Resource Orchestration in Digital Servitisation: A Case Study of Integrated Energy Service

Qiubo Huang[1], *Qing Xia[2]

[1] *School of Economics and Social Welfare, Zhejiang Shuren University, China*

qiubo_huang@zjsru.edu.cn

[2] *School of Economics and Social Welfare, Zhejiang Shuren University, China*

405232017@qq.com

INTRODUCTION

Manufacturers are continuously going downstream by adding services to products to improve sustainability. This process is referred to in the literature as servitization (Vandermerwe & Rada, 1988). Servitization strategy that is properly implemented can improve sustainable performance, and significantly enhance sustainable performance (Hao, Liu, & Goh, 2021). The emerging Industry 4.0 technologies (also known as Technologies 4.0) greatly facilitates the integration of products and services (Zambetti, Pinto, & Pezzotta, 2019). Technologies, such as the Internet of Things (IoT), Cloud computing or Big data and analytics, are supporting companies to enhance their product-service offering, both providing advanced infrastructure to deliver services and creating the potentiality to extend the service offering (Opresnik & Taisch, 2015). However, software was underemphasized in the early servitization research, it is now time to shed light on the role of digitalization in servitization and let digitalization rewrite the servitization narrative—digital servitization, which diverge from the original servitization story (Luoto, Brax, & Kohtamäki, 2017).

Digital servitization is the most definitive trend (T. Baines et al., 2017). Manufactures are moving from remote monitoring to optimization, control, and, ultimately, autonomous systems with advanced functionalities based on Artificial Intelligence. While some manufactures are still overcoming the challenges of data collection, warehousing, analytics, and prediction, leading companies such as ABB, Volvo, and Wärtsilä are rapidly moving toward more autonomous solutions (Parida, Sjödin, & Reim, 2019; Porter & Heppelmann, 2015). Studies have started documenting multiple industrial cases of the transition toward digital servitization (Cenamor, Rönnberg Sjödin, & Parida, 2017). Digitalization is increasingly viewed as an enabler and driver of the business model, value creation, and value capture in servitization (Parida et al., 2019; Porter & Heppelmann, 2015). Firstly, Digital technology is embedded in product service system, changing the service offering (Lerch & Gotsch, 2015). Manufactures come to digital product-service system supplier (Pagoropoulos, Maier, & McAloone, 2017). Large and complex equipment such as jet engines generate huge amounts of data during

operation, which can be used to generate predictive maintenance services (Luz Martin-Pena, Diaz-Garrido, & Maria Sanchez-Lopez, 2018). Videos and images collected by video surveillance equipment can support manufactures offering automated security services (Boucher Ferguson, 2013). The behavioral data collected by wearable devices can support offering health services. Beyond that , some manufactures even more proactively engage with customers by implementing so called customer success management systems (Hochstein, Rangarajan, Mehta, & Kocher, 2020). The data itself has become a sellable product (H. Zhu & Madnick, 2009). Data analytics and data sales that generate new value are collectively known as "data reuse," and this has become the biggest opportunity for servitization (Opresnik & Taisch, 2015). Secondly, the success of servitization always requires digital facilities and process support (Gobble, 2018)**.** Digitization extends the service network (Pohlmann & Kaartemo, 2017), increasing heterogeneous resources (Lyytinen, Yoo, & Jr, 2016) and resource mobility (Goduscheit & Faullant, 2018), which may fundamentally improve the innovation ability of the service and business model (Herterich, 2017), and solve "servitization dilemma" (Visnjic Kastalli & Van Looy, 2013).

Although, significant contributions have been made to the digital servitization literature, mostly, these research float on the level of phenomenon description and hold a static perspective. There is a lack of knowledge of the microfoundation focus on how to orchestrate organizational resources and capabilities. Furthermore, digital servitization research focus too much on technology application and pays insufficient attention on organizational change (Tronvoll, Sklyar, Sörhammar, & Kowalkowski, 2020). In fact, digital servitization relates to the overall transition of organization resource and structure, as well as the interaction with users and business ecosystem participants. The 'techie led' digital transformations often fail (Westerman, 2016). It needs a "technical-organizational" combined perspective.

This paper addresses this digital servitization phenomenon and aims to fill the gap in the existing literature on the internal transformation mechanism. We conducted a case analysis on one integrated energy service supplier. Based on a "technical-organizational" combined perspective, this paper aims to explore the configurations of resources and capabilities digital servitization strategy required. Therefore, the following research questions are addressed in the paper:

RQ1. What are the fundamental tactics of digital servitization strategy?

RQ2. What are the types of competitive strategies for digital servitization?

