

# Conceptual model of smart industry value chain

Larisa Hrustek, Neven Vrčak

University of Zagreb

Faculty of Organization and Informatics

Pavlinska 2, Varaždin

lhrustek@foi.unizg.hr

Slavko Vidović

Infodom d.o.o.

Andrije Žaje 61, Zagreb

slavko.vidovic@infodom.eu

**Abstract.** *The readiness of companies to successfully meet the market demands requires knowledge and opportunities based on cooperation by establishing digital ecosystems. Integration and management of advanced technologies within a networked digital ecosystem, and reconfiguration of all aspects of organizational and operational activities along the entire value chain, enable companies to achieve benefits in creating value and developing smart and sustainable products and services. In this paper, a conceptual model of the smart industry value chain is presented with an emphasis on how the environment and elements of the digital ecosystem should function. Also, the performance characteristics in this ecosystem are presented and discussed.*

**Keywords.** servitization, smart and sustainable product, smart industry, ecosystem, value chain

## 1 Introduction

Digital transformation is a set of actions taken by a business system to adopt modern digital technologies, create business models and improve business processes to change the organization's performance and create new value for all stakeholders. To successfully adapt, change, and prepare, organizations need a clear strategy, appropriate organizational structure, and a balanced change management system suited for digital transformation. Therefore, adopting the concept of digital transformation is vital for survival and necessary in most industries (Naimi-Sadigh et al., 2021).

Digital innovations and their widespread use cause disruptions, implying problems related to changes in business processes, and as such, can shake the core of any industry (Naimi-Sadigh et al., 2021). Digital development has led to a data revolution and lasting changes in customer needs and expectations, which are resulting in the disruption of the entire economy and society. With technological and digital advances, the boundaries between physical and digital channels of stakeholders interaction become blurred, and the impact of digital transformation on the value chain is

being felt in various ways (Reinartz et al., 2019), (Savastano et al., 2018).

Digital technologies change the strategy, business models, operational processes of the organization, value chain, skills, and relationships with stakeholders, which creates vulnerabilities and, at the same time, provides new and innovative opportunities to positively impact business and society (Büchi et al., 2020). In order to take full advantage of digital opportunities, appropriate models, methods, and tools are needed (Naimi-Sadigh et al., 2021). Digital tools and technologies enable manufacturing companies to reduce costs, increase productivity, improve product development, achieve faster time to market, and increase customer focus through various value chain elements (Savastano et al., 2018). Sustainability of the value chain requires dynamic management skills in a business environment (Breitenbauch de Moura et al., 2020) and efficient use of resources in the ecosystem (Alhawari et al., 2021), (Di, 2021). Collaboration, communication, and integration through new digital connections between companies and stakeholders, redesign of business models, and harmonization with digital tools, are vital for creating value and the production of smart and sustainable products or services through Servitization (Naimi-Sadigh et al., 2021), (Savastano et al., 2018). The competition of business systems in a dynamic market is based on new business models, which include smart products and services supported by servitization, providing customers with new experiences and benefits and at the same time engaging them to improve products and services.

The motivation for this paper is to investigate the influence and role of modern concepts of production, service delivery, and industrial development in the digital age observed in digital ecosystems and collaboration concepts. These concepts include servitization, smart and sustainable product development, smart industry, digital industry, digital transformation, smart factory, and digital factory. Section 2 presents the research methodology of these concepts, while Section 3 describes the concepts individually. In Section 4, the conceptual model of the smart industry value chain is presented.

## 2 Methodology

This paper is a preliminary report, research methodology is based on a literature review, and the obtained results are the baseline for future research. The relevant Scopus database was searched by title, with the complex query (Q1) "servitization" OR "smart products" OR "smart industry" OR "digital industry" OR "digital transformation" OR "smart factory" OR "digital factory" AND "ecosystem". The search result had 39 articles. In addition, the analysis was limited to articles published in the last 3 years, where a total of 29 articles, i.e., 21 available articles was found.

