the COVID-19 Pandemic Impact on Business and Planning Production Operations

In addition to the previous review, the paper also presents a study of the impact of COVID-19 on business and planning of production operations in several successful companies in the Republic of Serbia. The research was conducted in the period from 2020 to 2021 through a series of interviews, which were organized by the Serbian Supply Chain Professionals' Association (https://www.supplychain.rs/). The survey subjects were managers and professionals from the domain field who are employed in various positions in domestic and international production and service companies operating in the Republic of Serbia. The total number of interviewed professionals from diverse companies was 13. Interviewed supply chain professionals have various positions (logistics director, commercial director, executive director of operations, supply chain manager, logistics manager, procurement manager, transport director, planning manager, procurement expert) and the companies they come from operate in the following industries: FMCG, construction and building materials, pharmaceutical, beverages and soft drinks, processing, distribution and retail, transport, etc. The topics of the interview were trends and experiences in managing various processes in the integrated supply chain. Interviewees referred to the current situation caused by the COVID-19 pandemic and the process of planning production and service activities in conditions of uncertainty. In the mentioned interviews, content analysis was applied to obtain significant information upon the impact of the COVID-19 pandemic on the companies' business operations, the problems and challenges faced by the companies and further improvement and development to achieve expected resilience. The results of the interviews are shown in Table 2.

Based on the presented Table 2 and the opinions of experts from practice, it is possible to group the answers and thus identify those problems that are considered the most significant, as follows:

- General problems of global and local supply chains - based on responses related to disturbances in the global value chain, transformation of the classical supply chain, vulnerabilities of the global supply chain etc.
- The problem of inequality of supply and demand.
- Problems related to the lack of adequate business management systems - among other, based on the answer that traditional ERP systems are not flexible enough and that there is no integrated business process planning system.
- Problems related to digitalization - based on the experts' answers about the difficulties of digitalization and dislocation of production operations, and the digitalization difficulties of logistics and other processes.
- The problem of supply of raw materials due to unreliable suppliers and transport problems - based on answers about increased raw material costs, the unpredictability of delivery time, a limited market of Serbia for procurement of certain raw materials, collapses of air and ship transportation of goods, etc.
- Problems related to agility and flexibility - Based on the experts' answers about the lack of flexibility and adaptability and reactive approach to changes.
- Other problems - slowing economic growth, problems in planning, defining strategy, labour turnover etc.

Based on the previous review of scientific papers and analysis of the experts' answers, it can be seen that the problems which are in focus in the literature match with the perceived problems in practice at all levels of business. By the same principle, it is possible to identify the perceived challenges that arise as a result of the pandemic in the following domains:

- Digitalization and implementation of new technologies.
- Risk monitoring, assessment and forecasting.
- Adequate and fast reaction to new changes.
- Continuous improvement of business.
- Agility and adaptability of business processes.
- Planning in the conditions of uncertainty.
- Others (defining alternative suppliers, developing S&OP processes, environmental analysis, visibility and transparency, etc.)

Probably the most interesting are the observations of experts from practice related to the future development of supply chains and value chains, in order to overcome current problems, which can be grouped as follows:

- Suppliers and the entire supply process, i.e., Procurement - based on experts' responses about the development of alternative suppliers, the improvement of services for suppliers, the development of local suppliers, the development of new ways of supply, etc.
- Human resources - investing in the development of human resources and their competencies, improving the education system, fostering new knowledge and educating of employees.

- Digitalization and technology - introduction of new technologies, system automation, real-time process monitoring, focus on Blockchain, AI and big data, focus on planning and decision support systems, and digitalization of supply chain processes.
- Overcoming challenges through innovation - development of innovations in the value chain, investing in the development of new products and services, as well as expanding the portfolio.
- Sustainable development – Transfer to local sustainable value chains.
- Risk management - Risk analysis of alternative scenarios with development of mechanisms for mitigating negative effects; Risk management in SC as an emerging discipline.
- Other factors related to future development - Planning strategy, agility and creativity, new modes of transport, new types of distribution, cost optimization, environmental impact reduction, process automation, proactivity, mechanisms to mitigate negative effects.

