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## TECHNOLOGIES IN THE CHAINS OF SUPPLY OF INTERNATIONAL ENTERPRISES

### ABSTRACT

**Background:** Dynamic technological progress as well as more and more difficult business conditions are key factors that stimulate the increase in the use of modern IT tools to manage integrated links within chains. One can point to such approaches as: Industry 4.0, and increasingly even Industry 5.0, emphasizes the importance of technologies such as IIoT (Industrial Internet of Things) and ICT (Information and Communication Technologies). Nowadays, modern technologies are gaining more and more importance in supply chain management, leading to the transformation of its three elements: network structure, business processes and management components. Both in the literature and in business practice, the role of SMAC digital technologies is emphasized, in other words: social media, mobile technologies, advanced analytics and cloud computing (cloud).

**Methods:** The purpose of the article is to analyze modern technological solutions in the field of supply chain by international enterprises. The research methods used were the analysis of the literature on the subject and diagnostic soda (the original questionnaire form was used). 20 international entities constituted a research sample.

**Results:** Currently, although it is possible to point to examples of the use of SMAC technology in supply chain management, it should be noted that they are developed primarily by business leaders and are at the stage of developing implementations in the light of such supply chain management concepts as: agile, lean, demand driven, resilient, sustainable.

**Conclusions:** The current scope and effects of approximate applications in the technology article point to an evolutionary change in supply chain management. High potential for their development in the 21st century, creates the perspective of transformation of supply chain management models in the future.

**Keywords:** supply chain, digital technologies, digital supply chain, and digitalization

## INTRODUCTION

IT solutions have revolutionised the business models and processes of multinational companies, which are defined as entities with their headquarters in their home countries, for years, but generate a significant part of their revenues from other countries by extending their organisational structures (to other countries).

Skills of effective use of the potential of digital technologies and digital competences of organizations become a source of competitive advantage of entire industries and economies. In 2020, the saturation level of the world economy will reach 25%, while in 2005 it was only 15% [Concoran 2016]. The functioning of international organisations in the global economy has become synonymous with modern management. This becomes particularly important in the period of digital transformation, the essence of which comes down to building more effective supply chains based on new business models supported by advanced IT solutions.

There are many IT tools that can contribute to the digitalisation of the supply chain. These include social media, mobile devices, data analytics and cloud computing. This categorisation is referred to as the SMAC concept, also referred to as the third platform. It is a new generation of technological trends that individually have the potential to generate benefits in the supply chain, and together they can create a completely new quality of the process flow.

There is a wide range of information technology. However, in the case of four categories: social networks (Social), mobile devices (Mobile), data analytics (Analytics) and cloud computing (Cloud) they are described by the acronym SMAC. The SMAC effect is the creation of completely new models of supply chain management that significantly change the existing logistics processes.

It is pointed out that 76% of enterprises will now use social media, and 63% of entrepreneurs claim that analytical tools allow them to gain a competitive advantage. As many as 92% of entrepreneurs are satisfied with cloud services and plan to increase their use, and 54% of mobile phones are smartphones [Slowik 2015].

Such a significant business potential of SMAC technology may also translate into the functioning of supply chains, in particular those built by international companies, for which an

efficient information flow, ongoing monitoring of flows, the ability to access data by all employees regardless of location, ongoing analysis of complex numerical data, are essential.

## SMAC TECHNOLOGIES IN SUPPLY CHAINS

Ernst & Young's global reach study shows that Information and Communication Technology (ICT) managers currently spend more than 25% of their budget on SMAC innovation [Ernst & Young 2015], i.e. on technology development such as social media, mobile, advanced data analytics and cloud computing. These technologies create a specific ecosystem that enables enterprises to improve the quality of operations and get closer to the customer [Rutkowski 2016]. The individual SMAC categories (Social, Mobile, Analytics, Cloud) will be explained below.