The second part of the research aimed to investigate the impact of these modern concepts on value chain management and to identify the value chain's determinants in the digital age's smart industry ecosystem. Therefore, the search was performed in the relevant database in the Scopus area, according to the title, based on the complex query (Q2) "servitization" OR "smart products" OR "smart industry" OR "digital industry" OR "digital transformation" OR "smart factory" OR "digital factory" AND "value chain management" OR "value chain". The search result was 15 articles and 11 of them were available and included in further analysis.

Finally, based on the literature review, a smart industry value chain conceptual model is presented. The smart industry value chain model provides an overview and characteristics of modern production, service delivery and ecosystem collaboration. The internal value chain management and immersion of the value in the ecosystem is increasingly important for value creation in the smart industry environment. These two topics are considered separately because value chain management is observed at the company level and its value-creating activities, while the ecosystem includes all external stakeholders, technologies, data, and tools available to the company in creating value.

## 3 Literature review

Digital technologies have led to revolutionary changes in service and manufacturing business systems by changing how products and services are developed, created, delivered, and evaluated. The emerging digital technologies emphasize the development of smart products or services, which require knowledge and skills that business systems individually do not have enough (Kahle et al., 2020). Therefore, it is necessary to establish ecosystems with new opportunities for interactive relationships connecting all stakeholders, contributing to the creation of new business models (Manser Payne et al., 2021). Over the last decade, companies have redefined and adapted their product-oriented business models into service-oriented business models and synergy between products and

services, i.e. smart and sustainable products. The acceptance and transition to the concept of servitization is driven by the widespread adoption of digital technologies and increased dynamics of market demand. These two effects were disruptive, and companies strived to keep pace with these systemic changes. One of the responses was establishing a non-static ecosystem that enabled companies to interact and exchange experiences, technologies and, services dynamically.

Disruptive innovations in the ecosystem provide an opportunity for different stakeholders to recognize smart technological features and adapt their products and services to market dynamics. Under the influence of disruptive innovations, it is important to recognize how and to what extent all stakeholders are connected and what benefits they have from this relationship in the development of smart and sustainable products and services. Companies that do not recognize and accept new market demands face potentially severe economic consequences. Therefore, it is essential to identify key business models based on innovations and how companies drive innovations in products and services as well as how these innovations are accepted in the ecosystem (Manser Payne et al., 2021). Also, digital transformation requires new business models and the harmonization of business models of other different business systems within the ecosystem (Kohtamäki et al., 2019).

Smart and sustainable products and services are the results of the concept of servitization on which the functioning of the ecosystem is based. Such innovative products and services include integrating IoT solutions and other digital solutions such as the cloud, big data, and artificial intelligence, and they are a crucial driver of digital transformation in business systems. Furthermore, by applying digital technologies, smart products and services can create new opportunities for business model innovation. This results in new opportunities such as innovative product-related services, a new customer relationship or new pricing models, or even replacing the purchase of products with pay-per-use payment systems (Kahle et al., 2020).

### 3.1 Servitization

Servitization is a concept focused on business model transformation where a business system needs to change a product-oriented business model to a service-oriented approach, whereby digital technologies enable the creation of value for the customer. The ecosystems are being developed to take advantage of all the opportunities that servitization brings for all stakeholders while creating value for the customer with a particular service is in the focus. Servitization is defined as the transformation of processes, opportunities, and offers within business systems in cooperation and communication with other stakeholders. These stakeholders form ecosystems for the progressive creation, delivery, and recording of

increased output value, which is based on the application of digital technologies. (Manser Payne et al., 2021). The concept of servitization reshapes the common idea of products as independent concepts and emphasizes the connection of three dimensions of the offer, namely product, service, and software (Kohtamäki et al., 2019).

Technology-led servitization provides new opportunities for services, platforms, intelligent products, and new business models and becomes a business model driver for value perception, and creation (Kohtamäki et al., 2019). Servitization-oriented strategies use digital technologies as a mechanism to develop new revenue-generating values. However, success depends on the ability of business systems to leverage data collected from customers to create an effective strategy, tactics, and business model of value creation (Manser Payne et al., 2021). Recognizing and achieving this level of service integrated with the product is becoming a prerequisite for survival in increasingly complex markets. In addition, servitization has become a vital means for manufacturing and service companies to provide integrated product and service solutions with customized requirements, so many business systems are trying to switch from simple product delivery to providing customized supply and service-driven solutions (Wei et al., 2020).