LITERATURE REVIEW

Servitization

Research on servitization originated in 1960s (Greenfield, 1966). The concept of "servitization" was first proposed by Vandermerwe and Rada (1988). After that, many scholars contribute to the concept development, such as White (1999), Reiskin (1999). Other scholars have proposed similar concepts, like service-embedded manufacturing (Sun linyan, Li Gang, Jiang Zhibin, Zheng Li, & He Zhe, 2007), product-service System (PSS) (T. S. Baines et al., 2007), integrated solution (Miles, Andersen, Boden, & Howells, 2003). Although the perspectives vary, they all emphasize the shift of manufacturing enterprises to selling product-service combined offerings（Tukker,2004） The existing servitization research including: 1)Mode: For example, according to the degree of servitization, it is divided into three types, product extensional servitization, functional servitization and integrated solution (Davies, 2004). According to the way of offering services, it is divided into two types, supporting service and customer self-service (Kowalkowski, Kindström, & Gebauer, 2013). According to the competitive strategy, it is divided into outsourcing mode, integration mode, cooperation mode and service provider mode (LIU Jian-guo, 2012). **2)** Drivers: There are internal and external drivers. Internal drivers including Human Resources (Santamaría, Jesús Nieto, & Miles, 2012), corporate culture, organizational structure (Gebauer, Edvardsson, Gustafsson, & Witell, 2010), service innovation strategy (Ettlie & Rosenthal, 2012), organizational capabilities (Mennens, Van Gils, Odekerken-Schröder, & Letterie, 2018; Parida, Sjödin, Lenka, & Wincent, 2015) and so on. External drivers including network relationship (Feng & Sivakumar, 2016; Korhonen & Kaarela, 2011), industrial technology disturbance (Santamaría et al., 2012), social and economic environmental factors (Wan, Rongping, & Minglu, 2012) and so on. **3)** Strategy pathway: Including organizational structure installation (Gebauer et al., 2010), resource optimization and capacity construction (Daniel Kindström, Kindström, & Kowalkowski, 2014), establishing service ecology with platform thinking (Cenamor et al., 2017). 4)Performance: Although manufactures may encounter "servitization dilemma" (Brax, 2005), in general, it can promote the continuous growth of manufacturing enterprises and improve customer asset management (Tim Baines, 2015). Table 1 provides a brief summary of the research themes and corresponding representative literature.

Table 1:Research themes and Representative literature

Theme	**Topics**	**Representative literatures**
Mode	evolution stages, types, and patterns	(Christian Kowalkowski, Daniel Kindström, & Per-Olof Brehmer, 2011),(LIU Jian-guo, 2012) ,(J. Zhu & Yan, 2013) ,(Vandermerwe & Rada, 1988), (Davies, 2004), (Jinghua, Jianglu, & Qingyun, 2019),(A.Braxa & Visintin, 2017)

Driver	internal and external factors	(Gebauer et al., 2010),(Lin & Lin, 2012),(Santamaría et al., 2012),(Bastl, Johnson, Lightfoot, & Evans, 2012), (Laine, Paranko, & Suomala, 2012),(Demeter Krisztina & Levente, 2013) (Saccani, Visintin, & Rapaccini, 2014),(Alvarez, Martins, & Silva, 2015),(Li, Zhu, Lin, Ma, & Huang, 2015),(Tim Baines & Shi, 2015),(Benedettini, Neely, & Swink, 2015),(Feng & Sivakumar, 2016), (Ayala, Paslauski, Ghezzi, & Frank, 2017), (Lilong, Jiang, & Xiaoyong, 2012), (Mennens et al., 2018),(Lenka, Parida, & Wincent, 2017),(Valtakoski, 2017), (Chaping, Tao, & Qinfang, 2019),(Shah, Jajja, Chatha, & Farooq, 2020)
pathway and process change	strategy formulation and implementation, internal management of the organization, the external relationship change	(Qi, Mao, Zhang, & Guo, 2020),(Kohtamäki, Einola, & Rabetino, 2020), (Tim Baines, Ziaee Bigdeli, Sousa, & Schroeder, 2020),(Jinghua, Li, & Qianlan, 2019) ,(Tan et al., 2019),(Lafuente, Vaillant, & Vendrell-Herrero, 2017),(Jinghua, Li, et al., 2019) ,(Tim Baines & Lightfoot, 2013), (Cenamor et al., 2017),(Rabetino, Kohtamäki, & Gebauer, 2017) (Tim Baines, Howard Lightfoot, & Palie Smart, 2013), (Romeo Bandinelli & Valentina Gamberi, 2012), (Baines T., Lightfoot H., & P., 2011),(Oliva & Kallenberg, 2003),(Brax, 2005)
performance	Operation and innovation performance	(Zhou, Yan, Zhao, & Guo, 2020),(Sjödin, Parida, & Kohtamäki, 2019),(Visnjic Kastalli & Van Looy, 2013),(Li, Lin, Chen, & Ma, 2015),(Bustinza, Bigdeli, Baines, & Elliot, 2015),(Ting, Hua, & Peng, 2014) ,(Jie-xiong, 2010) ,(Neely, 2008)