**Big Data Analytics (BDA)** focuses on the use of advanced methods and models of data analysis mainly to identify interdependencies and predict future phenomena. The potential of Big Data Analytics is described in literature as a "management revolution" and assessed as a key element in value creation, gaining influence over all activities of enterprises [McAfee and Brynjolfsson 2012; Fosso Wamba et al. 2015]. Despite the huge potential for opportunities and benefits identified by the authors, Big Data Analytics is currently at an early stage of development in terms of its use in management, including supply chain management [Kache i Seuring 2017]. The gradual development of BDA applications is evolutionary and complementary to concepts such as business intelligence, business analytics and master data management. Understanding customer behavior and preferences is one of the greatest benefits of using analytical tools. From the collected data, analyzed by advanced algorithms, entrepreneurs are able to deduce how to take care of customer loyalty, improve marketing campaigns, improve product development processes and provide services that match the preferences and requirements of customers. By knowing the tastes of users, entrepreneurs are able to, among others present content in line with their expectations. The overriding goal of using analytical tools in running a business is therefore to make the right decisions based on current and aggregated information.

**Cloud computing** refers to the ability to use ICT resources shared and made available over the Internet. It covers the following main types of services: Infrastructure as a Service (IaaS), Software as a Service (SaaS) and Platform as a Service (PaaS). It has the most important

features such as: stand-alone configuration tailored to the individual needs of the user, availability from a variety of devices connected to the network regardless of location, flexibility to change the required resources, and measurability of service and charging according to the resources used. According to K. Nowicka [2016], cloud computing uses external resources through IT environment management in a service model based on virtualization and centralization of IT infrastructure. Cloud computing technology offers tools for efficient information gathering and effective business management. Using the tools available in the cloud allows entrepreneurs to reduce IT costs, overcome geographical barriers and have access to data at any time and place. The cloud is the factor that binds the other elements that make up SMAC.

**Mobile technologies** include mobile devices, mobile software and related professional IT and telecommunication services. In particular, attention is drawn to the huge potential of mobile technologies in the context of the Internet of Things. Their development is assessed as one of the greatest innovations in logistics, a powerful force capable of triggering significant changes in supply chain management [Frandsen 2014]. Integration of mobile technologies can lead to real-time business process management in an effort to reduce costs and improve flexibility, resulting in enhanced supply chain competitiveness [Eng 2006; Ferguson 2012]. Mobile devices have also increased the ability to reach companies who, using mobile devices, have become accustomed to shopping and using various types of services and applications at any time and in any place. The growing popularity of mobile shopping has forced entrepreneurs to develop their online marketing channels and provide mobile channels to customers. Under these conditions, presenting an offer on mobile devices is the basis for gaining or maintaining a high market position.

**Social media** refer to informational communication in the form of multimedia, multi-channel network communication for specific social or business purposes in various types of community portals. The data collected through social media and mobile technologies are of an individual nature, and their analysis allows companies to precisely identify customer segments. In this way, companies seek to hyperpersonalise the value delivered in relation to individual needs, expectations and experiences of consumers in supply chain management. Social networks break the barriers of information flow between people and become platforms thanks to which quick exchange of knowledge is more and more effective. Communication within

social platforms strongly displaces telephone or email communication. This phenomenon also occurs in the business area, where rapid exchange of information is extremely important. The use of social networks allows for better interaction with customers, thanks to which it becomes possible to respond faster to problems and build a knowledge base based on the preferences and behavior of users. Associated employees can exchange experiences, interesting content and speed up problem solving much easier and faster.

In addition, attention should be drawn to the clear need for technology integration to ensure the fullest possible access and transparent flow of information for decision-making at all levels of management: strategic, tactical and operational. Joint research by A.T. Kearney and WHU Otto Beisheim School of Management has shown the most important aspects: IT integration between all business functions in an enterprise and supply chain partners, use of Big Data Analytics to improve supply chain management, implementation of electronic circulation and archiving of transport documents and use of e-platforms as tools to support selection and transactions with carriers [Schmidt et al. 2015].

It is also worth noting the wider perspective of the possibility of integrating SMAC technology in the world of the Internet of Things, augmented reality or Industry 4.0.

Enterprises use the potential of digital technologies in different ways and to different degrees as value sources and transform supply chains. At the same time, it is pointed out that the implementation of digital technologies requires strategic changes in both the business model and the operational model of the enterprise [Bock, Iansiti and Lakhani 2017]. The main challenge for the development of applications of these technologies is the threats in global cyberspace, which significantly increase the negative risks for data security or transmitted information [Boyes 2015]. Barriers to digital deployment also include: lack of sufficient knowledge about the essence and importance of digitalisation, inadequate assessment of its potential, lack of capital for technology investment and lack of trust preventing information exchange [Sherman and Chauhan 2016].

