

Trust in Digital Supply Chain Management

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Companies managing supply chains are increasingly facing a decision to migrate or start operating in the digital world. Gaining competitive advantage by means of supply chain management means sharing the information which is perceived as the evidence of trust between partners. Digital Supply Chains are based on technologies that enable increasing competitiveness mainly by delivering information in real time simultaneously to many supply chain partners. However the type and range of the information shared indicates the level of trust. Research results show that partners in supply chain were sharing information about inventory and transport activities. These are the main areas of competing by logistics and supply chain management. The aspect of partnership and cooperation was also raised in the research. Cloud computing had been willingly used in Supplier Relationship Management, Customer Relationship Management and Customer Service Management processes by the respondents.

Keywords: trust, cloud computing, supply chain processes.

1. INTRODUCTION

The focus of supply chain management is concentrated on co-operation and trust and recognition that properly managed, the ‘whole can be greater than the sum of its parts’. Supply chains are interconnected and integrated by processes. The main aspect accompanying integration in supply chain is information sharing. Information sharing is the evidence of trust and willingness for further cooperation.

Traditional (characterized by sequential and linear flows) and digital supply chains (DSC) differ in terms of relationship character, period of cooperation and design or the management flows. However information sharing is the base for achieving common competitive advantage for all cooperating business partners. The quicker response to the demand the higher competitive advantage of the supply chain. Therefore if the companies engaged in the supply chain are able to get right information in the right time they are able to prepare either in terms of stock building in particular locations of the supply chain or start the production cycle right after to demand is notified at the retail level. Thus partnership and trust are those

aspects that should be revised during the evaluation of supply chain processes migration to virtual world.

The purpose of the paper is to analyze the influence of cloud computing on supply chain process in terms of cooperation manifested by information sharing. The paper aims to analyze the type of information shared within supply chain and the range of use of cloud computing as a technology supporting the development of DSC.

The article presents empirical research results based on CATI conducted on 122 respondents – supply chain or logistics managers. Research was conducted in September 2016 on companies located in Poland by INDICATOR on behalf of SGH and author of the paper.

Results show the high level of cloud computing usage in supply chain processes related to cooperation and information sharing (i.e. Customer Relationship Management, Supplier Relationship Management or Customer Service Management). Results show that managers are able to gain competitiveness by information sharing on stock level or transport and warehouse capacity availability also within DSCs. However these data is trust-sensitive. This means that relationship can

be supported by technology and improving competitiveness of whole supply chain. DSCs might gain competitive advantage by information sharing even more due to the technology features. In case of cloud computing the flexibility, agility and responsiveness of supply chain can be additionally improved.

2. SUPPLY CHAIN MANAGEMENT

All companies interact with each other and due to the development of different types of relationships and dependencies – as part of their cooperation – more and more is being said about the network of supply chains rather than individual chains. As a result, the supply chain can be defined as “the network of connected and interdependent organizations mutually co-operatively working together to control, manage and improve the flow of materials and information from suppliers to end users” (Christopher 2016). According to the same author supply chain management is “the management of upstream and downstream relationships with suppliers and customers in order to deliver superior customer value at less cost to the supply chain as a whole”. The focus of supply chain management is concentrated on co-operation and trust and recognition that properly managed, the ‘whole can be greater than the sum of its parts’ (Christopher 2016). Additionally, supply chain management is understood as “the integration of key business processes from the end user through original suppliers that provide products, services, and information that add value for customers and other stakeholders” (Lambert et. al 1998). Cooperation in supply chain can be observed in processes that characterize integrated (so willing to get into cooperation and partnership) supply chains. Eight key supply chain processes can be identified (Lambert and Cooper 2000). There are: Customer Relationship Management; Customer Service Management; Demand Management; Order Fulfilment; Manufacturing Flow Management; Supplier Relationship Management; Product Development and Commercialization; Returns Management.

