DEVELOPING SUPPLY CHAIN MANAGEMENT “AS-A-SERVICE” IN CLOUD PLATFORMS

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Abstract. *The purpose of this paper, is to introduce the concept of a cloud supply chain, a business model based on the networking of some physical and digital assets from third parties in the cloud for the purpose of designing and managing a supply chain network. The "supply chain as a service" model combines Industry 4.0 principles and technology with new digital platforms. For this aspect, the cloud supply chain is conceptualized as a fresh and original field of study where certain generalized properties of the cloud supply chain are determined by analysis of real-world situations.*

Keywords:*. Supply chain integration; Cloud technology; Cloud supply chain; Supply chain-as-a-service; Industry 4.0; Digital supply chain*

Introduction

Global innovation networks have emerged due to the “fine slicing” and dispersion of innovation processes to various businesses worldwide (Ambos et al., 2021). Research and development dispersion has been viewed positively for innovation by some academics since it gives businesses more access to a variety of knowledge hubs worldwide (Perri et al., 2017). Others have argued that it increases a firm's operational complexity because innovation activities are interdependent, resulting in managerial bandwidth limitations (Scalera et al., 2018) and more difficulties with internal or external firm boundaries (Ambos et al., 2021).

Advanced supply chain management principles and digital technologies are used to create a cloud supply chain based on the dynamic, situational composition of physical services into networks. The cloud supply chain combines concepts of flexible, reconfigurable supply chain formation by outsourcing with the goal of transforming the supply chain from some static, long-term, and fixed allocations of processes, products, and data to some firms towards dynamic reconfigurable services, such as forming the supply chain as a service (Ivanov et al, 2022). Integrating all digital manufacturing and logistics fulfillment processes, including material, financial, and information flows, into the cloud-based collaboration platform enables the creation of dynamic services focused on the client’s needs. This mix of manufacturing, purchasing, distribution, warehousing, and after-sales activities creates a physical supply chain network that is constantly (re)designed and operated as a customer-centered unit. Blockchain, the Internet of Things, Industry 4.0, cloud computing, 5G, and edge computing are examples of digital communication, collaboration, identification, and modeling technologies (Ivanov et al, 2022). These technologies create a technological framework for implementing the cloud supply chain.

Different network structures and their interactions are covered by the supply chain structural dynamics control theory. In Wang et al. (2015), a thorough assessment of the literature on service supply chains is offered. Supply chain networks are becoming more flexible and adaptable thanks to digital technologies like the cloud, Industry 4.0, Internet of Things (IoT), big data analytics, Blockchain, artificial intelligence (AI), edge computing, and additive manufacturing (Choi et al., 2022). Supply chain networks can be made more flexible and adaptable with the help of digital technologies like the cloud, Industry 4.0, Internet of Things (IoT), big data analytics, Blockchain, artificial intelligence (AI), edge computing, and additive manufacturing (Brintrup et al., 2020). The available research put up some compelling reasons in favour of end-to-end visibility to enhance the effectiveness of decision-making in manufacturing, logistics, and sales operations. (Yang et al., 2019).

Services are essential to supply chain management schemes. Many researchers have reviewed and discussed the various definitions of service supply chain management and service supply chain systems. A "product" that is produced by "the points of origin" and transported to "the sites of consumption" must exist in a supply chain system by definition (Wang et al., 2015). This "product" could be a service or something more concrete. Two different types of supply chain systems—the Service Only Supply Chains (SOSCs) and the Product Service Supply Chains—arise in the field of service supply chain management (PSSCs) (Wang et al., 2015).

The subject of supply chain outsourcing has become more complex with the rise of "as a service" platforms and providers. Outsourcing of logistics is no longer the only concern now, services for manufacturing, planning, warehousing, and other tasks are available (Barret & Higgins, 2021). Organizations must pick which components they will provide internally and which ones they will outsource. Because they don't have a solid outsourcing strategy in place, supply chain leaders frequently outsource for the wrong reasons (Barret & Higgins, 2021). Organizations should create an outsourcing strategy for their supply chains that strikes a balance between the significance of cost, service delivery, risk mitigation, and the duration of relationships in order to be future-ready (Barret & Higgins, 2021).