Digital Servitization

The majority of the literatures related to digital servitization holds a in a broader sense. Some studies focusing on the application of different digital technologies in servitization, such as the IoT (Zancul Eduardo de et al., 2016), big data analytics (Ardolino et al., 2018), and cloud computing (Wen & Zhou, 2016). Other studies focus on the business process perspective digital transformation in servitization as production (Coreynen, Matthyssens, & Van Bockhaven, 2017), and supply chain

management(Vendrell-Herrero, Bustinza, Parry, & Georgantzis, 2017), after-sales (Belvedere & Grando, 2017). However, digital servitization is a combination of digitalization and servitization. It is associated with: 1) the nature change that manufactures' service offerings become more digital and 'smart'; 2) shift in the organization's business models; 3) the deploy of new strategic assets and the generation of competitive advantages, mostly due to the exploitation of data and information; and 4) the launch, monitoring, and control of initiatives aimed at achieving a more sustainable business (Paschou, Rapaccini, Adrodegari, & Saccani, 2020). Thus, digital servitization can be conceptualized as the business model that manufactures offering digital technology supported combination of services and products, which aims shaping more sustainable competitive advantage.

Digital servitization commonly involves complex of organizational change. For outside, digital servitization facilitates new types of customer interaction and closer integration. The integration of digital technologies offers opportunities for developing customized value propositions based on higher-quality services and relationships (Kamalaldin, Linde, Sjödin, & Parida, 2020; Paiola, Schiavone, Grandinetti, & Chen, 2021; Rust & Huang, 2014). For inside, the application of new technologies enhances operational efficiency, new capabilities, and transparency in support of better decision making (Cimini, Adrodegari, Paschou, Rondini, & Pezzotta, 2021). However, no matter outside or inside, all the changes characterized by depending on the continuous acquisition, warehousing, analytics, and implementation of machine and fleet-level data. Thus, digital capability and resource about service-related data processing and interpretation is critical (Tian, Coreynen, Matthyssens, & Shen, 2021). Hasselblatt (2018) studied manufacturers' capabilities in the IoT and found five bundles of strategic IoT capabilities: 1) digital business model development, 2) scalable solution platform building, 3) value selling, 4) value delivery, and 5) business intelligence and measurement. IoT transformed the capability requirements of manufacturers significantly, and further research is needed to define manufacturers' benefits of digital servitization. Companies need software capabilities while their business dependent more on the continuous acquisition, warehousing, analytics, and implementation of machine and fleet-level data. Coreynen (2017; 2020) indicated that manufacturers should balance two dynamic capabilities (exploratory and exploitative) and reset resources configurations.

Resource Orchestration Theory

Resource orchestration theory is a strategic management theory about how an organization can update its resource configurations to establish competitive advantage. It is a theory between resource-based view (RBV) and organizational capability theory. RBV affirms the role of resources in organization competitive advantage. Assembling and deploying specific resources is the microfoundation of generating organizational capabilities (J. Barney, 1991; J. B. Barney, Ketchen, & Wright, 2011). However, having resources does not necessarily lead to a competitive advantage (Baert, Meuleman,

Debruyne, & Wright, 2016; J. B. Barney, 2001; Helfat & Peteraf, 2003). The organization should organize its resources effectively to form the specific capabilities to create a competitive advantage. The theory of organizational capacity jumps over the action mechanism of basic resources, directly discusses how an organization's ability affects its competitive advantage and performance. Resource orchestration theory answers the question of how enterprises evolve their capability through the construction, integration and utilization of resource portfolio(Gebauer et al., 2010). Based on the process perspective of resource to capability, resource orchestration theory links RBV and organizational capability theory. It provides an analytical framework including resource configuration, resource binding, and leverage strategy (Sirmon, Hitt, Ireland, & Gilbert, 2011). Resource configuration refers to a series of behaviors of acquiring, accumulating and stripping resources for the purpose of forming enterprise resource combination. Resource binding refers to the integration and coordination of resources to promote the formation of organizational capacity. Resource leverage refers to the strategic positioning of using resources to gain competitive advantage.

RESEARCH METHODS

Case Selection

Considering the availability and typicality of data and convenience, this study selected HUAWEI Digital Power Technology Co., Ltd. as case. HUAWEI Digital Power Technology Co., Ltd. is the latest subsidiary of Huawei Group. It focuses on communication power, data center power and other IT related digital power service business. Although HUAWEI Digital Power Technology Co., Ltd. is a new company established in 2021 June, it’s business has been developed for many years. Unlike Vertiv (formerly Emerson Network Power) and other Network integrated energy service providers, HUAWEI Digital Power focuses on the optimization of power management based on digital technology. It provides power solutions that fully meet the application scenarios of ICT industry, including full-scenario intelligent sites from fixed network to wireless and intelligent data centers from edge to cloud. HUAWEI Digital Power aims to offer digital-based services supported by AI technology for the IT related power generation, transfer, storage, deploy, distribution and use. They have formed several core businesses, including Data Center Power solution, Site Power solution, Fusion Solar Smart and so on.