### 3.2 Smart and sustainable product

Smart and sustainable products are a new generation of products whose main characteristics are servitization and care for sustainability and the environment. The basic features of such products are energy efficiency, intelligence, connectivity, human interaction, sense, and autonomy. To develop and produce these products, business systems need to integrate innovative product development and digital technologies, intelligent technology, and green and sustainable technology (Yin et al., 2020).

Smart products consist of three key components: a physical element, smart services, and connectivity. A wide range of smart and sustainable products, such as health-related bracelets, smart cars, smart home appliances, and industrial products such as machinery and equipment, connect based on IoT, enabling companies to make faster and more efficient decision-making based on data from smart products and providing new customer service. Equipped with technologies such as sensors, software and microchips, connectivity, and the ability to collect, process, and store data, smart products add value by creating better or 'smarter' interactions with customers, other products, performing tasks without human input, and collecting, monitoring, controlling and optimizing data from different sources for all stakeholders in the ecosystem. The ability to collect and process data distinguishes smart products from traditional products and provide opportunities to develop new services and create added

value resulting from these solutions, as data generated by smart products can be used in a variety of ways, such as helping companies improve their product development processes or create a smart offer to customers. Data collected from smart products are still focused on creating value for the user, but a value for all stakeholders in the ecosystem is still neglected (Kahle et al., 2020), so it is important to establish an ecosystem and create business models that will be acceptable in a dynamic market.

### 3.3 Business models in an ecosystem based on servitization

An ecosystem is an environment for multi-stakeholder collaboration, providing opportunities to create and develop advanced smart and sustainable products and services based on the interaction provided in the ecosystem and intense utilization of digital technologies. The ecosystem is the creator of servitization and smart products (Kapoor et al., 2021). A prerequisite for successful survival in the market is that companies utilize all the benefits brought by the digital age and treat them as a necessary prerequisite for development. Business systems must learn to participate in the ecosystem and contribute to building an ecosystem around products or services to gain a competitive advantage and establish partnerships with other companies for joint value creation and joint innovation (Yin et al., 2020). The values and innovations created by business systems derive from the benefits of data collected in the ecosystem from smart products and services. Such ecosystems in which different stakeholders are present can contribute and benefit from the development of integrated solutions based on advanced connectivity, can create a positive social impact and solve major problems such as disease, poverty, and environmental crises (Kahle et al., 2020). The role of business ecosystems is to enable the replication of capabilities, which requires a strong center to encourage the learning of all stakeholders (Jovanovic et al., 2019). Such interaction influences every participating business entity and suggests adjustment in centralization within individual business systems and their integration with others (Sklyar et al., 2019).

In an ecosystem based on the concept of servitization, business models for smart solutions involve a combination of different products, services, software, and analytics. The successful application of business models that support digital servitization expands the business processes beyond the boundaries of a business system. Therefore, the production and service business entities need to define the value system, understand its position and where, how, and why the boundaries of the business system are determined, and how digital transformation affects business models in different positions within value systems and ecosystems. It is a complex process that requires systematic and continuous changes in

processes, with the readiness of companies to experiment with the potential mistakes and successes brought by experimentation.

When moving to a business model based on servitization, business systems need to redefine the existing business model. In addition, they need to understand the configurations of other business systems within the ecosystem to create a strategic fit between business models of all stakeholders. The changes and emergence of new business models affect

business systems operations in the ecosystem and influence component manufacturers, system vendors, system integrators, solution providers, operators, distributors, and customers. In such an ecosystem, the business model should be understood as dynamic, constantly subject to change through continuous construction and reconstruction (Kohtamäki et al., 2019). For this to be possible, it is necessary to be guided by Digital Transformation Playground (Pihir et al., 2019).

