DIGITAL SUPPLY CHAIN: LEADING TECHNOLOGIES AND THEIR IMPACT ON INDUSTRY 4.0

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Abstract

In the era of rising technological innovations all parts of economy are affected by a tremendous amount of new, helpful and after all absolutely necessary business solutions. Supply chain management is one of the leading pioneers in the field of technological implementation among other industries. The need for new solutions is inevitably rising and demand for modified and better business models is an every- day struggle. New technological solutions have direct implications on servicing a variety of members in supply chain. Adoption time has been in positive correlation with the quantified amount of improvement. Improvement in manufacturing cost effectiveness, communication, procurement process, lead delivering time, final customer experience etc. are just some of positive final results in terms of gaining greater profit by using new technologies in business. For example, some research study showed that few companies even managed to reduce their document manipulation error to quote of zero by using blockchain based database. The aim of this research is to extract the leading innovative technologies, overview their possibilities of implementation and show the final effects on the members of supply chain. Further research can be focused on the deeper analysis of effects of each of the listed technology solutions and their practical implementation. Managing of interconnected entities and processes within supply chain in industry 4.0 is more than a challenge.

Key words: technology innovations, industry 4.0, supply chain, implementation effects

1. INTRODUCTION

Nowadays, a competitive business environment is additionally overwhelmed by a variety of digital technological business solutions which can or cannot be used in proper manner. There is a significant amount of innovative products which are

promoted as high level business problem solvers but only few of them are actually embraced by companies. The role of key members in any supply chain is to filter out the best solutions available on market and implement them in their businesses; otherwise, the strong competition on saturated market will force them to develop their own innovations. In both cases, it is in the best interest of companies to be proactive and to take steps in improving business processes, communications and finally, business results. The improvement in conventional Supply chain management (SCM) is recognized through rapid implementation of new technologies. Switching from computers to smart devices is any area of business is considered to be a pick milestone in Industry 4.0. The same thing can be transferred onto SCM (Tjahjono et al., 2017).

Industry 4.0 and Digital Supply Chain (DSC) are results based on desire to improve quality of life and doing business by implementing technological solutions (Dossou, 2018). Traditional supply chain faces many challenges, unnecessary costs, vulnerable problems and its need to be smarter (Abdel – Basset et al., 2018). In that manner, a company needs to understand that digitalization of its business processes in modern era is a necessity in order to reduce costs and improve productivity. Mechanization, automation, flexible manipulation, real time communication, improved trust, agile service, shortened expected delivery time are main focuses in DSC.

Digital disruptions and rising of internet business forced supply chain decision makers to empower relationships between supply chain members by using new technologies (Vendrell – Herrero et al., 2016). Downstream, from supplier and manufacturer to final customer, everybody in the mentioned supply chain needed to make changes and to accept the new way of business. There are new types of technologies in Industry 4.0 which affect SC, for example: 1. Communications (real time communication between entities), 2. Merchandize manipulation (solutions based on robotics and sensor technology), 3. Origin track (blockchain technology), 4. Distribution of goods (self-driving vehicles), 5. Data managing (Big data usage), etc. It is crucial for every member to understand the value of adopting new technologies in order to make synergetic effect throughout the SC.

Beside many advantages in Industry 4.0, certain risks can arise (Huo et al., 2015). Poorly executed implementation, misunderstanding with technology purpose, security breaches, high level of technology reliability, potential loss of personal relations with supply chain members are just some of the problems which can be identified at DSC.

There is a lot of potential to achieve positive effect from Industry 4.0 on SCM. For example, main practical advantages have been seen at certain logistics functions, such as: Internal SC logistics, Internal purchasing, Provider packaging, Provider port logistics etc. Expected potentials in these functions are shown throughout a variety of advantages: flexibility, decreasing documentation efforts, usability of data, cost savings, traceability, decreasing of incorrect delivery, etc. (Muller, et al., 2018).