An important aspect of advanced digitalisation is the deeper integration of technologies and business processes leading to the creation of intelligent digital supply chains (smart, digital supply chains). The Global Supply Chain Forum defines supply chain management as the integration of key business processes from initial suppliers to end users who provide products, services and information and add value to customers and other supply chain stakeholders

[Lambert 2001, p. 100]. Integrated systems extend the scope of technology implementation from individual companies to supply chain implementation. They ensure data acquisition, information exchange and communication between the links, supporting managerial decisions and actions that respond to customer needs.

### **ASSUMPTIONS OF OWN RESEARCH - METHODOLOGY**

The study focused on the use of SMAC technologies in the functioning of the supply chain of multinational companies, taking into account the effect of their use. The research sample consisted of 20 multinational companies (about 250 invitations to participate in the study were sent by e-mail). The selection method was a simple random sample, and the criteria for participation: running an international business and agreeing to participate in the survey.

The survey was completed by employees at various levels of the organization, among others: mention managers, logistics managers, operational managers, development managers, CEOs, branch directors, business change management. The method of the diagnostic survey was used. The technique was a questionnaire, and the research tool was an original questionnaire. The survey was conducted in August and September of 2019.

The aim of the study is to analyze modern technological solutions (SMAC) and the effects and application on the scale of the supply chain by international companies.

The author posed the following research problems:

- Q1: What tools do international companies (participating in the survey) use when it comes to social media?
- Q2: What are the effects of using social media in the functioning of the supply chain by international companies (participating in the survey)?
- Q3: What tools do international companies (participating in the survey) use when it comes to mobile technologies?
- Q4: What are the effects of the use of mobile technologies in the supply chain by multinational companies (participating in the study)?
- Q5: What tools do international companies (participating in the survey) use when it comes to data analytics?
- Q6: What are the effects of using data analytics in the functioning of the supply chain by multinational companies (participating in the survey)?

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- Q7: What tools do international companies (participating in the survey) use when it comes to cloud computing?
- Q8: What are the effects of the use of cloud computing in the functioning of the supply chain by multinational companies (participating in the study)?

The original questionnaire consisted of 9 questions in total and included also a metric, which concerned the industry in which it operates, the position of the person filling in the questionnaire, the logistics area in which the company operates, the range of activities and the number of employees.

The research methodology algorithm is presented in Figure 1.

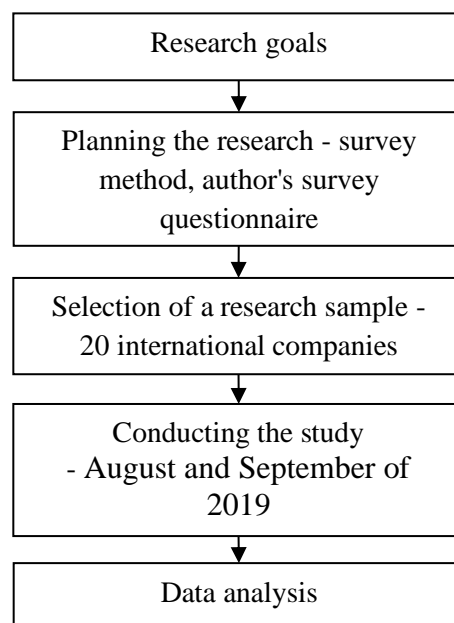


Fig. 1. Research methodology.

Source: own elaboration

Analysis of the survey questionnaire is included in the next section.

## ANALYSIS OF SMAC SOLUTION IN INTERNATIONAL ENTERPRISES - OWN RESEARCH

The majority of entities participating in the survey were manufacturing companies (60%), also from the transport sector, forwarding logistics (35%) and the remaining 5% from the automotive sector.

Among the employees who filled in the questionnaires we should first of all mention managers (35%), logistics managers (25%), operational managers (15%), development managers (10%), as well as CEOs, branch directors, business change management (all of them 5%).

Referring to the scope of activity (in geographical space), most entities (65%) operated on a European scale, on an intercontinental scale 20% and the remaining 15% globally.

The level of employment was considered in two ways: in Poland and globally. In the analysed entities, employment in Poland ranged from 80 to 15,000 (average 1688), while in the global perspective from 120 to 600,000 (average 4991) employees.