Business related concepts	Improvements, Increased Effectiveness/ Efficiency	Ecosystems/ green tech.	New Business Models	New services, competencies, skills	Customer experience, Journey	New alliances
Other ICT and digitalization concepts	Social Media & Platforms	Artificial Intelligence & Gamification	Metamodelling	IoT, Big Data and Data Analytics	Virtual Technologies & Knowledge management	Robotics & Autonomous systems
Mainstream concepts	Cloud Technologies	Mobile Technologies	Reference Models	ERP & CRM	SCM & DWH	BPM & Performance Management

**Figure 1.** Digital Transformation Playground (Pihir et al., 2019)

Digital Transformation Playground (Figure 1) shows that changing or improving any business concept such as developing a new business model, building an ecosystem, improving customer value by developing customer journey, or any other service-based business improvement idea requires recognizing the right technologies (Pihir et al. 2019), but also business environments and routines, value propositions and price logic (Kohtamäki et al., 2019).

### 3.4 Value chain management in the digital age

The value chain includes all business system activities that can facilitate the production process and business in general and make the final value-added product competitive in price and performances on the market. The digital age and technology evolution require a reassessment of the value chain by providing digital services, new communication channels with customers and partners, and new digital services to new partners in the digital ecosystem (Naimi-Sadigh et al., 2021). Porter divided the activities in the business system into basic and supporting. With the development of digital technologies, requirements have been set for achieving a certain level of technological maturity, which is a fundamental source of sustainability, acceleration, and proactivity in the value chain (Opresnik et al., 2013). Ribeiro (2019) presented the second generation of the

value chain where information systems are added as a primary activity, which means people, processes, and technology. A critical area within the business system always requires the appropriate alignment of people, processes, and technology.

Markets today are very competitive, changeable, and saturated with products, services, and offers, which means that no business system can afford the lack of information and data about their business, their customers, or changes that affect their business future (Ribeiro, 2019). Value chain management needs a strategic approach (Breitenbauch de Moura and Godoy Saroli, 2020) that allows business systems to adapt quickly by combining all resources in the ecosystem to improve competitiveness, developing closer strategic relationships with stakeholders. The development of smart solutions transcends the boundaries of the business system, and significant resources, knowledge, and skills necessary for success are acquired in the industry ecosystem. Digital transformation has created many new business opportunities by transforming product-based value chains. Szalavetz (2020) states that this was done in four key ways: servitization of operations and products, application of technological and organizational solutions that enable innovation activities, cooperation of business systems in the ecosystem, and high-intensity of interaction between stakeholders in producing and providing digital solutions. Manufacturers can use various digital

technologies and innovations to enhance the stages of their value chain, such as product design and innovation, manufacturing, supply chain management, marketing, sales, and services. The transformation in these phases includes advances in production equipment, smart products, data tools, and analytics, and the way products and services are designed, manufactured, and serviced in the industry has to change.

### 4 Conceptual model of the smart industry value chain

Contemporary digital concepts, value chain at the enterprise level, and the ecosystem have been observed separately, and the impact of some certain concepts on the value chain or ecosystem has been analyzed. However, these claims are changing, and it is necessary to show an overview of the conceptual model of the smart industry value chain, which is presented below (Figure 2) with the recognized characteristics.