These diverse arguments call for a systematic analysis of innovation in cloud services applied in supply chain management. In this article a conceptualization is offered that allows to analyze and advance the literature on innovation in and how can supply chain management services can be provided as SaaS business model through platforming model and integration of various state of the art technologies. Despite growing practical interest, cloud supply chain research is still lacking. This paper seeks to conceptualize the cloud supply chain as a fresh and original topic of study. Several conceptual and formal generalizations will be presented about the cloud supply chain through examination of practical situations case studies, and we explore potential lines of future research.

Literature review

Software as a Service (SaaS)

Software-as-a-service (SaaS) is a cutting-edge method for distributing software applications that uses cloud computing (Chou & Chou, 2007). For consumers to order based on their needs and pay for the services in accordance with actual consumption, SaaS providers host software applications on cloud servers (Armbrust et al., 2010). This "on-demand" service delivery model is comparable to the utility service mode in that a user subscribes to an application without purchasing, installing, or maintaining the software, much like using the grid for power instead of a personal generator. Additionally, SaaS improves software service quality through automated application upgrades and data backup (Xin & Levina, 2008).

SaaS enables businesses to outsource many of their applications, including business and generic tools (such as email, antivirus software, and office suites) (e.g. accounting, customer relationship management – CRM, enterprise resource planning – ERP). Based on cloud computing, businesses can also outsource their IT platforms (such as databases and business intelligence) and infrastructures (such as storage, backup, and computation) in the form of Platform as a Service (PaaS) (Vaquero et al., 2009). SaaS is seen as the most promising of the three because of its numerous real advantages to business clients, including decreased IT expenses and enhanced IT performance (Catteddu, 2010).

SaaS companies use cloud computing to divide up IT resources and capacities among customers in accordance with their in-the-moment needs. A dynamic approach to managing instances and data partitions is advantageous for economies of scale. Organizations can save a ton of money and concentrate on productivity because they don't have to bother purchasing and maintaining their software applications (Yang et al., 2015).

Existing research on SaaS adoption includes a qualitative analysis of the impact of IT infrastructure maturity and result uncertainties by Xin and Levina (2008). Similar findings were made by Wu et al. (2011) who discovered that businesses consider known and unknown risks when assessing the long-term effects of adopting SaaS. The influence of perceived values, uncertainties, and impacts on attitudes toward SaaS adoption were quantitatively studied by Benlian et al. (2009). Wu (2011) also determined the significant effects of relative benefit, ease-of-use, security, and trust using the attitude toward the innovation as the dependent variable. Benlian and Hess (2011), on the other hand, gathered data on perceived cost advantages and security issues and identified how these affect the choice to embrace SaaS.

Digitalised Supply Chain

A digital supply chain is an intelligent, value-driven network that uses cutting-edge technology and analytics to generate new revenue and business value. It does this by utilizing a centralized platform that captures and makes the most of real-time data from various sources (Kinnett, 2015).

Another definition given by Büyüközkan and Göçer (2018) is an intelligent best-fit technological system based on the ability of massive data disposal and excellent cooperation and communication for digital hardware, software, and networks to support and synchronize interaction between organizations by increasing the value, accessibility, and affordability of services with consistent, agile, and effective results.

On the other hand, the primary characteristics of the DSCs, referring to the operational management of the fundamental elements, as shown in Figure 1, and the proposal dimensions, distinguish them from the traditional SCs. These characteristics include accelerated, adaptable, smart, real-time data gathering, transparent, globally-connected, scalable and clustered, breakthrough, inventive, and sustainable (Garay-Rondero et al., 2020).

Figure 1 – proposed essential SCM elements (Garay-Rondero et al., 2020)

Impact of industry 4.0 technology on Supply Chain Management

While a supply chain can increase performance using traditional ICT technologies like enterprise resource planning (ERP) and transaction processing systems to reduce transaction costs and increase coordination effectiveness (Yao et al., 2007), the emergence of cloud technology (Marston et al., 2011) presents difficulties in making the switch to more effective cloud-based technologies.

Except for the research published by Wu et al. (2013), the literature discloses little empirical studies to date. An "ICT-enabled service model where hardware and software services are given on-demand to end-user consumers over the Internet in a self-service fashion fairly independent of devices and locations" is what the term "cloud technology" refers to (Marston et al., 2011, p.177). According to Jede and Teuteberg (2015), cloud technology is still in its infancy, especially in the supply chain. This calls for an empirical inquiry to help managers better appreciate its potential in the integration of cross-firm logistics processes. Since many businesses are becoming increasingly interested in using cloud technology but it has not yet entirely permeated industry norms, this study focuses on the intention to adopt rather than analyse the actual efficacy of the technology.