Data Acquisition

Data about the selected case were cited from related academic articles, news reports, research reports, interview records, and field interviews.

We collected 35 internal archived files, including the enterprises’ internal journals, business plans, strategic plans, internal memos, conference materials, annual strategic planning documents, customer lists, and historical sales materials. In addition, the research team collected 163 secondhand files by

analyzing related news reports and official websites and collecting industry analysis reports. The multi-level and multi-sources data collection method can be used to cross-check the interviews and control the backtracking bias, and the consequent triangulation data enhances the accuracy of the research results.

In total, the research team conducted four semi-structured interviews on the selected enterprises. Prior to the interviews the research team provided an interview syllabus to each of the enterprises so that appropriate respondents, who were familiar with the interview topics and who could thus prepare for the interviews, were designated. Throughout the interview process, the research team took notes and made audio recordings. Each interview lasted for an average of 40 minutes. We processed and checked the interview notes and audio records, and generated an interview contact sheet within 24 hours. In addition, we made follow-up calls to the respondents, to clarify uncertain and missing information.

Data Analysis

In this study, interview and text data were subjected to content analysis. First, the interview contents were categorized textually. Second, all the textual and video material were coded and analysis. Two members of the research team processed the case data, and then performed progressive coding, respectively. The coding process is as follows:

Step 1: Open coding:

The research team created 60 entries based on the digital transformation strategy and extracted 78 primary codes from the entry database. Two coders generated codes respectively, and compared the codes, to determine agreed-on primary codes. If the two coders failed to reach consensus, the research team determined primary codes through discussion.

Step 2: Axial coding by constructs:

From the 78 primary codes, the research team extracted 23 secondary codes, such as technical input level, and input and introduction modes. In the process of secondary coding, two members respectively determined the dimensions of codes in each construct database, and then compared them. If the codes were consistent, the coding results were confirmed. Otherwise, all members of the research team determined secondary codes through discussion.

Step 3: Selective coding by construct dimensions:

According to the type of digital transformation strategy, the 23 secondary codes were categorized under 4 construct coding directories: orchestration tactics for technological resources, human resources, organizational structure, and ecological relationship. If the two members reached consensus on entries, the entries were incorporated into the construct coding database. Failing that, through discussion all members of the research team agreed to either incorporate or delete the entries into the construct coding database.

FINDINGS

Resource Orchestration Tactics for Digital Servitization

Based on a coding analysis, we developed four resource orchestration tactics for digital servitization: technological resources orchestration, human resources orchestration, organizational structure orchestration, and ecological relationship orchestration.

Technological Resource Orchestration

The technological resource orchestration tactic includes three aspects, namely, technological level, input mode, and introducing mode.

Technology Level

The digital technology input has different levels, which can be divided into three levels according to the penetration into the organization structure. They are interactive digital technology, process digital technology, and fundamental digital technology. The interactive digital technology mainly refers to communication tools used on vendor-user interface as customer online community. HUAWEI Digital Power opened an online community as shared space for digital power businesses. The process digital technology refers to the technologies involves in organizational operation process, represented by the HUAWEI Digital Power's MRP/ERP management information system. HUAWEI Digital Power The fundamental digital technology refers to the basic digital construction, represented by the data collection system and data analysis technology based on AI. For example, HUAWEI Digital Power redesigned hardware part of the dada center by embedding over 200 sensors and developed matched application program. This fundamental technology combination enables remote monitoring and intelligent power management service offerings. **Technology input mode**

HUAWEI Digital Power invested in digital technologies in two ways, namely, self-development and outsourcing (purchasing or collaborating). For example, HUAWEI Digital Power established partnership with Intelligent Power Solution LTD. of Hungary. That Hungarian corporation shared their CRM system with Huawei Digital Power. Huawei Digital Power also purchased several related technologies from competitors in the world. However, most of the critical technologies are developed by themself. They constructed the framework of their hardware and software combined system, developed the hardware including the modular data center architecture, equipment cabinet, and software with AI function. They shape the core competitiveness through systematic technology innovation. **Technology introduction mode**

HUAWEI Digital Power takes a prudent attitude toward new digital technologies. They launched their digital power solution after pilot application and optimization. They even registered Digital Power Technology Co., Ltd. after years of business probe. Enterprises take a prudent attitude maybe because of

different reasons. HUAWEI Digital Power implemented the trial-and-error method on a small scale to test the feasibility of the business model.