Considering the problems, challenges and potential solutions recognized by supply chain practitioners, it can be concluded that there is an acute awareness of potential actions that need to be taken in this crisis period, especially if we look at the offered solutions in scientific research.

Thus, for example, Sharma, Adhikari & Borah (2020) state that companies are considering adopting more technologies that can ensure visibility throughout the value chain, as well as increase efficiency. Additionally, survey data from the interviews show that companies are looking for solutions that will provide visibility throughout the value chain. So, visibility in the supply chain has been recognized by experts as one of the main problems, and the application of new technology is often mentioned as a potential solution.

Automation of processes and operations is mentioned as a future direction of development, and it is Sarkis (2020) who states that production technology is going towards automation and data exchange systems in Industry 4.0, as well as that manufacturers use Industry 4.0 technologies, cyber-physical systems, Internet of things (IoT), Cloud computing, and cognitive computing, which can complement human decisions with technologies designed support and decentralize decision-making.

Table 2: Recognized problems, challenges, improvements, and future growth opportunities during the COVID-19 pandemic by experts from supply chain practice in different industries

Industry	Position	Problems during the pandemic	Challenges	Improvements	Future growth
Distribution and retail	SCM	Slowing economic growth; Impact on all segments of the supply chain; endangering the procurement and distribution process; Disorders of the global value chain are transferred to the local value chain; Impossibility of digitalization and dislocation of some production operations.	Digitalization of all processes; Rethinking traditional structures and building newer, more resilient chains based on risk assessments, creating potential scenarios, and responding to them; Defining alternative suppliers and selection strategies; Adapting long-term planning to current new circumstances.	The timely networking of information and value flows; A higher degree of digitalization has enabled teleworking in business processes, to protect the health of employees; Agile processes and a proactive approach.	Development of alternative suppliers, new types of distribution; Proactivity; Risk analysis of alternative scenarios, mechanisms for mitigating negative effects; Investing in the development of human resources and their competencies; The procurement function is becoming a strategic function for every business
IT engineering	COO	The problem of developing a reliable, flexible, and fast IT infrastructure and services and the timeliness of information flow; The global epidemiological situation has further raised the level of importance of IT infrastructure, IT services, information, data at the global level.	Challenges in the rapid reorganization of business processes and adaptation to the current situation; Preservation of the smooth/ uninterrupted flow of data, information, value of goods and materials; Flexibility and a willingness to change and progress have become a necessity; development of alternative scenarios due to radical transformations.	The IT infrastructure has enabled business processes and functions to run smoothly and the contribution to the protection of employees' health.	Further customers and suppliers service improvements.

Industry	Position	Problems during the pandemic	Challenges	Improvements	Future growth
Confectionery industry	SCM	At the beginning of the pandemic traditional information systems (ERP) were not flexible and fast enough to adapt to huge changes in supply and demand.	Efficient planning system; Development of S&OP processes and best practice of making planning decisions; Development of solutions that can quickly identify supply-side constraints and bottlenecks and run a multitude of simulations and what if scenarios. Understanding the process and how it generates the result.	Professions in the field of Supply Chain Management have once again gained importance.	Introduction of new technologies (AI) in the processes of planning and simulation, going towards transparency of the entire supply chain.
Distribution and retail	CD	Imbalance of supply and demand; Transformation of the classical supply chain.	Flexibility and supply chain adjustment; Digitalization that changes the habits and needs of consumers in retail; Introduction and acceptance of new technologies.	Digitalization; Integrating individual supply chain components to digital platforms.	Human resource development and adoption of high-tech knowledge for designing and managing complex automated systems.
Construction materials	LM	Digitalization of logistics processes and other business processes.	Paperless business; Networking as an informal form of integration within the value chain.	Logistics and supply chain management have gained the importance in the circumstances of the COVID-19 pandemic.	Sustainable development in focus; New technology opens the possibility of integration planning, cost optimization, real-time monitoring, reducing environmental impact: Blockchain, AI, Big data.
Oil industry	MN	Rising prices of raw materials and imported materials, limited Serbian market for the supply of specific materials; Long lead times for certain raw materials.	The importance of digitalization; Digitalization of business processes and documents: e-invoices, e-contracts, cloud platforms for negotiations, supplier database and selection, risk reduction of supplier selection. Lessons on the "black swan"; Agile approach.	Electronic invoicing; Teleworking; Increased importance of risk management.	Strategic orientation of procurement (prices, quality, delivery time) given the impact on the entire supply chain; Development of supply chain innovations.
Pharmaceutical industry	PM	Problems in the global supply chain; Global supply chain vulnerability.	Continuous analysis of the business environment, risk assessment, business risk management and readiness for change management; Improving visibility and transparency.	Digital transformation.	Support for the process of optimization and automation, Introduction of planning and decision support systems: ERP, WMS, IoT, blockchain, machine learning and AI.
Manufacturing of plastic products	LD	Lack of integration of business process planning systems; Lack of flexibility and adaptability to an unstable environment.	The planning process and synchronization of its factors is essential for an efficient supply chain; The development of organizational culture towards continuous improvements.	Integrated business process planning.	Improving the education system by connecting science and industry.