Currently, the companies’ internal processes, product components, communication channels and all other key aspects of the supply chain processes are undergoing an accelerated digitalization process (Geisberger and Broy, 2012). According to MacCarthy et. al. (2016) technology and innovations are one of the main factors influencing the supply chain evolution. As a result, the Digital

Supply Chain concept arose. It can be defined as “a customer-centric platform model that captures and maximizes utilization of real-time data coming from a variety of sources. It enables demand stimulation, matching, sensing and management to optimize performance and minimize risk.” (The Centre for Global Enterprise 2016).

DSCs are strongly influenced by digital technologies. According to Pfohl et. al. (2015) due to digitalization process supply chains are impacted by technologies being a base for the fourth industrial revolution development. There are also other concepts i.e. SMAC (Social, Mobile, Big Data Analytics and Cloud computing) describing different technologies that emerged some time ago and started to be important in terms of supply chain management in digital era (Verma et. al. 2016).

As the platform model that was underlined in the previous definition of DSC was mainly based on cloud computing solutions, the DSC can be also understood as “the broad concept that Cloud-based systems, analytics and monitoring of goods, vehicles and other assets via the Internet of Things (IoT).” (Michel, 2017).

Moving toward the DSC should be revised as a process for the company and for the whole supply chain. According to The Center for Global Enterprise (2016), the prioritization of technology that allows visibility of the whole supply chain should be done at first. Then companies should invest in the technologies that enable future agility, flexibility and responsiveness to customer demand, and in their constant changes. Thus it is important to analyze characteristics and features of particular technologies, as well as the whole ecosystem of technologies that could add value to the system. For example the cloud computing solutions should be revised in terms of its usefulness in particular supply chain processes. The other example could be 3D printing or robotics that can be used in the area of production. Additionally mobile technology is changing the way customers interact with a company, and so influencing most of the supply chain processes. Order fulfilment and delivery solutions now can be supported by drones or driverless vehicles. Nevertheless, for all of the supply chain processes, the information flow and its management is crucial. According to Chaffey (2015) “digital business technologies enable information flows to be redefined to facilitate the sharing of information between partners, often at the lower costs than were previously possible.” Information is the base of decision making, and

therefore the main aspect stimulating the competitiveness. However it must be underlined that at the same time information sharing among partners in a supply chain is the evidence of trust.

3. TRUST IN SUPPLY CHAIN MANAGEMENT

Enterprise management is risk management. Trust can mitigate the level of risk in uncertain environment of management. Sinha et al. (2004) mentioned that lack of trust is one of the major factors that contribute to supply chain risks. Therefore trust is often referred to as an essential element for a successful supply chain partner's relationship (Laequddin et. al. 2012). Agarwal and Shankar (2003) argued that one of the prevalent issues in the introduction of an e-commerce system along the supply chain is the ability to establish the dynamic and flexible structures for buyer-supplier relationships, and online trust that, deterministically, drive both the parties toward a strategic partnerships and cooperation. This is due to the fact that trust in cooperation and partnership leads to increased supply chain competitiveness.

According to Agarwal and Shankar (2003) four dimensions of trust can be identified: cooperating to minimize information asymmetry, improving interpersonal behaviour and fraud minimization and promotion on-line transaction simplification. Cooperating to minimize information asymmetry is input into trust building and addresses the need for having the same information shared between a buyer and a supplier.

Laequddin et. al (2012) underline that there are two important points to be noted in a trust building process. The first point is "information is pivotal to trust building." When the supply chain members have access to complete mutual information about their partner's reliability, calculations, consequences, controls and they are certain that there is no risk involved in the relationship, then trust has no relevance. On the other hand, when partners lack mutual information and they are in the state of total ignorance of future outcome of their relationship, there can be no reason to trust and it needs not be there, as risk prevails. The second point is that some level of uncertainty is required for trust to emerge and propensity to trust leads to risk taking. According to Laeequddin et. al (2012) the act of trust depends on the acceptable levels of economics, dynamic capabilities and technological risk in any relationship. Even though

the supply chain partners develop risk-worthy characteristic and risk-worthy rational related to these aspects, there is always an element of risk present in the partner's relationship from the changing political, institutional and business environment.