Human Resource Orchestration

Labor Resource Structure

HUAWEI Digital Power built man-machine cooperative labor structure through labor substitution and machine enhancement. First, digital technologies replace certain manual working. Huawei smart I-V Curve diagnosis system replaced manual inspection, shortening the inspection time for a 100MW data center from 40 days to 15 minutes. Second, digital technologies strengthen Huawei's engineers. AI technologies keep on learning the power consuming behaviors and formatted power management patterns to support Huawei's site engineer's decision-making, which help to optimizing the customer power sustainable consumption.

Human resource scale

Some jobs in HUAWEI Digital Power were eliminated while some new jobs were created. The total scale of the labor force reduced significantly. Although department like the R&D department expanded a lot to enhance the technology innovation, the human resource used in site construction reduced as the modular constructing way was developed. Moreover, human resource used in other working like equipment inspection was almost eliminated as the AI inspection technology was introduced. It can be predicted that, in the future, HUAWEI Digital Power will have more manpower in data mining, machine trainers, R&D and other knowledge intensive departments, while the operation personnel will be reduced furthermore.

Human Resource Management

HUAWEI Digital Power adjusted human resource management, including recruitment, training, and assessment. First, an organizations' dynamic nature increases in the context of digitalization, thus, HUAWEI Digital Power's employee recruitment highlights characteristics such as learning ability and young mentality. Second, in order to improve the ability of organization members to use digital technology and cooperate with digital tools, HUAWEI Digital Power increased employee digital ability training. For example, they trained site engineers' ability of data mining. Third, HUAWEI Digital Power adjusted performance assessment contents. They added consideration for site engineers in customer relationship maintenance into the performance assessment.

Organizational Structure Orchestration

Organizational structure orchestration regards to structure and relationship in organization.

Structure

First, reinforcing the front office. While the process automation decreased the number of technology support engineers, the customer-facing front-office department needs to be strengthened. Thus, the organization structure developed into front-back-office structure. Second, the business functions of the digital department are strengthened. HUAWEI Digital Power enhanced Business Intelligence Department. Third, flattening organization structure. Business automation improves the span of management, so the organization shows a trend of flattening. Fourth, strengthening leadership of digital department. The setup of HUAWEI Digital Power indicates that the digital power solution business was upgraded to a strategic business unit. The top leader of HUAWEI Digital Power is one of the group board members is also a corroboration of that.

Relationship

First, the vertical organizational relationship is weakened, whereas the horizontal organizational relationship is strengthened. For example, the budgets of HUAWEI Digital Power are highly integrated through digital operations. The digital department's budgets include not only its internal expenses, but also digitalized expenses of the sales and marketing departments. Second, the organizational relationship translates to extroverted rather than introverted. That means HUAWEI Digital Power become more customer oriented. Third, HUAWEI Digital Power reset the business process to achieve a reasonable balance of labor between intelligent tools and human employees. It aims to give full play to the advantages of intelligent tools, such as efficient and accurate, 24-hour standby, etc., and at meantime, give play to the unique abilities of human, such as "emotional protection" and intuition.

Ecological Relationship Orchestration

Digital servitization offers opportunities by connect enterprises, employees, and consumers, making their boundaries fuzzy. Integrated power service industry is no longer a vertical business, but an ecological business. It transcends the scope of technologies and traditional organizational boundaries. Equipment manufacturers, customers, external collaborators, and public sectors all connect and coordinate with each other. Internally, corporations' strategies, technologies, and operations are harmoniously combined; externally, corporations maintain the benefit sharing and controllable collisions. Within business ecosystem, value is co-created and shared. HUAWEI Digital Power established a service partner system. Digital power service suppliers all around the world can join its networking after certificated. However, Huawei ranked the partnership by five star levels according the

partner's size and cooperation performance. Customers and suppliers are linked more transparently and flexibly. Technologies increased involvement of customers into value co-creates. The relationship between integrated power services suppliers with public sector are more diversified. HUAWEI Digital Power plays a significant helpful role in achieving global carbon neutral goal. They also help to establish necessary electricity power station at some less developed area were lack of power facilities.