Industry	Position	Problems during the pandemic	Challenges	Improvements	Future growth
Confectionery industry	COO	Reactive approach to improvement (only with the appearance of problems in a crisis); Increased costs and longer lead time for raw materials from Asia.	Changing the way of thinking, encouraging desires and inspiration for constant improvement (preventive approach); Agile and E2E approach in management of business operations in SC. Focus on increasing efficiency and optimization in SC.	Working in a digital business environment; Communication in the digital environment.	Digitalization of processes in the supply chain. Investing in employees and development of their competencies; Improving the sustainability of business; Risk management in SC as emerging discipline. Development of local suppliers; Development of alternative sources of supply, as well as alternative raw materials.
Transport	TD	Disruptions in global supply and transport (air and sea transport). Agility and adaptability of business processes.	Digitalization in the supply chain; Investments in the domain of information systems and technologies (problem of the best solution selection).	Increase in internet sales and delivery.	Investing in people, in the development of their knowledge and competencies; Investment in the development of new services, portfolio and capacity expansion.
Pharmaceutical industry	MP	Problems in pharmaceutical market planning due to unknown approaches in treatment; Frequent changes in strategy and human resources lead to negative consequences and poor results.	Challenges of market planning, distribution of the right products at the right time.	Using advanced tools such as the SAP PP module for production planning.	Planning strategy and employee education as two key prerequisites for efficient operations management.
Non-alcoholic beverage industry	PM	Supply problems, disruption of strategic plans due to the epidemic crisis; Demand imbalance and delivery unreliability.	Actions and activities aimed at maintaining business activity due to the pandemic. Procurement risk and cost management; Timeliness and agility; Development and analysis of different scenarios in conditions of uncertainty and risk; Protecting employees' health.	Development of local supplier industries; Development of new relationships with suppliers; Product and service innovation.	Managing procurement risks and costs is a priority for adapting to the new economic reality. Agility and creativity of the organizational system.
Production of oils and lubricants	SCM	Transport (shipping). Predictability of delivery time and transport prices.	Digitalization of business processes; Adapting to new market conditions; Employee training for digital solutions.	Development of internal problem-solving initiatives; Exchange of experiences in the organization of operations in the integrated SC.	New modalities of transport, new ways of supply, market changes.

SCM – Supply Chain Manager COO – Chief Operations Officer CD – Commercial Director LM – Logistics Manager
PM – Procurement Manager LD – Logistics Director TD – Transport Director MP – Planning Manager

Sarkis (2020) also mentions companies that are turning to the concept of fourth-party logistics (4PL) in order to find more available logistics options, as opposed to using a single logistics provider with a single source, which can potentially stop production and delay deliveries. One of the main focuses of experts from practice was the improvement of the supply and procurement process, and the previously mentioned author provides a potential solution, the application of which simultaneously builds agility and resilience of the supply chain. This way of thinking is supported by both Ketchen and Craighead (2020), who say that many entrepreneurial companies rely on a single distribution channel, but that those who had different channels and those who managed to change channels during the COVID-19 pandemic had an advantage over others who could not. They also state that the importance of supply chain agility was at the centre of attention during the COVID-19 pandemic and that stock shortages and inert replenishment caused by the pandemic revealed how many companies must work on agility. The importance of the existence of multiple sources of raw materials is also mentioned by authors Fonseca & Azevedo (2020), who mention it along with increasing

stocks and reducing the physical distance between companies and their suppliers in the context of enhancing the resistance of supply chains and value chains.