This paper addresses an overview of fundamental impacts of new technologies onto SCM. In the first part, the subject will be on definitions, vision and main concept of DSC. The second part will be focused on the most important technologies that have been implemented in DSC. The third part will show what the impacts and final results

of digitalization of SC are. In the conclusion the paper will discuss the best recommendations for further technology implementation in SC.

2. DIGITAL SUPPLY CHAIN – DEFINITIONS, VISION AND CONCEPT

2.1. Digital supply chain - definitions

Traditional SCM is slowly but steadily shifting toward digitalization. The era of the usage of modern technologies in business models is on the way and a large number of companies have already taken steps in the redesign of its business processes. Making correct guidelines for companies will impact faster adoption time within SC members.

High quality of stated definitions and concept is something that must not be called into question. Providing the best advice for incoming Industry 4.0 is an obligation for every researcher. Before continuing elaboration on the impact of new technologies on SC the paper will focus on definitions, vision and concept of DSC. Büyüközkan, in his paper called Digital supply chain: literature review and a proposed framework for future research, claims that supply chains and logistics are in a rapid change and that today's digital model can replace physical model of warehouse management, trucks etc.

There is not a large number of authors who tried to define DSC, but few of them which did, made a great contribution to understanding the structure of DSC in one or two sentences.

Capgemini Consulting states that traditional supply chain relies on a mixture of electronic processes and paper-based documentations. The organizational structures are often illustrated by functional and geographical silos which are reluctant to share information openly, leading to a sub-optimal performance. DSC, on the other hand, has the capability of making widespread information available, superior collaboration and communications across digital platforms, resulting in enhanced reliability, agility and effectiveness.

Bhargava et al. state that DSC is composed of those systems (e.g. software, hardware, communication networks) that support interactions between globally distributed organizations and orchestrates the activities of the partners in supply chains. These activities include buying, making, storing, moving and selling a product.

Accenture Consulting proposes that digitalization has the potential to transform supply chains by making services more valuable, accessible and affordable. Accordingly, a different perspective is needed for digital technologies to create new supply chain opportunities. Organizations should reimagine their supply chains as a digital supply network that not only unites physical flows of products and services, but also talents, information and finance. In an abstract sense, people and data, as well as materials, products and supplies, must travel together across the extended enterprise.

According to **Kinnet,** DSC is an intelligent, value driven network that leverages new approaches with technology and analytics to create new forms of revenue and business value.

The analysis of the report prepared by **A.T. Kearney and WHU- Otto Beisheim School of Management** defines DSC as the best-fit technologies that support and synchronize supply chain processes – including warehouse and transportation systems, Radio Frequency Identification (RFID), advanced picking technologies, and innovative planning and scheduling systems to quickly alleviate areas of "pain", such as waste in the supply chain, in a world where demand is volatile and risks are high.

The Digital Supply Chain Initiative describes the DSC as a customer-centric platform that captures and maximizes the utilization of real-time information emerging from a variety of sources. They suggest that DSC enables demand stimulation, sensing, matching and management in order to have an optimized performance and minimized risk.

According to **Rouse**, DSC is a supply chain whose foundation is built on Web-enabled capabilities. Many supply chains use a mix of paper-based and IT-enabled processes. A true DSC goes far beyond this hybrid model to fully capitalize on connectivity, system integration and the information-producing capabilities of "smart" components.

Cecere defines DSC as a process that uses new technologies to define processes to sense, respond and orchestrate directionally from market to market (from the channel to supplier networks). The processes move at the cadence of the market.

2.2. Digital supply chain - vision

The best way to describe DSC vision is to show challenges which are facing current SCM and to give proper recommendation for further research. According to research on SC challenges conducted by SAP there are several topics regarding solving problems in modern SCM. Those challenges are: supply chain visibility; demand volatility and new demand channels; supply chain complexity management; globalization and sales growth; new business models and innovations; flexible response management; collaboration; process standardization and automation; fixing the supply chain basics; supply volatility management; segmentation of products and customers. Listed challenges are core basic of future development of SCM (Figure 1).