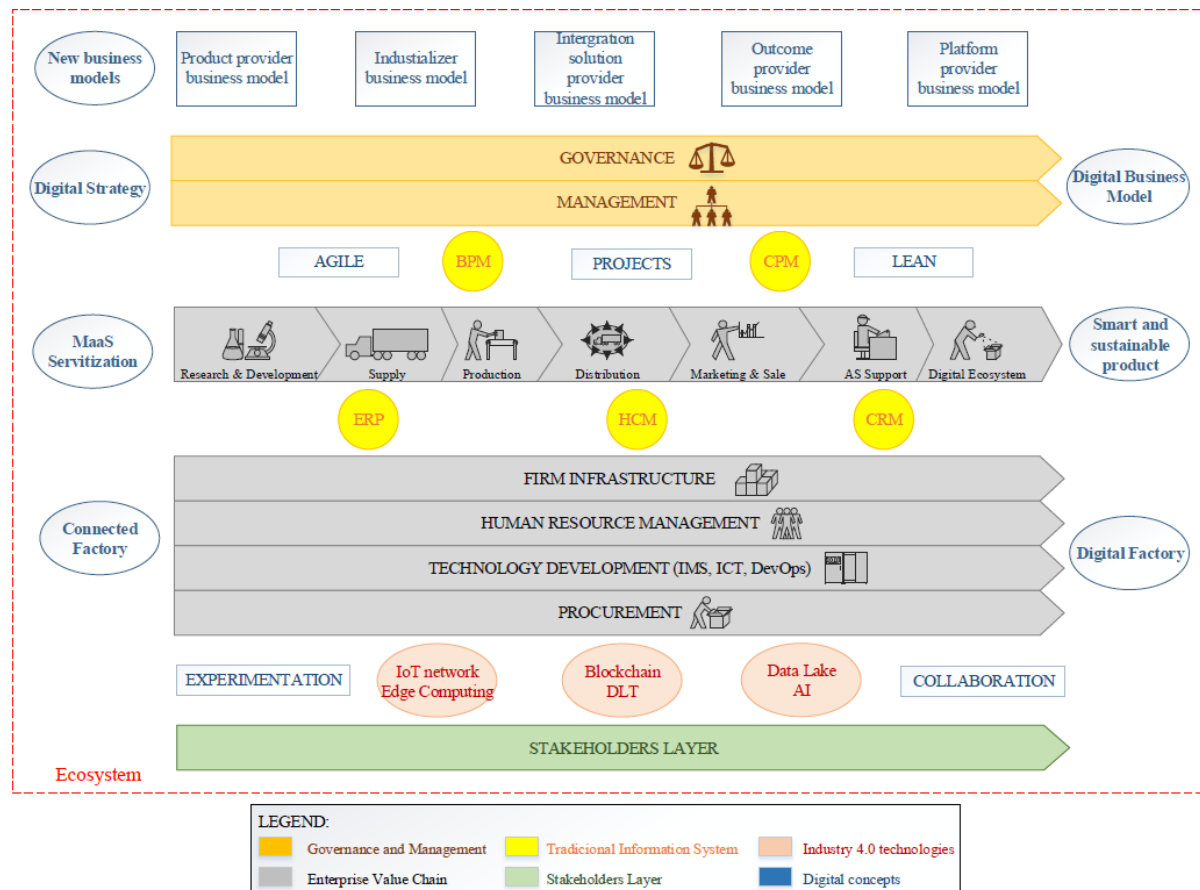


Figure 2. Conceptual model of the smart industry value chain

The figure of the conceptual model of the smart industry value chain begins with governance and management, which are responsible for defining the digital strategy and business models of companies. In developing products or services, companies have concentrated on internal value chains. Primary activities played a fundamental role in the production of products or services in companies, and traditional information systems, which supported these activities, represent a mature technology for almost any industrial application. Changes in the market and new requirements of customers have become greater and more complex. The needs of companies for resources in development, production, service delivery, and sustainability to successfully respond to market needs are a condition for survival. The changes that followed

the emergence of digital concepts in the industry can be described through the following characteristics (based on literature review presented in previous chapters and related to the complex queries (Q1 and Q2) in Table 1):

- continuous innovation of business models under the influence of Servitization (C1)
- ecosystem based on collaboration, communication, and exchange of resources (C2)
- redefining and integration the value chain in the ecosystem (C3)
- smart and sustainable product and Servitization (C4)
- sharing knowledge, competencies, and skills (C5)
- experiment culture (C6).