Technology and its application have been a frequently mentioned topic by interviewed experts from practice. Kumar et al. (2020) agrees with this, stating that the application of advanced technologies such as AI, 3D printing, data analytics, robots, and cyber-physical systems can help develop a decentralized production system. Additionally, Sarkis (2020), states that having the necessary systems based on data such as the big data concept can help organizations respond quickly to crises, especially environmental and social crises, as can technologies such as blockchain, enabling transparent, reasonably fast, accurate and wide exchange of information. Integrating listed systems with the Internet of Things (IoT) and Artificial Intelligence (AI) can change the way supply chain managers make decisions and do business in the future.

Digital production would help maintain social distance during the production process while at the same time controlling the workforce flow. Similarly, food and essential items delivered in cities can be regulated using technologies such as drones, resulting in the prevention of direct contact in product delivery (Kumar et al., 2020).

Human resources development with its proper management process, are the focus of the supply chain experts' answers. The pandemic is viewed from this angle by van Hoek, Gibson & Johnson (2020), who in this crisis period emphasize the role of line managers and human resources managers in aligning the required workforce with the needs of the company. They state that the focus is on managers with higher emotional intelligence, where it is considered that such managers are better equipped to build positive working conditions, retain employees, and achieve more positive results in relation to the needs of external clients. It can be assumed that in a pandemic environment, but also after it, emotional intelligence will gain importance. It is also assumed that the ability of managers to support employees through stressful and challenging periods can increase the resilience of supply chains, which is something that is imposed as an imperative in times of crisis (van Hoek, Gibson & Johnson, 2020).

Conclusion

The outbreak of the COVID-19 pandemic and its effects on the global supply chain are much greater than the previously perceived risk, and according to Pujawan & Bah (2022) the pandemic is likely to have negative effects in the forthcoming period. As a consequence of failure to assess risk and the effects of an adverse event, the pandemic as a risk category has changed priority in risk assessment. One of the lessons that can already be learned from this crisis is the urgent need to create and design more robust, resilient, and smarter supply chains (Hobbs, 2020). Decentralization of capacities, procurement of raw materials from several sources and small series of production, as well as digitalization are some of the concepts that could be important in the future creation of supply chains. Currently, the priority should be to build more resilient supply chains.

The just-in-time supply chain model is effective under normal circumstances. However, the consequences of the current pandemic suggest that this model is sensitive to short-term disruptions caused by supply and demand shocks. Robust and reliable supply chain relationships are essential to increasing supply chain resilience. Buyer-seller collaborative relationships build trust among supply chain partners and flexibility in responding to unexpected changes in demand or unexpected supply disruptions (Hobbs, 2020). In this context, some companies might consider moving from a just-in-time methodology to a just-in-case methodology and have enough inventory in place to reduce uncertainties due to fluctuations in supply and demand and to shift the focus from pure efficiency to efficiency balanced with flexibility, resilience, and reliability. This would require that safety stocks are given priority over modern concepts of timely inventory replenishment, but it is also necessary to reach a compromise between the high cost of safety stock and the risk of revenue loss due to supply disruptions. This paradigm change, however, would require a greater quantity of products in stock, which represents additional costs and is not in line with the lean approach. This new approach would represent a compromise between efficiency and resilience (Fonseca & Azevedo, 2020).