In terms of operational efficiency (e.g., inventory sharing, order status and tracking, demand forecasting), time compression, higher IT-performance (e.g., high-speed data access, add-on services, customizability, latest hardware and software, as well as service bundles), and with a medium to low security level (e.g., data access and data networks), cloud-based technology adoption is thought to provide advantages over conventional ICT-enabled SCI (Jede & Teuteberg, 2015). In order to maintain the connections among manufacturers, suppliers, retailers, and customers for the integration of the logistics process, cloud services—specifically SaaS—are likely to revolutionise the game. Shee et al. (2018) suggest a concept from the RBV perspective to expand the conventional ICT-enabled SCI to build a cloud capability, which is likely to enable improved SCI and so increase performance in the supply chain and the company.
Technologies like CPSs, IoT, BDA, and Cloud are regarded as the primary drivers of Industry 4.0. When smart embedded systems are integrated and networked with one another and the Internet in an environment that is supported by Industry 4.0, the physical and digital worlds converge, creating CPSs (cyber-physical systems) (Fatorachian & Kazemi, 2020). CPSs are intelligent systems that bring together computing, communication, and engineering systems. They consist of a number of digital and physical assets whose purpose is to carry out a number of specified tasks (Poovendran et al. 2012). According to Leitao et al.(2016), CPSs are one of the main forces behind Industry 4.0 and can connect the physical and virtual worlds by enabling a high level of connectivity between software and hardware. This can result in advanced communication between people, machines, processes, and products (Babiceanu et al., 2013). Computing components of a CPS allow for communication with sensors and actuators. This enables all of the environment's scattered intelligence to be connected. A smart production line with an intelligent machine capable of carrying out numerous tasks through communication with components is an illustration of CPS (Fatorachian and Kazemi 2020).

Another important enabler, the Internet of Things (IoT), describes a global ecosystem where all linked and intelligent processes, systems, and objects are connected to it (Fatorachian and Kazemi 2020). This technological advancement, which is an extension of the Internet, is characterised by a world of pervasive connectivity in which intelligent, Internet-connected devices continuously interact and provide useful information to help decision-making (Fatorachian & Kazemi 2020). IoT enables the integration of smart technologies like sensors, actuators, and other intelligent systems. By completely changing industries and organizations, it introduces a new paradigm in how businesses operate (Agrifoglio et al., 2017). This is made possible by cloud computing, which has enabled a paradigm shift in information systems management through the convergence of technologies such as networking, computing, and management systems (Helo & Hao, 2017).

Cloud technologies enable remote communication between systems, devices, and products. They can also enable the transmission of data produced by various processes and systems to central data warehouses for later aggregation and analysis (Brousell et al., 2014). In other words, cloud systems can offer large amounts of storage and fast computing, allowing for independent and quick access to data from any location (Schuh et al., 2014). Given the importance of responsiveness and visibility in supply chain management, this capability can significantly aid in planning and decision-making and lessen the bullwhip effect in the supply chain (Tan et al., 2017).

Methodology

This research paper undertook a systematic literature review approach, successfully identifying each field's present state of research (Fettke, 2006). Furthermore, the classification stage of each individual manuscript adhered to the framework developed by Dibbern et al. (2004). The pursuit of systematic knowledge development is directly related to the articles that have been published.
Case study research is regarded as a reliable way to find contextual information that is practically applicable (Wu & Choi 2005). Ivanov (2021b) demonstrates that visualizing new, emergent research streams in order to generalize their characteristics is a particularly effective use of case study analysis. In order to determine the general characteristics of the cloud supply chain paradigm, the target was to highlight its practical context through the case studies in this section. Secondary data, particularly the companies' websites, was used to gather the information for the case-study development.
Three case studies have been identified that match the research direction, relevant enough to portray a clear view of how cloud technology is implemented in various supply chains and the implications of cloud computing across the globe.

Results and discussion

Case Studies

Case1: Amazon FBA - Let Amazon pick, pack, and ship your orders

Key elements of Amazon's business model FBA (fulfillment by Amazon) are summarised as "Let Amazon pick, pack, and ship your items" (2022). The main goal of Amazon FBA is to enable outside businesses to utilize Amazon's logistical networks. Companies can ship their goods to Amazon fulfillment facilities. When a consumer orders, Amazon takes care of the order's receiving, packing, shipping, customer service, and returns. In other words, the FBA business model employs a form of the supply chain "renting" (Ivanov et al., 2022).