**Table 1.** Recognized characteristics of the smart industry value chain in literature

Authors	C1	C2	C3	C4	C5	C6
<b>Q1</b>						
Manser Payne et al., 2021.		+	+	+		
Song et al., 2021.	+	+		+		
Yang et al., 2021.				+		
Komninou et al., 2021.	+		+	+	+	+
Kapoor et al., 2021.		+		+		
Yin et al., 2020.	+		+	+		
Hermes et al., 2020.	+	+	+	+		
Mohammadian et al., 2020.				+	+	
Tan et al., 2020.	+	+		+		
Wei et al., 2020.			+	+		
Hofmeister Kahlea et al., 2020.			+	+	+	+
Zemrane et al., 2020.	+		+	+		
Jih & Hung, 2020.	+	+	+	+		
Riasanow et al., 2020.		+	+	+		
Kohtamäki et al., 2019.	+	+	+	+	+	+
Jovanovic et al., 2019.	+		+	+	+	
Sklyar et al., 2019.			+	+		+
Horváth & Rabetino, 2019.		+			+	
Burmeister et al., 2019.	+			+		
Yildirim & Tunçalp, 2019.	+			+		
Chirumalla et al., 2019.	+	+	+	+	+	+
<b>Q2</b>						
Cho & Jun, 2021.		+				
Naimi-Sadigh et al., 2021.		+	+		+	+
Ribeiro, 2021.		+			+	
Uduvela et al., 2021.		+	+	+		
Szalavetz, 2020.	+	+	+	+		
Reinartz, 2019.	+	+	+	+		
Zighan et al., 2018		+	+			
Savastano et al., 2018.	+	+	+			
Bustanza et al., 2015.		+	+			
Xu et al., 2015.		+	+	+		
Opresnik et al., 2013.	+	+	+			

With the concept of servitization in companies, the value chain transcends internal boundaries and expands to the external environment. Internal borders are open for advanced collaboration, projects, and support between companies and all stakeholders. The integration and sharing of resources, a multidisciplinary environment, and the reliance of the manufacturing sector on the service sector enable corporations to implement all the values and elements of services to develop smart and sustainable products and/or services. Product and service lifecycle boundaries are disappearing with the provision of advanced services and the constant upgrading of new services.

New value flows in the ecosystem help to better understand customer needs, and disruptive innovation has enabled the integration of new values into business models. Some business models based on servitization in the ecosystem recognized by Kohtamäki et al. (2019) are product provider, industrializer, integrated

solutions provider, outcome provider and platform provider. These business models are included in the conceptual model of the smart industry value chain and present some possible utilization of resources in the value chain. The product provider business model emphasizes standardized products and add-on services where some smart features based on remote diagnostics are included. The Industrializer business model presents modular product offerings and service agreements. The integrated solutions provider business model presents customized and modular product-service systems with some performance guarantees or operational services, including sales and delivery, remote diagnostic, preventive maintenance, advanced services, IoT solutions, and increasing emphasis on project management capabilities. The outcome provider business model is customized, modular product-service systems owned by the manufacturer, predominantly performance pricing, and this business model is based on value-based selling, delivery of

outcome-based services, IoT, and AI solutions. Finally, the platform provider business model is a service-dominant business model where the platform provider enables provider-customer interactions and sharing services.

Operating in an ecosystem requires knowledge, skills, and a culture of experimentation, where common capabilities and resources, especially infrastructure and data, are used to build smart and sustainable products and/or services, which individual companies have not had so far.

## 5 Conclusion

The development of smart and sustainable products and services requires ecosystems to align in the collaboration and integration of complementary capabilities. Integration and management of a wide range of networked ecosystem capabilities allow companies to achieve important gains in creating value for different stakeholders at all levels of the system. Companies need to adopt a systematic approach to address business opportunities throughout the value chain. The first step should be to set a strategic path and define business goals to be achieved. Next, companies need to identify and select potential innovations and resources in the ecosystem for further development and projects that can provide business value. If companies want to do this, they need knowledge, skills, and a culture of experimentation with the digital innovations in the value chain. This paper provides an overview of new concepts and their connections in the ecosystem, which provides a basis for further research on the operations of these concepts in the ecosystem. Future research will be based on several case studies through which we are going to empirically analyze value chain concepts established in this paper.

## Acknowledgments

This work has been fully supported by the Croatian Science Foundation under the project IP-2019-04-4864.