Traditional supply chain structures are cost-optimized and are not eligible to deal effectively with multiple unplanned outages and disruptions. Recommendations for a strategy to reduce the impact of COVID-19 on value chains could be (Sharma et al., 2020; Driessen, 2020; Kumar et al., 2020; Shih, 2020):

- The sustainability of the supply chain should be evaluated from the aspect of health and safety of employees. Communication with employees to raise safety and health awareness should be increased.
- Redesign of the supply chain in order to increase flexibility and resiliency through procurement of alternative raw materials and suppliers of those materials, change of production location, development of more resistant transport and distribution systems; Cooperation and collaboration in the value chain and exchange of accurate and reliable

information with chain partners; implementation of blockchain technology; moving away from rigid and linear chains and towards adaptive network ecosystems; Transformation into digital supply networks (DSNs); Development of alternative business models.

- Make the value chain visible from end to end. Conduct an E2E risk assessment to test the whole supply chain and identify critical scenarios and define potential responses. Regular performing of "what-if analysis", and scenario risk assessment, implementation of stress tests and ability development. Risk assessment of new products and identification of changes in supply and demand.
- Capacity development: investing in key business capabilities; development of own production capabilities; Identification of potential bottlenecks in the value chain.
- Application of advanced technologies in production process: Digital production (Industry 4.0 based production, Digital Twins, 3D printing), continuous monitoring, reporting and early warning by the use of Artificial Intelligence, fast real-time data processing of production and consumption patterns, Internet of Things, Machine Learning etc.
- "Pandemic planning" - agile planning that should be adjusted to current market conditions. Establishing an integrated planning process, coordinating it with partners in the supply chain. Additionally, the introduction of the plans for post-COVID periods is advisable. Pandemic planning should include adjusted forecasts, integrated plans with strategic and operational horizons as well as external sources of information from suppliers and customers.

“There’s never been a better time in society’s history to finally get that visibility so we can make better business decisions,” Steinberg (2021) said. If the recommendations are not sufficiently well followed, companies in supply chains with long delivery times and lacking end-to-end visibility are in the "danger zone". Besides, most companies upstream in the value chain will be affected by the bullwhip effect. During the crisis caused by the COVID-19 pandemic, agile and network enterprise ecosystems are the key to maintaining the flexibility of a successful business.

This paper is also aimed at future researchers to identify key success factors, inhibitors, and drivers for tackling the pandemic situation and to propose policy frameworks to improve the resilience of production and operational processes. It is, therefore, necessary to discuss a sustainable pattern of planning production operations in the post-pandemic COVID-19.

REFERENCES

[1] Alkahtani, M., Omair, M., Khalid, Q. S., Hussain, G., Ahmad, I., & Pruncu, C. (2021). A covid-19 supply chain management strategy based on variable production under uncertain environment conditions. *International Journal of Environmental Research and Public Health,* 18(4), 1662. DOI: 10.3390/ijerph18041662

[2] Ardolino, M., Bacchetti, A., & Ivanov, D. (2022). Analysis of the COVID-19 pandemic’s impacts on manufacturing: a systematic literature review and future research agenda. *Operations Management Research,* 1-16. DOI: 10.1007/s12063-021-00225-9

[3] Belhadi, A., Kamble, S., Jabbour, C. J. C., Gunasekaran, A., Ndubisi, N. O., & Venkatesh, M. (2021). Manufacturing and service supply chain resilience to the COVID-19 outbreak: Lessons learned from the automobile and airline industries. *Technological Forecasting and Social Change,* 163, 120447. DOI: 10.1016/j.techfore.2020.120447

[4] Chowdhury, P., Paul, S. K., Kaisar, S., & Moktadir, M. A. (2021). COVID-19 pandemic related supply chain studies: A systematic review. *Transportation Research Part E: Logistics and Transportation Review,* 102271. DOI: 10.1016/j.tre.2021.102271

[5] del Rio-Chanona, R. M., Mealy, P., Pichler, A., Lafond, F., & Farmer, J. D. (2020). Supply and demand shocks in the COVID-19 pandemic: An industry and occupation perspective. *Oxford Review of Economic Policy,* 36(Supplement_1), S94-S137. DOI: 10.1093/oxrep/graa033

[6] Driessen, M. (2020). Supply chain scenario planning: navigate your way out of COVID-19 lockdowns. LinkedIn article. Link: https://www.linkedin.com/pulse /supply-chain-scenario-planning-navigate-your-way-out-maarten-driessen/

[7] El Baz, J., & Ruel, S. (2021). Can supply chain risk management practices mitigate the disruption impacts on supply chains’ resilience and robustness? Evidence from an empirical survey in a COVID-19 outbreak era. *International Journal of Production Economics,* 233, 107972. DOI: 10.1016/j.ijpe.2020.107972

[8] Ernst & Young Global Limited (2020). Responding to COVID-19: What’s next for supply chains. EY webcast poll, April 2020.