An "end-to-end solution for inventory storage, shipping, and returns, together with handling customer care on those purchases" is what the Amazon FBA offers (Amazon 2022). Additionally, FBA uses multi-channel fulfilment. Customers can place orders for the company's goods through their "website, Amazon, social media, or elsewhere." Additionally, drop shipping through Amazon's Merchant Fulfilled Network can extend FBA (MFN) (Ivanov et al., 2022). Drop shipping entails outsourcing the majority or all of the supply chain process, from product sourcing or production through fulfilment, according to Amazon (2022). Production, storage, shipping, and delivery to clients could be handled by a manufacturer or other entity (Ivanov et al., 2022).

Amazon has observed that established e-commerce businesses with sizable sales volumes and a range of products and sales channels can gain the most from the FBA model (Ivanov et al., 2022). Through a developed digital supply chain, FBA may assist in ensuring end-to-end visibility over all fulfilment activities, including returns. According to Bigcommerce (2022), the FBA platform is used by around two-thirds of Amazon's third-party retailers. In conclusion, Amazon offers supply chain as a service by outsourcing storage, shipping, customer service, and returns operations through FBA (Ivanov et al., 2022).

Case2: Industry 4.0 and cloud manufacturing – Manufacturing-as-a-service platforms

"A methodology for offering ubiquitous, accessible, on-demand network access to a shared pool of configurable manufacturing resources that can be promptly deployed and released with minimal management effort or service provider contact," according to the definition of cloud manufacturing (Xu, 2012). Cloud manufacturing uses the manufacturing-as-a-service paradigm, as demonstrated in (Zhang et al., 2011), will be exemplified with two cases.

First, the Industry 4.0-based MindSphere cloud-based manufacturing platform from Siemens can be mentioned, which employs advanced analytics to digitally manage interconnected systems and machines throughout physically dispersed physical facilities (Ivanov et al, 2022). "MindSphere drives Internet-of-Things (IoT) solutions from the edge to the cloud with data from linked products, plants, and systems to optimise operations, generate better-quality goods, and implement new business models," according to the company (Siemens, 2022). Second, the open manufacturing platform (OMP) developed by BMW and Microsoft embodies key Industry 4.0 concepts of cross-enterprise digital communication of machines and people. Supporting collaboration and data transparency in Industry 4.0 networks is the main goal of OMP. The OMP's goal is to make manufacturing more intelligent by utilising open standards and data analytics to solve practical issues as efficiently as possible while maximising the use of available resources (Ivanov et al., 2022).

Case3: Different regional implications of using cloud computing in SCM

Regional differences in terms of technology, culture, politics, and economy may have a big impact on how CC usage develops within SCM. In addition, we have demonstrated through quantitative analysis that the factors influencing implementation are complex and not generally applicable. As a result, we looked into all papers for country-specific prerequisites in each country to determine the relationships between implementation factors and CC adoption premises. Most of the conclusions listed below are based on empirical surveys (Jede & Teuteberg, 2015).

Due to China's restricted financing options for small and medium-sized businesses, management is reluctant to invest significantly in IT infrastructure and software (Li et al., 2012). The Chinese logistical infrastructure, in particular, suffers from a low level, so the renting model of CC can improve the usage of the newest IT without capital expenditure and give transparency across SC processes (Li et al., 2012). Given that logistics organizations have a low beginning security level, the Chinese authors underline the possible increases in data security from using CC (Jede & Teuteberg, 2015).

In order to create a well-functioning SaaS market system in South Korea, the government also forced the SaaS market there through strict laws and SaaS quality certifications (Jede & Teuteberg, 2015). However, neither the introduction of the SaaS marketplace nor the certificates did much to promote development. Lee et al. (2013) determined that South Korea has changed from a policy-led to a customer-driven market, in which reduced costs and quick deployment options strongly influence companies implementing SaaS. They reached this conclusion using an analytical hierarchy process and a survey. They conclude that the widespread mistrust of security remains a significant obstacle to CC markets expanding.