Each of the SMAC technologies (social media, mobile devices, data analytics, cloud computing) was analyzed in terms of the tools (functions) used and the effects achieved in the supply chains of multinational companies.

As the tools and functions used in the field of social media, social media (Lindedln, Facebook, Twitter) - 46.94%, marketing channel (16.33%) and algorithms of data analysis (14.29%) (Table 1) were indicated.

Table 1. The role and use of social media in supply chains (functions and tools used)

| Used tools  | [N] | [%]    |
|---|-----|--------|
| The use of social networking sites, which LinkedIn, Facebook, Twitter | 23  | 46,94% |
| Marketing channel   | 8   | 16,33% |
| Integration of social platforms with CRM sytems                       | 3   | 6,12%  |
| Data analysis algorithms  | 7   | 14,29% |
| Cooperation with clients  | 6   | 12,24% |
| We don't use such tools   | 2   | 4,08%  |

Source: own elaboration.

The use of social media technologies in supply chains contributes primarily to improving flexibility in the implementation of orders (41.86%), increase in efficiency in managing

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production flows, including inventory management (20.93%) and improving the level of customer service (18.60%) (Table 2).

Table 2. The role and use of social media in supply chains (main effects in supply chain management)

| Effects in supply chain management  | [N] | [%]    |
|---|-----|--------|
| Improving flexibility in the implementation of orders                               | 18  | 41,86% |
| Improving the level of customer service   | 8   | 18,60% |
| Improving customer satisfaction   | 2   | 4,65%  |
| Shortening the response time to customer needs                                      | 5   | 11,63% |
| Increase in efficiency in managing production flows, including inventory management | 9   | 20,93% |
| Other, building the company's image   | 1   | 2,33%  |

Source: own elaboration.

Among the functions and tools related to mobile technologies, the most frequently indicated were use of PDA mobile devices (36.67%), Applications for mobile devices with the ability (33.33%), and also reading data using a mobile application operating in a Wi-Fi wireless network on other mobile devices (30%) (Table 3).

Table 3. The role and use of mobile technologies in supply chains (functions and tools used)

| Used tools  | [N] | [%]    |
|---|-----|--------|
| use of PDA mobile devices   | 11  | 36,67% |
| Applications for mobile devices with the ability  | 10  | 33,33% |
| Terminals enabling ongoing monitoring of product status and immediate updating                        | 5   | 16,67% |
| Reading data using a mobile application operating in a Wi-Fi wireless network on other mobile devices | 9   | 30,00% |
| Mobile applications providing access to simulation of change in augmented reality                     | 2   | 6,67%  |
| We don't use such tools   | 1   | 3,33%  |

Source: own elaboration.

The use of mobile technologies in supply chains contributes to greater flexibility in order processing (30.19%), moreover, minimizing response time to customer needs (24.53%) and improving the level of customer service (16.98%) (Table 4).

Table 4. The role and use of mobile technologies in supply chains (main effects in supply chain management)

| Effects in supply chain management  | [N] | [%]    |
|---|-----|--------|
| Increasing the efficiency of product flow management and inventory management | 7   | 13,21% |
| Greater flexibility in order processing                                       | 16  | 30,19% |
| Minimizing response time to customer needs                                    | 13  | 24,53% |

|  |   |        |
|--|---|--------|
| Improving the level of customer service  | 9 | 16,98% |
| Increasing the degree of product customization and delivery method in response to customer needs | 5 | 9,43%  |
| Shortening order cycles  | 1 | 1,89%  |
| Reduction of stocks of finished products   | 2 | 3,77%  |

Source: own elaboration.

The functions and tools related to data analysis include mainly application in the design of transport routes (36,36%), the use of Big Data Analytics, mobile applications using augmented reality and wireless communication in the world of the Internet (18,15%) and use in product design processes (11,36%) (Table 5).

Table 5. The role and use of advanced data analytics in supply chains (functions and tools used)

| Used tools   | [N] | [%]    |
|--|-----|--------|
| The use of Big Data Analytics, mobile applications using augmented reality and wireless communication in the world of the Internet | 8   | 18,18% |
| Use in product design processes  | 7   | 15,91% |
| Application in production management and order processing  | 5   | 11,36% |
| Application in the design of transport routes  | 16  | 36,36% |
| Mobile applications providing access to simulation of change in augmented reality  | 3   | 6,82%  |
| We don't use such tools  | 5   | 11,36% |

Source: own elaboration.