[9] Farooq, M. U., Hussain, A., Masood, T., & Habib, M. S. (2021). Supply chain operations management in pandemics: a state-of-the-art review inspired by COVID-19. *Sustainability,* 13(5), 2504. DOI: 10.3390/su13052504

[10] Fonseca, L. M., & Azevedo, A. L. (2020). COVID-19: outcomes for Global Supply Chains. Management & Marketing. *Challenges for the Knowledge Society,* Vol. 15, No. Special Issues, 424-438. DOI: 10.2478/mmcks-2020-0025

[11] Govindan, K., Mina, H., & Alavi, B. (2020). A decision support system for demand management in healthcare supply chains considering the epidemic outbreaks: A case study of coronavirus disease 2019 (COVID-19). *Transportation Research Part E: Logistics and Transportation Review,* 138, 101967. DOI: 10.1016/j.tre.2020.101967
[12] Grida, M., Mohamed, R., & Zaied, A. N. H. (2020). Evaluate the impact of COVID-19 prevention policies on supply chain aspects under uncertainty. *Transportation Research Interdisciplinary Perspectives,* 100240. DOI: 10.1016/j.trip.2020.100240
[13] Hobbs, J. E. (2020). Food supply chains during the COVID-19 pandemic. *Canadian Journal of Agricultural Economics/ Revue canadienne d'agroeconomie,* 68(2), 171-176. DOI: 10.1111/cjag.12237
[14] Ivanov, D., & Das, A. (2020). Coronavirus (COVID-19/SARS-CoV-2) and supply chain resilience: A research note. *International Journal of Integrated Supply Management,* 13(1), 90-102.
[15] Ivanov, D., & Dolgui, A. (2020). Viability of intertwined supply networks: extending the supply chain resilience angles towards survivability. A position paper motivated by COVID-19 outbreak. *International Journal of Production Research,* 58(10), 2904-2915.
[16] Ivanov, D., Sokolov, B., & Dolgui, A. (2014). The Ripple effect in supply chains: trade-off 'efficiency-flexibility-resilience'in disruption management. *International Journal of Production Research,* 52(7), 2154-2172. DOI: 10.1080/00207543.2020.1750727
[17] Kannan, V. R., & Tan, K. C. (2005). Just in time, total quality management, and supply chain management: understanding their linkages and impact on business performance. *Omega,* 33(2), 153-162. DOI: 10.1016/j.omega.2004.03.012
[18] Ketchen Jr, D. J., & Craighead, C. W. (2020). Research at the intersection of entrepreneurship, supply chain management, and strategic management: opportunities highlighted by COVID-19. *Journal of Management,* 46(8), 1330-1341. DOI: 10.1177/0149206320945028
[19] Kumar, A., Luthra, S., Mangla, S. K., & Kazancoglu, Y. (2020). COVID-19 impact on sustainable production and operations management. *Sustainable Operations and Computers,* 1, 1-7. DOI: 10.1016/j.susoc.2020.06.001
[20] McIvor, R. (2001). Lean supply: the design and cost reduction dimensions. *European Journal of Purchasing & Supply Management,* 7(4), 227-242. DOI: 10.1016/S0969-7012(01)00004-1
[21] Nagurney, A. (2021). Optimization of supply chain networks with inclusion of labor: Applications to COVID-19 pandemic disruptions. *International Journal of Production Economics,* 235, 108080. DOI: 10.1016/j.ijpe.2021.108080
[22] Paul, S. K., & Chowdhury, P. (2020). A production recovery plan in manufacturing supply chains for a high-demand item during COVID-19. *International Journal of Physical Distribution & Logistics Management.* DOI: 10.1108/IJPDLM-04-2020-0127
[23] Pujawan, I. N., & Bah, A. U. (2022). Supply chains under COVID-19 disruptions: literature review and research agenda. *Supply Chain Forum: An International Journal,* 23(1), 81-95. DOI:10.1080/16258312.2021.1932568
[24] Qin, X., Godil, D. I., Khan, M. K., Sarwat, S., Alam, S., & Janjua, L. (2021). Investigating the effects of COVID-19 and public health expenditure on global supply chain operations: an empirical study. *Operations Management Research,* 1-13. DOI: 10.1007/s12063-020-00177-6
[25] Remko, V. H. (2020). Research opportunities for a more resilient post-COVID-19 supply chain–closing the gap between research findings and industry practice. *International Journal of Operations & Production Management,* 40(4), 341-355. DOI: 10.1108/IJOPM-03-2020-0165
[26] Sahoo, P., & Ashwani. (2020). COVID-19 and Indian economy: Impact on growth, manufacturing, trade and MSME sector. *Global Business Review,* 21(5), 1159-1183. DOI: 10.1177/0972150920945687
[27] Sarkis, J. (2020). Supply chain sustainability: learning from the COVID-19 pandemic. *International Journal of Operations & Production Management.* DOI: 10.1108/IJOPM-08-2020-0568
[28] Sarkis, J., Cohen, M. J., Dewick, P., & Schroder, P. (2020). A brave new world: Lessons from the COVID-19 pandemic for transitioning to sustainable supply and production. *Resources, Conservation, and Recycling,* 159, 104894. DOI: 10.1016/j.resconrec.2020.104894
[29] Seifert, R. W., & Markoff, R. (2020). Digesting the shocks: how supply chains are adapting to the COVID-19 lockdowns. IMD. https://www. imd. org/researchknowledge/articles/supply-chains-adapting-to-COVID-19.
[30] Shahed, K. S., Azeem, A., Ali, S. M., & Moktadir, M. (2021). A supply chain disruption risk mitigation model to manage COVID-19 pandemic risk. *Environmental Science and Pollution Research,* 1-16. DOI: 10.1007/s11356-020-12289-4
[31] Sharma, A., Adhikary, A., & Borah, S. B. (2020). Covid-19's impact on supply chain decisions: Strategic insights from NASDAQ 100 firms using Twitter data. *Journal of Business Research,* 117, 443-449. DOI: 10.1016/j.jbusres.2020.05.035
[32] Sharma, M., Luthra, S., Joshi, S., & Kumar, A. (2020). Developing a framework for enhancing survivability of sustainable supply chains during and post-COVID-19 pandemic. *International Journal of Logistics Research and Applications,* 1-21. DOI: 10.1080/13675567.2020.1810213