Figure 1. Summary of challenges and their priority in terms of creating new DSC vision

Source: https://www.sap.com/documents/2017/04/88e5d12e-b57c-0010-82c7-eda71af511fa.html, [access April 18, 2019]

Listed data in Figure 1 represents challenges which should be modified and improved. Given level of necessity in the changing of current state is represented in percentage so it can be fully understood. There is an obvious need for improving SC visibility for all members of chain. Full scale transparency is something which would almost every SC manager want to see in DSC. Demand, complexity management and sales growth are at a high level in necessity for change as well. New business models, flexible response management, collaboration and process standardization are something that approximately every other SC manager would like to see. In the end, fixing the basics of SCM, volatility management and segmentation of products is a basis for a change.

In conclusion, the vision of DSCM can be defined as an improved business model of doing business in SC based on innovative intelligent technological solutions in order to achieve top performance throughout SC network. The vision of DSC is most certainly one of the most important parts in terms of the implementation of a new concept in SCM. Foremost, it should be a true guideline to companies to embrace new aspects of doing business. Adopting new vision is a real challenge for companies' culture and there is a need to provide the guidelines and persuade SC members to change their business behavior.

2.3. Digital supply chain - concept

The conducted research on DSC carried out in 2018 indicated that the concept of DSC is still in its early years of research and development among academics, while it is widely recognized and discussed among practitioners. As far as

it is known, there are no academic studies that explicitly focus on the DSC concept. However, there are supply chain focused articles which discuss DSC technologies in terms of their applications. The following analysis supports this statement (Büyüközkan et al. 2018).

According to the concept designed at **PWC** in 2016, the concept of DSC is best described as a model of an integrated supply chain ecosystem. The concept relies on digital tower as a centered and most important function in DSC (Figure 2). Concept recognizes Digital control as the crucial part of DSC functioning.