However, the CC provider market is firmly established in Central Europe (Repschläger et al., 2012). But when it comes to data security, European businesses are more risk-averse than those in the US and China (Benlian, 2009). Adequate data protection guidelines established by the European Union would improve CC dependability, especially for SMEs (Tarzey, 2012). Benlian & Hess (2011) found that security concerns outweighed performance and economic risks as the main determinants of CC implementation in a sizable cross-sectional study of German enterprises. On the other hand, they address costs, followed by strategic flexibility and quality improvements as the strongest SaaS opportunity factors. According to experts, there is generally little difference between the average knowledge of European businesses and the information found in the most recent body of scientific literature (Jede & Teuteberg, 2015).

The influence of the CC elements in American businesses is more nuanced than those in CC markets in less developed countries, which are mostly cost-driven. These factors include business process complexity, functionality, compatibility, and company culture (Wu et al., 2012). Furthermore, empirical studies (Cegielski et al., 2012) highlighted the significance of CC for inter-organizational SC performance inside US-based organizations. Furthermore, most of the largest CC providers, such as Salesforce.com and Amazon, are US-based. However, due to their poorer IT performance, US companies face next-level problems due to the advanced use of CC services (Compuware, 2011). Again, the national government is in charge inside a nation since the US government is one of the greatest Community- and Hybrid-CC adopters, making efficient use of various specialized services and responding to citizen requests. Additionally, a smartly created hybrid-CC system connects the federal, state, and local US agencies (Gupta, 2013).

Despite the fact that the examples provided only cover a small portion of the sample, the literature's overall evidence supports the fact that North America and Europe presently hold the top positions in the underlying field's science and application(Jede & Teuteberg, 2015). No matter the region's degree of development, all mention that the possibility for cost reduction is a significant influencing element. This suggests that before further advances in CC enable multi-dimensional benefits like increased flexibility and inter-organizational supply chain connectivity, this element may serve as a fundamental baseline (Jede & Teuteberg, 2015). Additionally, governments undoubtedly play a fascinating and significant dual role in the CC-ecosystem. On the one hand, users anticipate them to assume the regulatory role and serve as a standard-setting body that ensures strong data security, particularly in Central Europe. On the other hand, by deploying, offering, and utilising their own CC services, governments attempt to act as a catalyst that forces CC development (Jede & Teuteberg, 2015).

Conclusions

Supply chains are no longer constrained by technologies and what they can achieve, but rather by the creativity of those who use them and professionals today must reinvent business models, organisational structures, and operations to flourish now and in the future as businesses around the globe deal with a perfect storm of upheaval (Barret & Higgins, 2021). Determining a digital supply chain road plan to improve present performance and investing in capabilities that drive competitive advantage will be essential for any future supply chain organisation to succeed. Future supply chains will need to be far more adept at identifying customer cues, analysing data, segmenting markets, figuring the cost of service, and managing partners and knowledge. As a result, brand promise will be driven by new roles, such as supply chain architects.

Future market leaders will excel in modelling the "voice of the customer," enabling a supply chain that is service-oriented, comprehending the cost of complexity, managing new types of partner networks, and boosting supply chain autonomy, among other critical competency areas (Barret & Higgins, 2021). Apart from developing the structure of the digital supply chain, an important factor in developing such a project is the fact that employees exhibit more inventive behaviour when working inside a framework of transformational leadership style because they feel valued, empowered, and have a lot of autonomy and competence (Stanescu et al., 2020). Leaders could have a larger positive impact on employees' levels of innovative work behaviour by fostering a greater sense of empowerment (Stanescu et al., 2020), which in turn provides for a better prepared organisation in adopting complex systems such as a cloud integrated supply chain.

The cloud supply chain paradigm presents fresh and possibly significant research directions at several levels of decision-making. Only a few examples of research topics where novel and significant contributions can be made include contracting in the context of platforms, supply chain design with consideration of outsourcing possibilities, cost/benefit analysis of creating one's own supply chains vs. borrowing a supply chain, inventory management, and multi-channel logistics optimization.

In order to maintain the ties among manufacturers, suppliers, retailers, and customers for the integration of the logistics process, cloud services—specifically SaaS—are likely to revolutionize the game. Therefore, from the standpoint of RBV (resource-based view), we suggest a model expands the conventional ICT-enabled SCI in order to establish a cloud capability that is likely to enable improved SCI and thus increase performance in the supply chain and the company (Shee et al., 2018). The findings demonstrate that cloud-enabled SCI (such as the exchange of demand information, inventory status, production, and delivery schedules) has a favorable, considerable impact on supply chain performance, which therefore enhances the sustainable performance of the company (Shee et al., 2018). According to the findings, top management initiative increases the possibility that cloud services would be adopted and used.