The use of data analysis technologies in supply chains contributes to cost reduction and reduction of product development time (25%), reduction of transport costs (18,18%) and waste elimination on prototyping and production resources (13,64%) (Table 6).

Table 6. The role and use of application of advanced in supply chains (main effects in supply chain management)

| Effects in supply chain management   | [N] | [%]    |
|--|-----|--------|
| Improving the accuracy of demand forecasts and the diagnosis of customer needs | 4   | 9,09%  |
| Cost reduction and reduction of product development time                       | 11  | 25,00% |
| Eliminate waste on prototyping and production resources                        | 6   | 13,64% |
| Increasing the efficiency of production flow management                        | 5   | 11,36% |
| Optimization of transport routes   | 2   | 4,55%  |
| Shortening of routes and delivery time in transport processes                  | 1   | 2,27%  |
| Reduction of transport costs   | 8   | 18,18% |
| Reduction of CO2 emissions   | 4   | 9,09%  |
| Improving the transparency of information flow between the supply chain        | 3   | 6,82%  |

Source: own elaboration.

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Among the functions and tools related to data analysis, the following have been identified in particular shared use of resources made available via the Internet (use of infrastructure, software, platforms) (36,67%), availability through a variety of network connected devices, regardless of location (30%) and independent configuration tailored to the individual needs of the user data analysis for threats, updating information on planned delivery dates (20%) (Table 7).

Table 7. The role and use of cloud computing in supply chains (functions and tools used)

| Used tools   | [N] | [%]    |
|--|-----|--------|
| Shared use of resources made available via the Internet (use of infrastructure, software, platforms)   | 11  | 36,67% |
| Availability through a variety of network connected devices, regardless of location  | 9   | 30,00% |
| Independent configuration tailored to the individual needs of the user data analysis for threats, updating information on planned delivery dates | 6   | 20,00% |
| We don't use such tools  | 4   | 13,33% |

Source: own elaboration

The use of data analysis technology in supply chains contributes to reduction of administrative costs in the supply chain (38,46%), reduction of customs service time (20,51%) and increasing the ability to avoid negative events (15,38%) (Table 8).

Table 8. The role and use of cloud computing in supply chains (main effects in supply chain management)

| Effects in supply chain management  | [N] | [%]    |
|---|-----|--------|
| Reducing fluctuations in the delivery cycle   | 5   | 12,82% |
| Increasing security of supply   | 3   | 7,69%  |
| Shortening the response time to phenomena that have a nagtive impact on business process continuity | 1   | 2,56%  |
| Increasing the ability to avoid negative events   | 6   | 15,38% |
| Reducing the cost of maintaining inventory in transport   | 1   | 2,56%  |
| Reduction of customs service time   | 8   | 20,51% |
| Reduction of administrative costs in the supply chain   | 15  | 38,46% |

Source: own elaboration.

## CONCLUSION

The functioning of modern international organizations within the global economy requires the use of management methods and supply chain development strategies adequate to the new management conditions at the digital transformation stage.

The developmental direction of the digital supply chain maturation period in the field is now the use of SMAC information technologies, which apart from flexible and effective data collection, analysis and knowledge generation through automatic conclusions based on the results of this analysis, can also "understand" the importance of phenomena occurring in the environment of the organization.

The economic changes in the digital transformation process and the evolution of business relations mean that international entities, in order to compete effectively in global markets, must give decisive importance to their flexibility and ability to implement innovative business models and process reorganisation through the organisation of supply chains. This will allow to achieve higher levels of digital maturity, which will translate into greater efficiency of supply chain operation during the digital transformation period - significant changes in the reconfiguration of logistics processes and business communication are already visible.

Research has shown that SMAC-class digital technologies generate positive changes in the functioning of supply chains of multinational companies. It is worth noting that digitalisation is a phenomenon that will continue in the future. The main benefits are as follows: improving flexibility in the implementation of orders, increase in efficiency in managing production flows, including inventory management, greater flexibility in order processing, minimizing response time to customer needs, cost reduction and reduction of product development time, reduction of transport costs, reduction of administrative costs in the supply chain as well as reduction of customs service time.

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