## References

- Alhawari, O., Awan, U., S. Bhutta, M. K., Ali Ülkü, M. (2021). Insights from Circular Economy Literature: A Review of Extant Definitions and Unravelling Paths to Future Research. *Sustainability*, 13(2), 1-22.
- Breitenbauch de Moura, G. and Godoy Saroli, L. (2020). Sustainable value chain management based on dynamic capabilities in small and medium-sized enterprises (SMEs). *International Journal of Logistics Management*, 32(1), 168-188.
- Büchi, G., Cugno, M., Castagnoli, R. (2020). Smart factory performance and Industry 4.0. *Technological Forecasting and Social Change*, 150, 119790.
- Burmeister, F., Drews, P., Schirmer, I. (2019). An Ecosystem Architecture Meta-Model for Supporting Ultra-Large Scale Digital Transformations. *Twenty-fifth Americas Conference on Information Systems (AMCIS)*, Cancún, Mexico
- Bustinza, O.F., Bigdeli, A.Z., Baines, T., Elliot, C. (2015). Servitization and competitive advantage: The importance of organizational structure and value chain position. *Research Technology Management*, 58(5), 53-60.
- Chirumalla, K., Emmanuel-Ebikake, O., Leoni, L., Servati, M. (2019). Intra-Firm and Inter-Firm Challenges in Servitization Ecosystem: Experiences from Five Product-Centric Firms in Different Industries. *Proceedings of the Design Society International Conference on Engineering Design (ICED19)*, 1(1), 3071-3080, Delft, The Netherlands, DOI:10.1017/dsi.2019.314
- Cho, I. & Jun, J. (2021). Effect of the smart factory system in value chain on competitiveness of Korean SMEs manufacturing. *Proceedings - 2021 21st ACIS International Semi-Virtual Winter Conference on Software Engineering, Artificial Intelligence, Networking and Parallel/Distributed Computing (SNPD-Winter 2021)*, 9403461, 142-147, 10.1109/SNPDWinter52325.2021.00038
- Di, P. (2021). The Research and Implementation in Digital Transformation of Manufacturing Enterprises. *Journal of Physics*, 1820, 012098.
- Hermes, S., Riasanow, T., Clemons, E. K., Böhm, M., Krcmar, H. (2020). The digital transformation of the healthcare industry: exploring the rise of emerging platform ecosystems and their influence on the role of patients. *Business Research*, 13, 1033–1069.
- Hofmeister Kahle, J., Marcon, É., Ghezzi, A., Frank, A. G. (2020). Smart Products value creation in SMEs innovation ecosystems. *Technological Forecasting and Social Change*, 156, 120024.
- Horváth, K. & Rabetino, R. (2019) Knowledge-intensive territorial servitization: regional driving forces and the role of the entrepreneurial ecosystem. *Regional Studies*, 53(3), 330-340.
- Jih, CY. & Hung, WH. (2020). Digital Transformation Research of Taiwan's Traditional Manufacturing Industry based on the Ecosystem Perspectives. In *Proceedings of The 20<sup>th</sup>*