In all of the mentioned areas the problem of trust, and consequently the risk, is connected with the access to information. As underlined, the ability to share information with a partner influences the competitiveness of the entire supply chain. The right information received in the right moment enables to exploit market opportunities and might change the competitive position of the whole supply chain.

Information shared within the supply chain concerns the demand and supply. While it is sensitive data in terms of ability of quick response on the operational level, it influences also the tactical and strategic level of supply chain decisions. The information shared in the supply chain may concern delivery or production schedules, purchasing decisions, production planning, inventory management or transport data (Ravindran, Warsing 2013).

When considering DSC, for all of the information shared within supply chain processes, the digital technology can serve as enabler of speed, accuracy, and reliability. Therefore it stimulates the competitiveness in terms of the agility and flexibility of supply chains. Technologies are now one of the best tools supporting on-line communication and reacting on real-time basis.

4. CLOUD COMPUTING AS A SOLUTION SUPPORTING INFORMATION SHARING IN THE SUPPLY CHAIN PROCESSES

Mell and Grance (2011) defined cloud computing as "a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction." This cloud model is composed of five essential characteristics: on-demand self-service, broad network access, resource pooling, rapid elastic and measured service. This technology is unique in terms of wide possibilities of application in all supply chain processes.

The technology of cloud computing enables digital processes and value propositions and increases the modularization and scalability of products, processes and facilities in a supply chain. Additionally, according to Pfohl et. al. (2015) study, it counts for the features “Digitalization” and “Modularization” in the Industry 4.0 concept and the companies’ value chains. Cloud computing can be introduced for supporting transformation of a particular activity or whole processes within a supply chain. For example it can transform transportation management from a silo internal activity to a process that can link up with third-party logistics providers, carriers or digital freight matching providers. Transport Management Systems can become a central market place connecting various stakeholders in a supply chain. (Michel, 2017).

Cloud computing enables easier and less costly digitalization of supply chains. It enables also smaller companies to develop their own DSCs capability since it reduces implementation and management costs significantly. (The Centre for Global Enterprise 2016). According to the Harvard Business Review (2011) study the highly valued benefits from cloud computing implementation are: increased business agility (44% respondents marked that response), flexible capacity (41%) and faster adaptation on new technology (36%). Additionally, respondents marked lower fixed costs and up-front costs. One of the major advantages of cloud computing was enabling deeper collaboration with business partners. 61% of respondents agreed that “cloud makes it easier to quickly share information and collaborate with customers and suppliers quickly (...). This (cloud computing) will improve the company’s forecasting, as well as supply chain and inventory management.” (Harvard Business Review 2011). Later study on cloud computing by Harvard Business Review (2015) highlighted that cloud leaders (companies that use numerous cloud services; have defined policies for criteria they must meet and how they are acquired/managed) launched new products, expanded into new market segments, expanded geographically and entered into new business more often than other types of the companies. Almost one-third of companies use cloud computing in supply chains and procurement, these functions being at the same time their core business functions. (Harvard Business Review 2015). Simultaneously, the study lists the biggest barriers to cloud adaptation which are: security concerns (62% of respondents marked

this obstacle), integration challenges (36%), costs of changing over from the current system (34%).

The study on cloud computing influence on supply chains and information sharing was conducted on 122 supply chain and logistics managers in Poland during August and September 2016 by the INDICATOR on behalf of the author of this paper. The study was carried out on the companies that had already implemented cloud computing solutions in their supply chains or logistics operations.

According to the results of the study, the information about inventory levels occurred to be the most frequently shared within the supply chains. Half of the respondents plan the stock levels of individual products in cooperation with their suppliers. 44% managers know current stock levels of all the partners in the supply chain and 40% keep them informed about their own inventories. Almost half of the managers admitted that they planned their logistics’ activities in cooperation with suppliers.

In the overall approach, cloud computing plays an important role almost in all supply chain processes. Respondents of the study underlined its significance mostly in the Supplier Relationship Management (91% of managers admitted that cloud computing strongly influences activates carried out during this process implementation). Also Customer Relationship Management and Customer Service Management are the processes that made use of the cloud computing features in supply chain operations. For both of those processes more than 80% of respondents indicated the impact of cloud computing.