[33] Sherman E. (2020). 94% of the Fortune 1000 are seeing coronavirus supply chain disruptions: Report. Fortune 1000. Link: https://fortune.com/2020/02/21/fortune%20-1000-coronavirus-china-supply-chain-impact/
[34] Shih, W. C. (2020). Global supply chains in a post-pandemic world. *Harvard Business Review,* 98(5), 82-89.
[35] Shokrani, A., Loukaides, E. G., Elias, E., & Lunt, A. J. (2020). Exploration of alternative supply chains and distributed manufacturing in response to COVID-19; a case study of medical face shields. *Materials & Design,* 192, 108749. DOI: 10.1016/j.matdes.2020.108749
[36] Singh, S., Kumar, R., Panchal, R., & Tiwari, M. K. (2021). Impact of COVID-19 on logistics systems and disruptions in food supply chain. *International Journal of Production Research,* 59(7), 1993-2008. DOI: 10.1080/00207543.2020.1792000
[37] Spieske, A., & Birkel, H. (2021). Improving supply chain resilience through industry 4.0: a systematic literature review under the impressions of the COVID-19 pandemic. *Computers & Industrial Engineering,* 158, 107452. DOI: 10.1016/j.cie.2021.107452
[38] Steinberg, G. (2021). Covid-19: How to build resiliency into your supply chain. Ernst & Young Global Limited. Link: https://www.ey.com/en_us/covid-19/covid-19-how-to-build-resiliency-into-your-supply-chain
[39] Sulaiman, M. A. B. A., Ahmed, M. N., & Shabbir, M. S. (2020). Covid-19 challenges and human resource management in organized retail operations. *Utopia y Praxis Latinoamericana,* 25(12), 81-92. DOI: 10.5281/zenodo.4280092
[40] Trautrims, A., Schleper, M. C., Cakir, M. S., & Gold, S. (2020). Survival at the expense of the weakest? Managing modern slavery risks in supply chains during COVID-19. *Journal of Risk Research,* 23(7-8), 1067-1072. DOI: 10.1080/13669877.2020.1772347
[41] Van Hoek, R., Gibson, B., & Johnson, M. (2020). Talent Management For a Post COVID 19 Supply Chain—The Critical Role for Managers. *Journal of Business Logistics,* 41(4), 334-336. DOI: 10.1111/jbl.12266
[42] Verma, S., & Gustafsson, A. (2020). Investigating the emerging COVID-19 research trends in the field of business and management: A bibliometric analysis approach. *Journal of Business Research,* 118, 253-261. DOI: 10.1016/j.jbusres.2020.06.057
[43] World Trade Organization (WTO), 2020. Trade set to plunge as COVID-19 pandemic upends global economy. Link: https://www.wto.org/english/news_e/pres20_e/ pr855_e.htm
[44] Xu, Z., Elomri, A., Kerbache, L., & El Omri, A. (2020). Impacts of COVID-19 on global supply chains: facts and perspectives. *IEEE Engineering Management Review,* 48(3), 153-166. DOI: 10.1109/EMR.2020.3018420