References

Agrifoglio, R., Cannavale, C., Laurenza, E., & Metallo, C. (2017). How Emerging Digital Technologies Affect Operations Management through Co-Creation. Empirical Evidence from the Maritime Industry. *Production Planning & Control, 28*(16), 1298–1306. https://doi.org/10.1080/09537287.2017.1375150

Amazon (2022, September 4). *The ecommerce fulfillment guide to grow your business.* https://sell.amazon.com/learn/ecommerce-fulfillment?ref_=sdus_fba_ecommf_what_h1

Ambos, B., Brandl, K., Perri, A., Scalera, V. G., & Van Assche, A. (2021). The nature of innovation in global value chains. *Journal of World Business, 56*(4), 101221. Doi: 10.1016/j.jwb.2021.101221

Armbrust, M., Fox, A., Griffith, R., Joseph, A.D., Katz, R., Konwinski, A., Lee, G., Patterson, D., Rabkin, A., Stoica, I. & Zaharia, M. (2010). A View of Cloud Computing. *Communications of the ACM, 53*, 50-58. https://doi.org/10.1145/1721654.1721672

Barret, R., & Higgins B. (2021, September 4). *The future of supply chain.* KPMG. https://advisory.kpmg.us/insights/future-supply-chain.html

Benlian, A. (2009). A transaction cost theoretical analysis of Software-as-a-Service (SaaS)-based sourcing in SMBs and enterprises. P*roceedings of the 17th European Conference on Information Systems (ECIS). https://aisel.aisnet.org/cgi/viewcontent.cgi?article=1020&context=ecis2009*

Benlian, A., & Hess, T. (2011). Opportunities and risks of software-as-a-service: Findings from a survey of IT executives. *Decision Support Systems, 52*(1), 232-246. https://doi.org/10.1016/j.dss.2011.07.007

Benlian, A., Hess, T., & Buxmann, P. (2009). Drivers of SaaS-adoption–an empirical study of different application types. *Business & Information Systems Engineering, 1*(5), 357-369. Doi:10.1007/s12599-009-0068-x

Brintrup, A., Pak, J., Ratiney, D., Pearce, T., Wichmann, P., Woodall, P., & McFarlane, D. (2020). Supply chain data analytics for predicting supplier disruptions: a case study in complex asset manufacturing. International. *Journal of Production Research, 58*(11), 3330-3341. https://doi.org/10.1080/00207543.2019.1685705

Brousell, D. R., Moad, J. R., & Tate, P. (2014). *The Next Industrial Revolution: How the Internet of Things and Embedded, Connected, Intelligent Devices will Transform Manufacturing. Frost & Sullivan, A Manufacturing Leadership* [White paper]. https://www.readkong.com/page/the-next-industrial-revolution-9748069

Catteddu, D. (2009). *Cloud Computing: benefits, risks and recommendations for information security.* European Network and Information Security Agency. https://www.enisa.europa.eu/media/news-items/cloud-computing-speech

Catteddu, D. (2010). Cloud Computing: Benefits, Risks and Recommendations for Information Security. In C. Serrão, V. Aguilera Díaz, & F. Cerullo (Eds.), *Communications in Computer and Information Science*. Springer. https://doi.org/10.1007/978-3-642-16120-9_9

Cegielski, C.G., Jones-Farmer, L.A., Wu, Y. & Hazen, B.T. (2012). Adoption of cloud computing technologies in supply chains: An organisational information processing theory approach. *International Journal of Logistics Management, 23*(2), 184-211. https://doi.org/10.1108/09574091211265350

Choi, T. M., Kumar, S., Yue, X., & Chan, H. L. (2022). Disruptive technologies and operations management in the Industry 4.0 era and beyond. *Production and Operations Management, 31*(1), 9-31. https://doi.org/10.1109/TCYB.2015.2507599

Chou, D. C., & Chou, A. Y. (2007). Analysis of a new information systems outsourcing practice: software-as-a-service business model. *International Journal of Information Systems and Change Management, 2*(4), 392-405. https://doi.org/10.1504/IJISCM.2007.017385