Figure 2. Traditional SC model

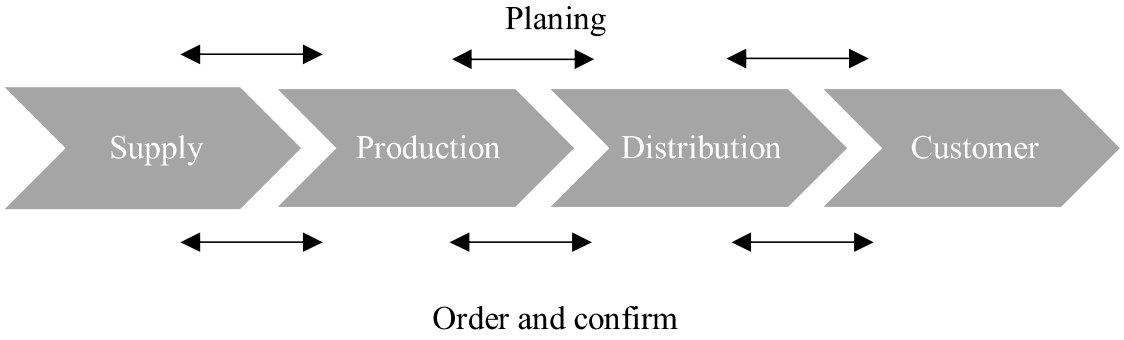
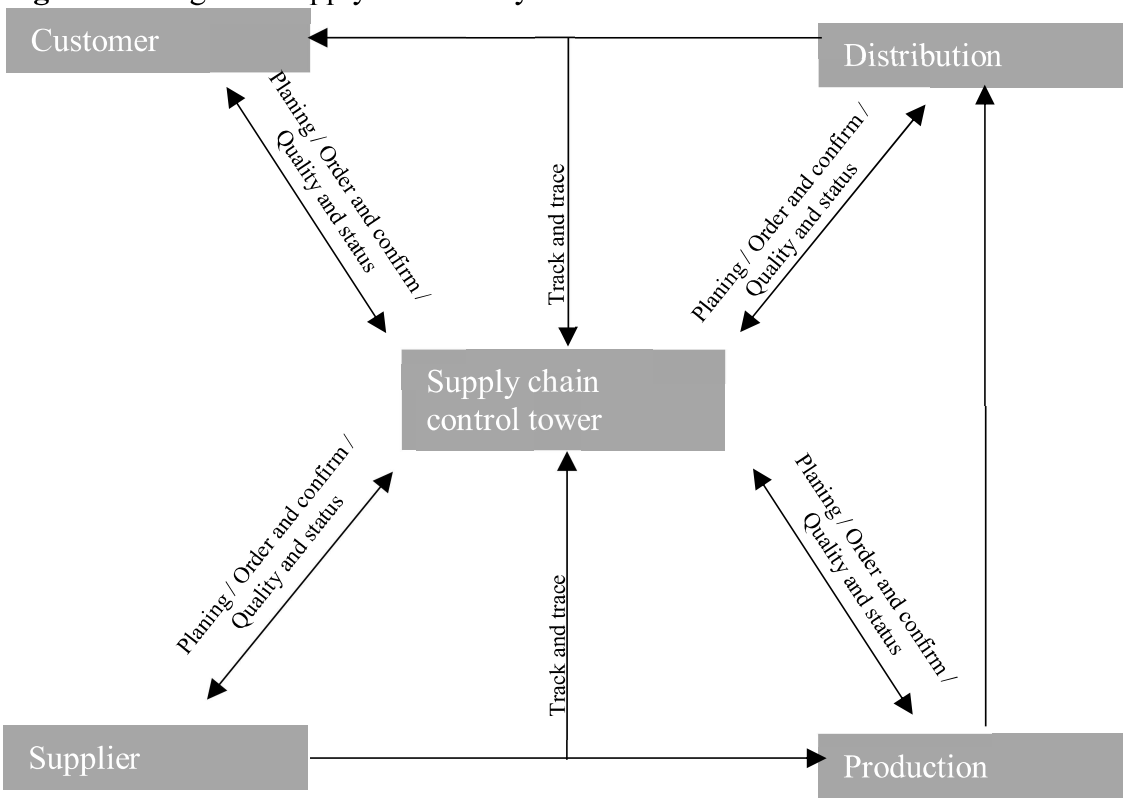


Figure 3. Integrated supply chain ecosystem



Source: https://www.strategyand.pwc.com/media/file/Industry4.0.pdf [access April 19, 2019]

The data in Figure 2 and Figure 3 show comparison between two concepts of SCM. Traditional-based concept depends on planning between two entities in SC. The

result of planning is transferred to the next member in line etc. Ordering process is still much oriented on notifying the previous member about predicted demand. Process organization in traditional SCM can result in miscommunication, poorly executed strategy, late deliveries and finally, loss of customers. DSCM detected flaws with previous concept and delivered a new way of understanding SCM thanks to new technological solutions. Integrated supply chain ecosystem is now based on Digital control tower, a new function within SC, based on innovative technology. The control tower is set into the center of all business functions interconnected with all members in SC.

For example, if there is a rise of demand for a certain product, centralized system will recognize and immediately alert all stakeholders. System will also alert suppliers and manufacturers if it is out of stock. Simultaneously, system will send a notification to distributer and consumer about delivery time and place. If there is a blockchain system integrated, the producer can, for instance, track origin of ordered materials for production of its product. All these processes can be executed in real time. This brings another advantage to consumer who can now easily check the status of its delivery.

In conclusion, a new presented concept is the result of improvement in the understanding of optimization of processes inside SC and business oriented technology solutions.