Received: 2022-23-03
Revision requested: 2022-05-05
Revised: 2022-05-18 (1 revision)
Accepted: 2022-05-27

About the Authors

Zoran Rakićević
University of Belgrade, Faculty of Organizational Sciences, Serbia
zoran.rakicevic@fon.bg.ac.rs

Zoran Rakićević is an assistant professor at the Faculty of Organizational Sciences, University of Belgrade, Department for Production and Services Management. He got his PhD degree in Information systems and quantitative management at the same University. Zoran published more than 10 scientific papers in international journals and 30 papers in proceedings of international conferences. He is an active member of the Serbian Supply Chain Professionals' Association. His research interests are Operations management, Production planning and Management of SMEs.

Ognjen Anđelić
University of Belgrade, Faculty of Organizational Sciences, Serbia
ognjen.andjelic@fon.bg.ac.rs

Ognjen Anđelić is a teaching associate at the Faculty of Organizational Sciences, University of Belgrade, Department for Production and Services Management. He got his Master's degree in business analytics at the same University. His research interests are in the fields of Production and services planning, with a focus on quantitative approach, as well as Entrepreneurship and Management of SMEs.

Goran Popović
Koncern Bambi a.d. Požarevac, Serbia
gpopovic@bambi.rs

Goran Popović is a graduate engineer at the Faculty of Mechanical Engineering, University of Belgrade. After 25 years of dynamic and intensive work experience in different industries he is inspired by and passionate about the continuous implementation of global innovations, standards and sustainable business and operational models in Serbia and the region. Goran is an experienced leader with a demonstrated history of working in the Packaging, FMCG, Agriculture and Automotive industry. He also possesses strong professional skills in Change Management, People and Talent development, Business Planning, Supply Chain Set Up and Optimization, Operations Management, S&OP, Negotiation.

Bojana Branković
Beorol d.o.o., Belgrade, Serbia
brankovic.b@beorol.rs

Bojana Branković is a Logistic Director at Beorol LLC, where she handles production and distribution of painting tools. She previously worked as a supply chain manager in food production at Neoplanta, and as a supply planning and purchasing manager in a distribution company at Nelt. She is skilled in Inventory Management, Material Requirements Planning (MRP), Production Planning, Process Optimization, Forecasting, as well as continuous process improvement. Bojana is also a certified Lean Six Sigma Black Belt holder.