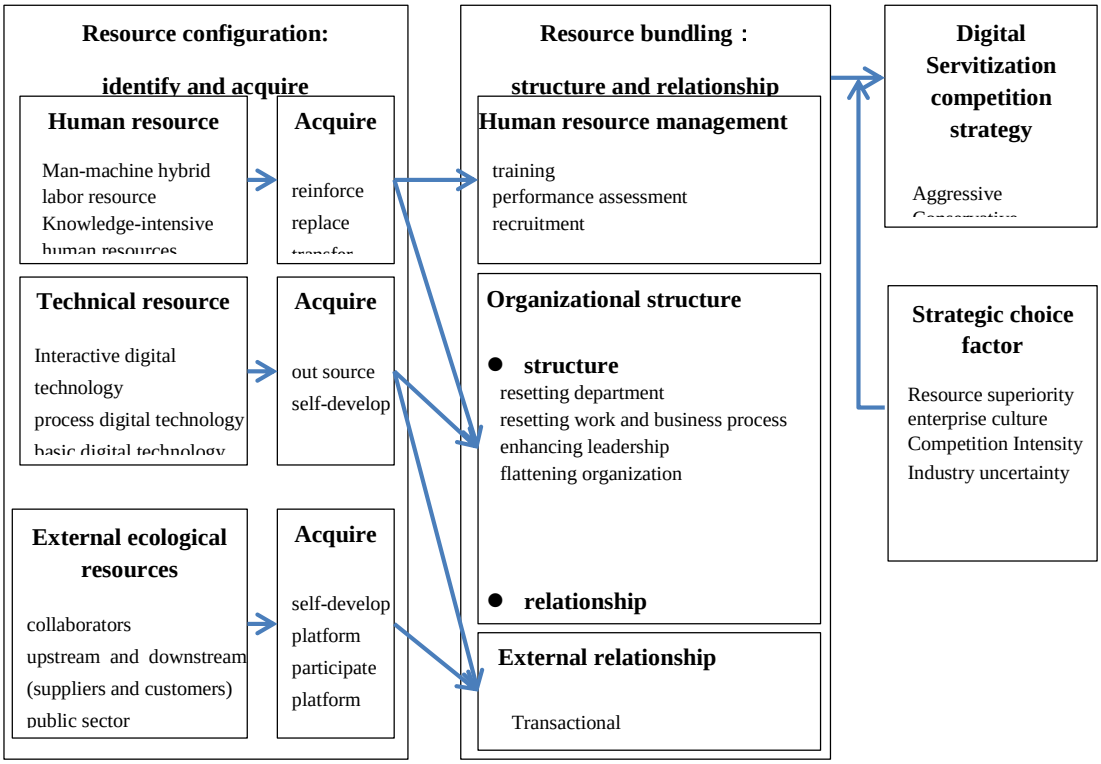
CONCLUSION

Through case study, we generalized four fundamental tactics of digital servitization strategy, which are technological resource orchestration, human resource orchestration, organizational structure orchestration, ecological relationship orchestration.

It can be predicted that the digital servitization resource orchestration strategies would be different in the investment level, investment mode, organizational structure adjustment, external relationship. The difference may stem from the enterprise strategic ambition. A manufacturer's digital servitization strategy maybe conservative. Manufacturer holds conservative digital servitization strategy prone to extend its existing servitization business by superficial digital technology. While some manufacturers' digital servitization strategy may be aggressive. The manufactures hold this kind of strategy aims to reconstruct the business model from bottom up and build up core competitive.

Basing on the resource orchestration theory, we develop a digital servitization strategy framework including three aspects: resource configuration, resource bundling, and leveraging strategy. With regarding to resource orchestration, this study identifies three types of key resources (technological, human, and external ecological), and the methods for acquiring them. Each type of resource must be acquired in an appropriate way. Specifically, technical resources are developed independently or outsourced; human resources are acquired through enhancement, replacement, or job transfer. Resource bundling mainly refers to the adjustment of human resource management, organizational structure (including the structure and relationship), and external relationships. It serves to build up a coordinated internal/external organizational relationship and maintain the stability of resource structure for digital servitization. Specifically, human resources are stabilized mainly through human resource management and organizational structure adjustment; technological resources are stabilized mainly through organizational structure adjustment (e.g., process adjustment) and external relationship coordination; and external ecological resources are stabilized mainly through the adjustment of external relationships. Ultimately, resource development and resource bundling are oriented toward a digital servitization competition strategy. Two digital servitization strategies are proposed, which are conservative or aggressive strategy. Two digital servitization strategies differ in actions of resource orchestration tactics. The choice of a competition strategy is affected by diverse factors such as resource advantages, corporate culture, industry uncertainty, and competitive situation. Figure 1 shows the strategic implementation framework.

Fig.1. Framework of digital servitization strategy



Acknowledgment

The authors would like to thank the anonymous reviewers for their valuable comments and suggestions which helped us improve the content, quality, and presentation of this paper. This work was supported in part by academic funding project for Zhejiang key research base of philosophy and Social Sciences (Zhejiang Modern Service Industry Research Center) under Grant（20JDZD073） and Soft Science Research Program of Zhejiang Province Department of Science and Technology under Grant（2021C35025）.

REFERENCES

A.Braxa, S., & Visintin, F. (2017). Meta-model of servitization: The integrative profiling approach. *Industrial Marketing Management, 60*, 17-32.