Respondents were also asked to indicate the effects that occurred after the cloud computing solutions were introduced into the supply chains processes. According to the results, the most important role of cloud computing in terms of its impact on different activates within a supply chain can be noticed in the area of possibility to reduce inventory levels and increase stock rotation. This effect of information sharing based on cloud computing has been recognized by 82% of respondents. Within the particular processes the mostly impacted by this effect were Demand Management, Product Development and Commercialization and Returns Management.

The second important area of the cloud influence was the increase of the level of processes automation by eliminating certain activates or their execution by IT systems. This result was indicated by 79% of the surveyed managers. It was

recognized in the following processes – Product Development and Commercialization, Returns Management and Manufacturing Flow Management.

The third aspect influenced by cloud computing being the effect of information sharing in supply chain was the ability to communicate simultaneously with several business partners in real time. Three-fourths of respondents marked this effect within their supply chains activities. This impact was noticed in the process of Demand Management and process of Suppliers Relationship Management.

Managers underlined also the information sharing that allowed to track freight transport in real time. 74% of respondents marked usefulness of cloud computing in this area.

The results of the study present a broad range of aspects concerning logistics and supply chain operations that are implemented and developed using cloud computing. All of them are based on information sharing and lead to increased competitiveness by supply chain management. That is done either by cost reduction or quality improvement or both of these activities. Cloud computing features additionally stimulate the effects of supply chain competitiveness. These effects can be seen e.g. in the responses concerning sales increase, decreasing warehouse space usage or expanding distribution range with new sales channels.

It must be underlined that sharing information on inventory levels or transport activities on real time basis is the evidence of trust between supply chain partners. That situation can be noticed in the presented study results. Thus, the trust that accompanies sharing information can be the domain of supply chains based on digital technology solutions – DSC. Such a solution is cloud computing, which in the broad spectrum is able to support business relations and their effects in the various processes of the supply chain.

Additionally, respondents underlined the highest impact of cloud computing on the Supplier Relationship Management, Customer Relationship Management and Customer Service Management processes. These are the processes that require communication with external partners. It might mean that cloud computing as a technology supporting DSC could be a solution for improving integration among partners in the whole supply chain in the new digital reality. However, this would need a further, in-depth study.

During the research respondents were also asked about obstacles accompanying cloud computing implementation. It must be underlined that none of respondents agreed that the sensitive data had leaked and had been misused due to the cloud computing implementation. Also, there have not been noticed any loss of the trust in the business partners. However, 45% managers admitted that employees were reluctant to use the new IT systems and more than 65% respondents admitted that business risk had increased. This might mean that additional activities in terms of cyber security should be taken into account if companies want to develop their DSCs and move more activities into the virtual, digital world.

5. CONCLUSIONS

Companies managing supply chains are increasingly facing the decision to migrate or start operating in the digital world. Gaining competitive advantage by supply chain management means sharing the information as the evidence of trust between partners. That also improves integration level between partners. Information drives all the supply chain processes. Digital Supply Chains are based on technologies that enable increasing competitiveness mainly by delivering information in real time simultaneously to many supply chain partners. However the type and range of the information shared indicates the level of trust.

The case of cloud computing – as the example of technology that could support information sharing in the supply chain processes – was analyzed. Research results show that partners in the supply chain were sharing information about inventory (level and rotation) and transport (planning and monitoring) activities. These are the main areas of competing by logistics and supply chain management. The aspect of partnership and cooperation was also raised in the research. Cloud computing had been willingly used in Supplier Relationship Management, Customer Relationship Management and Customer Service Management processes by study respondents. This solution was also introduced to the other processes of supply chains.

The research results can be the base for further in-depth study on information sharing and partnerships leading to trust building in DSC. Cloud computing is one of the most interesting technology that is able to improve supply chain competitiveness. However managers should also revise other technologies like Internet of Things,

Mobile or Big Data Analytics as the ones that create a specific ecosystem of technologies dedicated to the supply chain specific needs.