3. LEADING TECHNOLOGIES IN DSC

Supply chain innovations are a combination of information and related technology developments and new marketing and logistic procedures to enhance service effectiveness, improve operational efficiency, increase revenue, and maximize joint profits (Bello et al., 2004).

Industry 4.0 brought an expanded focus on importance of resources, facility management, quality and/or speed of communication and delivery and finally increases in customer servicing efficiency. Logistics service providers are now equipped with more tools for satisfying customer needs than ever before. But in order to fully understand impacts of new technologies onto business models there is a need to list and explain main innovations that can be implemented in SC.

There are several main technological innovations which brought a turnover in business models at some or all members in SC (Tjahjono et al., 2017):

- blockchain technology
- AI (artificial intelligence)
- AR (augmented reality)
- big data advanced analytics
- drones (UAV)
- self-driving vehicles
- internet of things (IoT).

Blockchain technology - Blockchain technology (also known as distributed ledger technology) is essentially a peer-to-peer distributed asset database that can be

shared across a network of multiple sites, geographies or institutions (Brown, 2016). This technology brings several essential values to DSC, such as: 1. Transparency, authenticity, trust and security and 2. Efficiency and cost/waste reduction (Wang et al., 2019). The benefits of using blockchain technology in supply chain are listed in Table 1. Blockchain technology is one of leading technologies in terms of changing business models in DSC.

Table 1. Perceived benefits of using blockchain technology in supply chains

Benefits of blockchain to SC	Explanation
Improves supply chain visibility	Reduces the need for double-checking and guesswork
	Allows the automation of data analysis activities (e.g. demand forecasting, asset monitoring, optimization and lean improvements)
	Allows the development of services such as track-and-trace
	Crucial for implementation in cold chains and luxury-item supply chains to provide provenance and proof-checking
	Information visibility improves internal business processes while adding value to the service/product for customers
Ensures secure information sharing and builds trust	One single data pool and system available to all stakeholders
	Highly secure system behind blockchains, as demonstrated in Bitcoin
	Standards can be set, thus increasing the overall quality of data in the entire chain
	Built-in trust helps brands gain customer confidence
Allows for operational improvements	Increased volume/accuracy of data helps organizations better monitor and evaluate their performance
	Opportunities to spot issues before they occur
	Speeds end-to-end supply chain execution

Source: Wang Y. (2019) Making sense of blockchain technology: How will it transform supply chains?, *International Journal of Production Economics,* p. 221-236

Artificial intelligence (AI) - to understand AI and how it works, AI can be viewed as a system which operates as a part of a larger framework comprising big data, machine learning, and AI. Computer algorithms and programs are created for these models. A class of models, called machine learning models, is particularly useful for learning from the data and making predictive decisions. At the heart of AI are data science models. Most AI models can be classified as predictive and prescriptive models. Predictive models predominantly offer forecasts of focal outcomes. These

models typically offer an insight to retailers and supply chain members for key decisions. Prescriptive models focus on providing normative decision recommendations. These models can be thought of as offering foresight (Shankar 2018). According to Shankar, concrete benefits from AI system can be seen at: 1. Understanding and anticipating omnichannel and customer behavior, 2. Personalization and recommendation system, 3. Sales/customer relationship management, 4. In-store customer experience management, 5. Media optimization, 6. Inventory optimization, 7. Logistics, transportation and manipulation improvements, 8. Store cleaning and layout management etc.

Augmented reality (AR) - Augmented Reality refers to the layering of computer simulation models over the physical layout of current surroundings. In a sense, this is the hallmark of virtual reality, but AR refers to using this information to improve the efficiency of today's processes as they relate to the supply chain. Most common forms of Augmented Reality involve some sort of glass, visual display for a wearer to use in the process of increasing productivity and performance. For example, smart glasses in the warehouse are considered a form of Augmented Reality Supply Chain, explains Supply Chain Digest. Concrete benefits from AR can be seen at: 1. Picking optimization, 2. Facility planning, 3. Freight/container loading and 4. Dynamic traffic support (Merlino & Sproge, 2016).