Alvarez, R. L. P., Martins, M. R., & Silva, M. T. (2015). Applying the maturity model concept to the servitization process of consumer durables companies in Brazil. *Journal of Manufacturing Technology Management, 26*(8), 1086-1106. doi: http://dx.doi.org/10.1108/JMTM-04-2014-0050

Ardolino, M., Rapaccini, M., Saccani, N., Gaiardelli, P., Crespi, G., & Ruggeri, C. (2018). The role of digital technologies for the service transformation of industrial companies. *International Journal of Production Research, 56*(6), 2116–2132. doi: https://doi.org/10.1080/00207543.2017.1324224

Ayala, N. F., Paslauski, C. A., Ghezzi, A., & Frank, A. G. (2017). Knowledge sharing dynamics in service suppliers' involvement for servitization of manufacturing companies. *International Journal of Production Economics, 193*, 538-553. doi: https://doi.org/10.1016/j.ijpe.2017.08.019

Baert, C., Meuleman, M., Debruyne, M., & Wright, M. (2016). Portfolio Entrepreneurship and Resource Orchestration. *Strategic Entrepreneurship Journal, 10*(4), 346-370. doi: doi:10.1002/sej.1227

Baines, T. (2015). Exploring Service Innovation and the Servitization of the Manufacturing Firm. *Research Technology Management, 58*(5), 9-11. doi: 10.5437/08956308X5805002

Baines, T., Bigdeli, A. Z., Bustinza, O. F., Shi, V. G., Baldwin, J., & Ridgway, K. (2017). Servitization: revisiting the state-of-the-art and research priorities. *International Journal of Operations & Production Management, 37*(2), 256-278. doi: 10.1108/IJOPM-06-2015-0312

Baines, T., & Lightfoot, H. W. (2013). Servitization of the manufacturing firm: Exploring the operations practices and technologies that deliver advanced services. *International Journal of Operations & Production Management, 34*(1), 2-35. doi: doi:10.1108/IJOPM-02-2012-0086

Baines, T., & Shi, V. G. (2015). A Delphi study to explore the adoption of servitization in UK companies. *Production Planning & Control, 26*(14/15), 1171-1187. doi: 10.1080/09537287.2015.1033490

Baines, T., Ziaee Bigdeli, A., Sousa, R., & Schroeder, A. (2020). Framing the servitization transformation process: A model to understand and facilitate the servitization journey. *International Journal of Production Economics, 221*, 107463. doi: https://doi.org/10.1016/j.ijpe.2019.07.036

Baines T., Lightfoot H., & P., S. (2011). Servitization within manufacturing: Exploring the provision of advanced services and their impact on vertical integration. *Journal of Manufacturing Technology Management, 22*(7), 947-954. doi: 10.1108/17410381111160988

Baines, T. S., Lightfoot, H. W., Evans, S., Neely, A., Greenough, R., Peppard, J., . . . Wilson, H. (2007). State-of-the-art in product-service systems. *Proceedings of the Institution of Mechanical Engineers, Part B: Journal of Engineering Manufacture, 221*(10), 1543-1552. doi: 10.1243/09544054jem858

Barney, J. (1991). Firm Resources and Sustained Competitive Advantage. *Journal of Management, 17*(1), 99-120. doi: 10.1177/014920639101700108

Barney, J. B. (2001). Is the Resource-Based "View" a Useful Perspective for Strategic Management Research? Yes. *The Academy of Management Review, 26*(1), 41-56. doi: 10.2307/259393

Barney, J. B., Ketchen, D. J., & Wright, M. (2011). The Future of Resource-Based Theory:Revitalization or Decline? *Journal of Management, 37*(5), 1299-1315. doi: 10.1177/0149206310391805

Bastl, M., Johnson, M., Lightfoot, H., & Evans, S. (2012). Buyer-supplier relationships in a servitized environment: An examination with Cannon and Perreault's framework. *International Journal of Operations & Production Management, 32*(6), 650-675. doi: doi:10.1108/01443571211230916

Belvedere, V., & Grando, A. (2017). ICT-enabled time performance: an investigation of value creation mechanisms. *Production Planning & Control, 28*(1), 75-88. doi: https://doi.org/10.1080/09537287.2016.1233359

Benedettini, O., Neely, A., & Swink, M. (2015). Why do servitized firms fail? A risk-based explanation. *International Journal of Operations & Production Management, 35*(6), 946-979. doi: doi:10.1108/IJOPM-02-2014-0052

Brax, S. (2005). A manufacturer becoming service provider - challenges and a paradox. *Managing Service Quality, 15*(2), 142-155. doi: 10.1108/09604520510585334

Bustinza, O. F., Bigdeli, A. Z., Baines, T., & Elliot, C. (2015). Servitization and Competitive Advantage. *Research Technology Management, 58*(5), 53-60. doi: 10.5437/08956308X5805354