REFERENCES

- [1] Agarwal A., Shankar R., (2003) "On-line trust building in e-enabled supply chain", *Supply Chain Management: An International Journal*, Vol. 8 Issue: 4, pp.324-334
- [2] Chaffey D. (2015), *Digital Business and e-commerce management. Strategy, implementation and practice*, Pearson, Harlow, UK.
- [3] Christopher, M. (2016), "Logistics and Supply Chain Management", London, FT Publishing International; 5 edition
- [4] Geisberger, E., Broy, M., (2012), *agenda CPS – Integrierte Forschungsagenda Cyber-Physical Systems*. Berlin, et al.: Springer
- [5] Harvard Business Review (2011), *How the Cloud Looks from the Top: Achieving Competitive Advantage In the Age of Cloud Computing*, A Harvard Business Review Analytic Services Report
- [6] Harvard Business Review (2015) *Cloud Computing Comes of Age*, A Harvard Business Review Analytic Services Report
- [7] Laeequddin, M. Sahay, B.S., Sahay V., Waheed K.A., (2012) "Trust building in supply chain partners relationship: an integrated conceptual model", *Journal of Management Development*, Vol. 31 Issue: 6, pp.550-564
- [8] Lambert, D.M., Cooper, M. C. and Pagh, J.D. (1998), "Supply Chain Management: Implementation Issues and Research Opportunities", *The International Journal of Logistics Management*, Vol. 9, No. 2, pp. 2
- [9] Lambert, D. M. Cooper, M. C. (2000), *Issues in Supply Chain Management*, "Industrial Marketing Management", vol. 29, pp. 72–74.
- [10] MacCarthy B.L., Blome C., Olhager J., Srari J.S., Zhao X., (2016) *Supply chain evolution – theory, concepts and science*, *International Journal of Operations & Production Management*, Vol. 36 Issue: 12, pp.1696-1718
- [11] Mell P., Grance T. (2011) *The NIST Definition of Cloud Computing. Recommendations of the National Institute of Standards and Technology*, NIST Special Publication 800-145, National Institute of Standards and Technology, Gaithersburg
- [12] Michel R. (2017), *The Evolution of the Digital Supply Chain*, *Logistics Management*, May 2017, pp. 23.
- [13] Pfohl H-Ch., Yahsi B. and Kurnaz T., (2015) *The Impact of Industry 4.0 on the Supply Chain in: Kersten W., Blecker T. and Ringle Ch.M. (Eds.) Innovations and Strategies for Logistics and Supply Chains, Business Models and Risk Management*, *Proceedings of the Hamburg International Conference of Logistics (HICL) 2015*
- [14] Ravindran R., Warsing Jr D.P. (2013) *Supply Chain Engineering: Models and Applications*, CRC Press, Boca Raton.
- [15] Sherer S. A., (2005) "From supply-chain management to value network advocacy: implications for e-supply chains", *Supply Chain Management: An International Journal*, Vol. 10 Issue: 2, pp.77-83,
- [16] Sinha, P.R., Whitman, L.E. and Malzahn, D. (2004), "Methodology to mitigate supplier risk in an aerospace supply chain", *Supply Chain Management: An International Journal*, Vol. 9 No. 2, pp. 154-68.
- [17] The Centre for Global Enterprise (2016), *A Digital Supply Chains: FRONTSIDE FLIP. Building Competitive Advantage to Optimize Performance and Customer Demand*, 2016, <http://thecge.net/web/viewer.html?file=http://thecge.net/wp-content/uploads/2016/09/FINAL-DSCiwhitepaper.pdf>
- [18] Verma, P. and Kumar, V. and Sharma, R. R. K., (2016) *Role of SMAC Stack on Competitive Advantage and Innovation with Supply Chain Performance*. University of Sri Jayewardenepura, Sri Lanka, 13th International Conference on Business Management (ICBM).

Date submitted: 2018-09-07

Date accepted for publishing: 2018-09-28

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