Big data advanced analytics - Big data analytics is defined as a huge or complex set of data, which has a range of Exabyte and more. It exceeds the space of the technical ability of storage system, processing, managing, interpreting and visualizing of a traditional system (Kaisleret al., 2013).The term big data analytics can be defined as the application of advanced analytic techniques including data mining, statistical analysis, predictive analytics, etc. on big datasets as new business intelligence practice (Russom, 2011). Concrete benefits from Big data analytics can be seen in form of: 1. Descriptive analytics (analytics deal with the question of what has happened what is happening and why), 2. Predictive analytics deal with the question of what will be happening or likely to happen, by exploring data pattern using statistics, simulation, and programming, 3. Prescriptive analytics deal with the question of what should be happening and how to influence it, by driving alternative decision-based on descriptive and predictive analytics, using mathematical optimization, simulation or multi-criteria decision-making techniques.

Drones (UAV) - An unmanned aerial vehicle (UAV), commonly known as a drone, offers the advantage of speed, flexibility and ease in delivering goods to customers. They are particularly useful for tasks that are hazardous, dirty or simply to ease the process. Although the use of drone delivery is beneficial to the environment, cost saving is still a topic under debate. Ideally, drones yield lower energy consumption and reduce greenhouse gas emissions, thus reducing the carbon foot print and enhancing environmental sustainability (Chyuan Chiang et al., 2019). Concrete benefits from drone implementation are: 1. Reduce in time/cost of last mile delivery, 2. Diversification of transport services, 3. Customization of customer relationship, 4. Environment protection, 5. Better monitoring of traffic and optimization of transport routes, etc.

Self-driving vehicles –Self-driving vehicles (SDV) are automotive based solutions which are designed to transport people and goods from point A to point B

completely autonomously (without human interference). This technology possesses a great potential in terms of cost savings, decrease in delivery time, safety, flexibility, monitoring etc. Special technique of SDV is so called `platooning`. Vehicle platooning is a coordinated movement strategy that has been proposed to address a range of current transport challenges, such as traffic congestion, road safety, energy consumption and pollution (Maiti et al., 2017).

Internet of things (IoT) - it as a grid of software, hardware, databases, virtual and physical objects, and sensors connecting and working together for serving humanity. The internet of things [IOT] enables anytime, anywhere, anything and any media communications. The IOT can be applied in any aspect of our lives. The smart devices of IOT enables supply chain companies to reduce cost which results from the acquisition process of knowledge. Applying IOT in supply chain management will make it smarter and have the following characteristics: 1. Instrumented: information in supply chain being machine generated, 2. Interconnected via using smart objects and IT systems, 3. Intelligent: optimize performance via making a large-scale of optimal decisions, 4. Automated: all processes must be automated to substitute low efficiency resources, 5. Integrated: collaboration between supply chain stages, 6.Innovative: the evolution (Abdel-Basset et al., 2018).

The presented technologies are main accelerators in current Industry 4.0 in terms of changing business models in SCM. There are several more technological solutions, such as Virtual Reality (VR), 3D printing, Simulations, Cyber security solutions, etc. but this paper focused on the most important technologies nowadays. The overall impact from implementation of these solutions will be presented in the next part of the research. Today's technology innovations are rapidly becoming elementary part of every business model. There is a need for proactivity in the domain of adopting new solutions all the way downstream from supplier to consumer.