- International Conference on Electronic Business (ICEB'20)*, (pp. 63-70), Hong Kong SAR, China
- Jovanovic, M., Raja, J. Z., Visnjic, I., Wiengarten, F. (2019). Paths to service capability development for Servitization: Examining an internal service ecosystem. *Journal of Business Research*, 104, 472-485.
- Kapoor, K., Bigdeli, A.Z., Schroeder, A., Baines, T. (2021). A platform ecosystem view of servitization in manufacturing. *Technovation*, 102248.
- Kohtamäki, M., Parida, V., Oghazi, P., Gebauer, H., Baines, T. (2019). Digital servitization business models in ecosystems: A theory of the firm. *Journal of Business Research*, 104, 380-392.
- Komninos, N., Kakderi, C., Collado, A.Papadaki, I. & Panori, A. (2021). Digital Transformation of City Ecosystems: Platforms Shaping Engagement and Externalities across Vertical Markets. *Journal of Urban Technology*, 28, 1-2.
- Manser Payne, E. H., Dahl, A. J., Peltier, J. (2021). Digital servitization value co-creation framework for AI services: a research agenda for digital transformation in financial service ecosystems. *Journal of Research in Interactive Marketing*.
- Mohammadian, H. D., Shahhoseini, H., Merk, R., Castro, M. J. (2020). Digital Transformation in Academic Society and Innovative Ecosystems in the World beyond Covid19-Pandemic with Using 7PS Model for IoT. *IEEE international conference "Learning with MOOCS 2020"*, (pp. 112-117), Antigua, Guatemala, 10.1109/lwmoocs50143.2020.9234328
- Naimi-Sadigh, A., Asgari, T., Rabiei, M. (2021). Digital Transformation in the Value Chain Disruption of Banking Services. *Journal of the Knowledge Economy*.
- Opresnik, D., Zanetti, C., Taisch, M. (2013). Servitization of the manufacturer's value chain. *IFIP Advances in Information and Communication Technology*, 415, (pp. 234-241), 10.1007/978-3-642-41263-9\_29
- Pihir, I., Tomičić-Pupek, K., Tomičić Furjan, M. (2019). Digital Transformation Playground - Literature Review and Framework of Concepts. *Journal of information and organizational sciences*, 43(1), 33-48.
- Riasanow, T., Jäntgen, L., Hermes, S., Böhm, M., Krcmar, H. (2020). Core, intertwined, and ecosystem-specific clusters in platform ecosystems: analyzing similarities in the digital transformation of the automotive, blockchain, financial, insurance and IIoT industry. *Electronic Markets*, 31(4).
- Ribeiro, R. (2019). Digital Transformation of the Enterprise Value Chains. *Global Forum of Intellectual Capital*, Lisbon, Portugal
- Reinartz, W., Wiegand, N., Imschloss, M. (2019). The impact of digital transformation on the retailing value chain. *International Journal of Research in Marketing*, 36(3), 350-366.
- Savastano, M., Amendola, C., D'Ascenzo, F. (2018). How Digital Transformation is Reshaping the Manufacturing Industry Value Chain: The New Digital Manufacturing Ecosystem Applied to a Case Study from the Food Industry. In book: *Network, Smart and Open*, 127-142.
- Sklyar, A., Kowalkowski, C., Tronvoll, B., Sörhammar, D. (2019). Organizing for digital Servitization: A service ecosystem perspective. *Journal of Business Research*, 104, 450-460.
- Song, Y., Escobar, O., Arzubiaga, U., De Massis, A. (2021). The digital transformation of a traditional market into an entrepreneurial ecosystem. *Review of Managerial Science*.
- Szalavetz, A. (2020). Digital transformation – enabling factory economy actors' entrepreneurial integration in global value chains?, *Post-Communist Economies*, 31(6), 771-792.
- Tan, F. T. C., Ondrus, J., Tan, B., Oh, J. (2020). Digital transformation of business ecosystems: Evidence from the Korean pop industry. *Information System Journal*, 30, 866-898.
- Uduwela, W.C., De Silva, R.K.J., Rupasinghe, T.D. (2020). Digital transformations in the apparel value chain for mass personalization. *IEEE International Conference on Industrial Engineering and Engineering Management (IEEM)*, 9309852, 450-454, 10.1109/IEEM45057.2020.9309852
- Zemrane, H., Abboua, A. N., Baddib, Y., Hasbia, A. (2020). Internet of Things Smart Factories Ecosystem based on SDN. *Procedia Computer Science*, 175, 723-729.
- Zighan, S.M., Bamford, D., Reid, I. (2018). From order-qualifier to order-winner? servitization value chain and the real estate development projects. *Journal of Modern Project Management*, 6(2), 130-149.
- Xu, X., Wang, X., Zhang, R. (2015). The research on influence factors of the servitization of the equipment manufacturing industry under the global value chain (GVC) perspective. *International Journal of Security and its Applications*, 9(5), 289-296.
- Yang, W., Liu, J., Li, L., Zhou, Q., Ji, L. (2021). How Could Policies Facilitate Digital Transformation of Innovation Ecosystem: A Multiagent Model. *Complexity*, 2021, 8835067.



- Yildirim, N. & Tunçalp, D. (2019). A Policy Design Framework for Digital Transformation: University-based Innovation and Entrepreneurship Ecosystems Revisited. *28th International Conference for the Management of Technology (IAMOT 2019)*, (pp. 341-358), Mumbai, India
- Yin, D., Ming, X., Zhang, X. (2020). Sustainable and smart product innovation ecosystem: An integrative status review and future perspectives. *Journal of Cleaner Production*, 274, 123005.
- Wei, F., Feng, N., Yang, S., Zhao, Q. (2020). A conceptual framework of two-stage partner selection in platform-based innovation ecosystems for servitization. *Journal of Cleaner Production*, 262, 121431.