Compuware. (2022, September 4). *North American and European Businesses Lose Millions of Revenue Dollars Yearly Due to Poor Cloud Performance.* http://investor.compuware.com/releasedetail.cfm?ReleaseID=553490

Dibbern, J., Goles, T., Hirschheim, R., & Jayatilaka, B. (2004). Information Systems Outsourcing: A Survey and Analysis of the Literature. *ACM SIGMIS Database: the DATABASE for Advances in Information Systems, 35*(4), 6-102. https://doi.org/10.1145/1035233.1035236

Fatorachian, H., & Kazemi, H. (2020). Impact of Industry 4.0 on supply chain performance. *Production Planning & Control*, 63-81. https://doi.org/10.1080/09537287.2020.1712487

Fettke, P. (2006). State-of-the-Art des State-of-the-Art: An investigation of the research method "Review" within the business informatics. *Business Informatics*, *48*(4), 257-266. https://doi.org/10.1007/s11576-006-0057-3

Garay-Rondero, C. L., Martinez-Flores, J. L., Smith, N. R., Morales, S. O. C., & Aldrette-Malacara, A. (2020). Digital supply chain model in Industry 4.0. *Journal of Manufacturing Technology Management, 31*(5), 887-933. https://doi.org/10.1108/JMTM-08-2018-0280

Gupta, P., Seetharaman, A., & Raj, J.R. (2013). The usage and adoption of cloud computing by small and medium businesses. *International Journal of Information Management, 33*(5), 861-874. https://doi.org/10.1016/j.ijinfomgt.2013.07.001

Helo, P., & Hao, Y. (2017). Cloud Manufacturing System for Sheet Metal Processing. *Production Planning & Control, 28*(6–8), 524–537. https://doi.org/10.1080/09537287.2017.1309714

Ivanov, D., Sokolov, B., & Dolgui, A. (2020). Introduction to Scheduling in Industry 4.0 and Cloud Manufacturing Systems. In B. Sokolov, D. Ivanov, & A. Dolgui (Eds.), *Scheduling in Industry 4.0 and Cloud Manufacturing. International Series in Operations Research & Management Science*, *289*. https://doi.org/10.1007/978-3-030-43177-8_1

Ivanov, D., Sokolov, B., Chen, W., Dolgui, A., Werner, F., & Potryasaev, S. (2021). A control approach to scheduling flexibly configurable jobs with dynamic structural-logical constraints. *IISE Transactions, 53*(1), 21-38. https://doi.org/10.1080/24725854.2020.1739787

Jede, A., & Teuteberg, F. (2015). Integrating cloud computing in supply chain processes: a comprehensive literature review. *Journal of Enterprise Information Management, 28*(6), 872-904. https://doi.org/10.1108/JEIM-08-2014-0085

Kinnett, J. (2018, November 26). *Creating a digital supply chain: Monsanto's Journey.* SlideShare. www.slideshare.net/BCTIM/creating-a-digital-supply-chain-monsantos-journey

Lee, S.G., Chae, S.H., & Cho, K.M. (2013). Drivers and inhibitors of SaaS adoption in Korea. *International Journal of Information Management, 33*(3), 429-440. https://doi.org/10.1016/j.ijinfomgt.2013.01.006

Li, X., Wang, Y., & Chen, X. (2012). Cold chain logistics system based on cloud computing. *Concurrency and Computation: Practice and Experience, 24*(17), 2138-2150. https://doi.org/10.1002/cpe.1840

Marston, S., Li, Z., Bandyopadhyay, S., Zhang, J., & Ghalsasi, A. (2011). Cloud computing – the business perspective. *Decision Support Systems, 51*(1), 176-189. https://doi.org/10.1016/j.dss.2010.12.006

Perri, A., Scalera, V. G., & Mudambi, R. (2017). What are the most promising conduits for foreign knowledge inflows? Innovation networks in the Chinese pharmaceutical industry. *Industrial and Corporate Change, 26*(2), 333-355. https://doi.org/10.1093/icc/dtx025

Poovendran, R., Sampigethaya, K., Gupta, S. K. S., Lee, I., Prasad, K. V., Corman, D. & Paunicka, J. L. (2012). Special Issue on Cyber-Physical Systems. *Proceedings of the IEEE, 100*(1), 6–12. Doi: 10.1109/JPROC.2011.2167449