4. IMPACT OF LEADING INNOVATIVE TECHNOLOGIES ON DSC IN INDUSTRY 4.0 ERA

Companies need to integrate new technologies in their supply chain systems in order to be in race for lower operational costs of business (Eric – Dossou et.al., 2018). The overview impact of digital technologies can be seen in developing four key features: rapid, scale, intelligence and connection (Büyüközka, et al., 2018) So, the obvious question arise from an explanation of technologies mentioned above: what are crucial impacts of leading technologies in DSC? A change of course in business operations in supply chain nowadays cannot be imagined without digitalization of activities and processes within SC. According to **McKinsey and Company,** new leading technologies are making a new impact on SC in terms of:

Speed - Product distribution get new way of operating – its reducing the delivery time of high runners to a few hours. Advanced forecasting approaches, e.g. predictive analytics of internal (e.g. demand) and external (e.g. market trends, weather, school vacation, construction indices) data, as well as machine status data for spare-parts demand, and provides a much more precise forecast of customer demand. Forecast

are updated to real time and generated into the new software. The customer order is later on matched with a shipment that is already in the logistics network (being transported towards the customer region) and the shipment is rerouted to the exact customer destination. In conclusion, it is necessary to improve speed of processes in order to reduce costs.

Flexibility - Real-time planning allows a flexible reaction to changing demand or supply situations. Planning cycles and frozen periods are minimized and planning becomes a continuous process that is able to react dynamically to changing requirements or constraints (e.g. real-time production capacity feedback from machines). Once the products are sent, increased flexibility in the delivery processes allows customers to reroute shipments to the most convenient destination. Transport management is relieving renaissance in terms of new approaches to navigating and monitoring trucks. Increase in flexibility in the supply chain organization is obvious than ever. There has been possibility to buy a supply chain as a service and to pay a members fee. Economy of scale is still one of leading focuses of SC managers.

Granularity – Customized production is always on rise. That gives a strong push towards micro segmentation, and mass customization ideas will finally be implemented. Customers are gathering in clusters, but with different individual preferences. This enables customers to select one of multiple "logistics menus" that exactly fits their need. Drone delivery allow companies to manage the last mile efficiently for single and high-value dense packages.

Accuracy - The next generation of performance management systems provides real-time, end-to-end transparency throughout the supply chain. New transport solutions are offering feature which show the overview of transport fleet with exact positioning in transport network. This range of data provides a joint information basis for all levels of seniority and functions in the supply chain. Supply chain cloud ensures that all stakeholders steer and decide based on the same facts. In digital performance management systems, clean-sheet models for warehousing, transport, or inventory are used to set targets automatically. To keep its maxim performance the machine automatically adjust any unpredicted appearance that cannot be achieved anymore to a realistic aspiration level. The AI systems are management systems that "learn" to automatically identify risks or exceptions and will change supply chain parameters in a closed-loop learning approach to mitigate them. Broad spectrum of activities could be realized without human involvement and to only leverage the human planner for the disruptive events/new events - with this, a supply chain is continuously developing towards its efficient frontier.

Efficiency - Boost in automation of processes is driver of efficiency. Robots handle the material (pallets/boxes, as well as single pieces) completely automatically along the warehouse process - from receiving/unloading to putting away to pick, pack, and ship. Autonomous trucks transport the products within the network. To optimize truck utilization and increase transport flexibility, cross-company transport optimization is applied to share capacities between companies. The network setup itself is continuously optimized to ensure an optimal fit to business requirements. To create an ideal workload in the supply chain, various transparency and dynamic planning approaches are leveraged to drive advanced demand shaping activities (e.g. special offers for delivery time slots with low truck utilization).

Listed improvements are result from high quality analysis conducted with goal to present positive impacts from digitalization in SC. In next table (Table 2), there is comparative analysis from between two types of SC in today's business.