Repschlaeger, J., Wind, S., Zarnekow, R., & Turowski, K. (2012). Selection criteria for software as a service:an explorative analysis of provider requirements. *Proceedings of the 18th American Conference on Information Systems (AMCIS)*. https://aisel.aisnet.org/amcis2012/proceedings/EnterpriseSystems/3

Schuh, G., Potente, T., Wesch-Potente, C., Weber, A. R., & Prote, J. P. (2014). Collaboration Mechanisms to increase Productivity in the Context of Industry 4.0. *Procedia CIRPI, 19*, 51–56. https://doi.org/10.1016/j.procir.2014.05.016

Shee, H., Miah, S. J., Fairfield, L., & Pujawan, N. (2018). The impact of cloud-enabled process integration on supply chain performance and firm sustainability: the moderating role of top management. *Supply Chain Management: An International Journal*, *23*(6), 500-517. https://doi.org/10.1108/SCM-09-2017-0309

Siemens (2022, September 4). *MindSphere*. https://siemens.mindsphere.io/en

Stanescu, D. F., Zbuchea, A., & Pinzaru, F. (2020). Transformational leadership and innovative work behaviour: the mediating role of psychological empowerment. *Kybernetes, 50*(5), 1041-1057. https://doi.org/10.1108/K-07-2019-0491

Tan, K. H., Ji, G., Lim, C. P., & Tseng,M. L. (2017). Using Big Data to Make Better Decisions in the Digital Economy. *International Journal of Production Research, 55*(17), 4998–5000. https://doi.org/10.1080/00207543.2017.1331051

Tarzey, B. (2012). *Adapting to new data rules.* Computer Weekly. https://www.computerweekly.com/

Vaquero, L. M., Rodero-Merino, L., Caceres, J., & Lindner, M. (2008). A break in the clouds: towards a cloud definition. *ACM sigcomm computer communication review, 39*(1), 50-55. http://ccr.sigcomm.org/online/files/p50-v39n1l-vaqueroA.pdf

Wang, Y., Wallace, S. W., Shen, B., & Choi, T. M. (2015). Service supply chain management: A review of operational models. *European Journal of Operational Research, 247*(3), 685-698. https://doi.org/10.1016/j.ejor.2015.05.053

Wu, W. W., Lan, L. W., & Lee, Y. T. (2011). Exploring decisive factors affecting an organization's SaaS adoption: A case study. *International Journal of Information Management, 31*(6), 556-563. https://doi.org/10.1016/j.ijinfomgt.2011.02.007

Wu, Y., Cegielski, C.G., Hazen, B.T., & Hall, D.J. (2013). Cloud computing in support of supply chain information system infrastructure: understanding when to go to the cloud. *Journal of Supply Chain Management, 49*(3), 25-41. https://doi.org/10.1111/j.1745-493x.2012.03287.x

Wu, Z., & Choi, T. Y. (2005). Supplier–supplier relationships in the buyer–supplier triad: Building theories from eight case studies. *Journal of Operations management, 24*(1), 27-52. https://doi.org/10.1016/j.jom.2005.02.001

Xin, M., & Levina, N. (2008, December). Software-as-a-service model: Elaborating client-side adoption factors. In R. Boland, M. Limayem, & B. Pentland (Eds.), *Proceedings of the 29th International Conference on Information Systems*.. http://dx.doi.org/10.2139/ssrn.1319488

Xu, X. (2012). From cloud computing to cloud manufacturing. *Robotics and computer-integrated manufacturing, 28*(1), 75-86. https://doi.org/10.1016/j.rcim.2011.07.002

Yang, Z., Sun, J., Zhang, Y., & Wang, Y. (2015). Understanding SaaS adoption from the perspective of organizational users: A tripod readiness model. *Computers in Human Behavior, 45*, 254-264. https://doi.org/10.1016/j.chb.2014.12.022

Yao, Y., Palmer, J., & Dresner, M. (2007). An interorganizational perspective on the use of electronically enabled supply chains. *Decision Support Systems, 43*(3), 884-896. https://doi.org/10.1016/j.dss.2007.01.002

Zhang, A., Wang, J. X., Farooque, M., Wang, Y., & Choi, T. M. (2021). Multi-dimensional circular supply chain management: A comparative review of the state-of-the-art practices and research. *Transportation Research Part E: Logistics and Transportation Review, 155*, 102509. https://doi.org/10.1016/j.tre.2021.102509