Table 2. Improved activities and business operations in DSC

	Traditional supply chain model	**Integrated supply chain ecosystem**
Transparency	Limited view of supply chain	Complete view of supply chain
Communication	Information delayed as it moves through each organization	Information available to all supply chain members simultaneously
Collaboration	Limited visibility to the entire chain, hindering meaningful collaboration	Natural development of collaboration depth to capture intrinsic supply chain value
Flexibility	End customer demand distorted as information flows along the material path	End customer demand changes are rapidly assessed
Responsiveness	Different planning cycles resulting in delays and unsynchronized responses across multiple tiers	Real-time response on planning and execution level (across all tiers to demand changes)

Source:https://www.mckinsey.com/business-functions/operations/our-insights/supply-chain-40--the-next-generation-digital-supply-chain [access April 20, 2019]

The data in Table 2 shows comparison between operations in traditional and digital SCM. There are significant improvements in the managing of supply chain in Industry 4.0. With implementation of new technologies in business processes there is less uncertainty and potential risks which can arise. Trust is something which every member of SC wants to see, so transparency of activities is at most crucial significance. Nowadays, faster and more reliable communication between members of SC is the basic foundation of digital improvements. Flexibility, fast reaction and high quality service should be the final result of digitalization in SC. Defining true KPIs and using digital solutions for its accomplishment is right recipe for improvement of business decisions and after all measurable results. Synchronization within one SC is ultimate goal in Industry 4.0.

It has been considered that there are two dimensions which would be vital for quick shift to DSC: smart manufacturing and smart product (Frank et al., 2019). Smart manufacturing is referring to implementation of new technologies, and derived from the smart manufacturing is smart product. Smart product is product which has its primary characteristics upon which customers have been used to but with plenty additional features which is required to have on market.

In conclusion, there is a clear path for implementation of new technologies. Willingness of SC managers and CEOs as well is of vital importance for companies. Impacts of new technologies are showing that there is a need for new unlimited way

for reach to customer, new flexible way of software implementation and installation of time saving features to already existing equipment. Therefore, companies will be able to improve their efficiency.

5. CONCLUSION

Industry 4.0 principles such as decentralization, information readiness, and prompt information exchange channels can help achieve optimized sustainable supply chain solutions including reduced resource utilization and environmental impacts. Industry 4.0 and CE together have motivated business organizations to evolve towards effective and prompt sustainable supply chain management (Jabbour et al.2018). Businesses have initiated design efforts for Industry 4.0 to help achieve CE principles (Kumar et al. 2018).

This paper relates to overview of most important digital innovations which are currently on the market and have impact on SCM. The main focus of paper is gathering information about digitalization in SCM and providing concrete overview about challenges, best practices and final impacts on SC. Throughout the paper it has been explained importance of DSC as a newly established concept. This concept and its implementation has given a profitable results with goal to improve existing processes in SC.

First part of paper has mainly been focused on DSC. Its definitions, vision and concept has been shown and demonstrated through various text, figures and tables. The aim of chapter is to make closer approach to reader in order to explain main foundations of concept.

Second part has been oriented on leading technologies in DSC at the moment. These technologies, such as blockchain, AI, AR, big data, drones, SDV and IoT, are changing business models of all members in SC. These solutions are mostly implemented in SC with proactive members. Also, there is free room for other innovative software and hardware designs to redefine shape of DSC, but at moment there is lack of significance.

Third part of paper is showing what are true beneficial impacts from Industry 4.0 and technological innovations. Some clear benefits can be identified from the implementation of Industry 4.0. The most relevant benefits are increased flexibility, quality standards, efficiency and productivity. This will enable mass customization, allowing companies to meet customers' demands, creating value through constantly introducing new products and services to the market. Moreover, the collaboration between machines and humans could socially impact the life of the workers of the future, especially with respect to the optimization of decision making (Tjahjono et al., 2017).

Further research can be focused on exploring the advantages and disadvantages of each technology individually and its effects on DSC; tracking of efficiency of blockchain in transport industry; usability of AI for end user promotion; renewed level of flexibility considering digital model of DSCM etc.

Industry 4.0 is bringing new solutions for business models in SCM. Visibility, transparency, collaboration, synchronization, responsiveness, quality and speed of

communication and customer service is something what every digital innovation brings to business. Efficiency and accuracy of business operations are reaching highest levels in SC history. Established connection between SC and digitalization represents revolution in relationship between technology and supply chain business.

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