Cenamor, J., Rönnberg Sjödin, D., & Parida, V. (2017). Adopting a platform approach in servitization: Leveraging the value of digitalization. *International Journal of Production Economics, 192*, 54-65. doi: https://doi.org/10.1016/j.ijpe.2016.12.033

Chaping, H., Tao, W., & Qinfang, H. (2019). Formation and mechanism of manufacturing companies' servitizaiton strategy:A multi-cace study based on the manufacturing indusry. *Science Research Management, 40*(08), 71-81. doi: 10.19571/j.cnki.1000-29952019.08.008

Christian Kowalkowski, Daniel Kindström, & Per-Olof Brehmer. (2011). Managing industrial service offerings in global business markets. *Journal of Business & Industrial Marketing, 26*(3), 181-192. doi: http://dx.doi.org/10.1108/08858621111115903

Cimini, C., Adrodegari, F., Paschou, T., Rondini, A., & Pezzotta, G. (2021). Digital servitization and competence development: A case-study research. *CIRP Journal of Manufacturing Science and Technology, 32*, 447-460. doi: https://doi.org/10.1016/j.cirpj.2020.12.005

Coreynen, W., Matthyssens, P., & Van Bockhaven, W. (2017). Boosting servitization through digitization: Pathways and dynamic resource configurations for manufacturers. *Industrial Marketing Management, 60*, 42-53. doi: https://doi.org/10.1016/j.indmarman.2016.04.012

Coreynen, W., Matthyssens, P., Vanderstraeten, J., & van Witteloostuijn, A. (2020). Unravelling the internal and external drivers of digital servitization: A dynamic capabilities and contingency perspective on firm strategy. *Industrial Marketing Management, 89*, 265-277. doi: 10.1016/j.indmarman.2020.02.014

Daniel Kindström, D. C. K., Dr, Kindström, D., & Kowalkowski, C. (2014). Service innovation in product-centric firms: a multidimensional business model perspective. *Journal of Business & Industrial Marketing, 29*(2), 96-111. doi: doi:10.1108/JBIM-08-2013-0165

Davies, A. (2004). Moving base into high-value integrated solutions: a value stream approach. *Industrial and Corporate Change, 13*(5), 727–756. doi: 10.1093/icc/dth029

Demeter Krisztina, & Levente, S. (2013). Towards solution based thinking: characteristics of servitization at Hungarian manufacturing companies. *Journal for East European Management Studies, 18*(3), 309-335. doi: doi.org/10.5771/0949-6181-2013-3-309

Ettlie, J. E., & Rosenthal, S. R. (2012). Service innovation in manufacturing. *Journal of Service Management, 23*(3), 440-454. doi: doi:10.1108/09564231211248499

Feng, C., & Sivakumar, K. (2016). The Role of Collaboration in Service Innovation Across Manufacturing and Service Sectors. *Service Science, 8*(3), 263-281. doi: 10.1287/serv.2016.0135

Gebauer, H., Edvardsson, B., Gustafsson, A., & Witell, L. (2010). Match or Mismatch: Strategy-Structure Configurations in the Service Business of Manufacturing Companies. *Journal of Service Research, 13*(2), 198-215. doi: 10.1177/1094670509353933

Gobble, M. M. (2018). Digitalization, Digitization, and Innovation. *Research-Technology Management, 61*(4), 56-57. doi: 10.1080/08956308.2018.1471280

Goduscheit, R. C., & Faullant, R. (2018). Paths Toward Radical Service Innovation in Manufacturing CompaniesA Service-Dominant Logic Perspective. *Journal of Product Innovation Management, 35*(5), 701-719. doi: 10.1111/jpim.12461

Greenfield, H. I. (1966). Manpower and the Growth of Producer Services. *Economic Development*, 163.

Hao, Z., Liu, C., & Goh, M. (2021). Determining the effects of lean production and servitization of manufacturing on sustainable performance. *Sustainable Production and Consumption, 25*, 374-389. doi: https://doi.org/10.1016/j.spc.2020.11.018

Hasselblatt, M., Huikkola, T., Kohtamäki, M., & Nickell, D. (2018). Modeling manufacturer's capabilities for the Internet of Things. *Journal of Business & Industrial Marketing, 33*(6), 822-836. doi: https://doi.org/10.1108/JBIM-11-2015-0225

Helfat, C. E., & Peteraf, M. A. (2003). The dynamic resource-based view: capability lifecycles. *Strategic Management Journal, 24*(10), 997-1010. doi: doi:10.1002/smj.332

Herterich, M. M. (2017). *On the Design of Digitized Industrial Products as Key Resources of Service Platforms for Industrial Service Innovation*. Paper presented at the 12th International Conference on Design Science Research in Information System and Technology,DESRIST 2017, Karlsruhe, Germany. https://doi.org/10.1007/978-3-319-59144-5_22

Hochstein, B., Rangarajan, D., Mehta, N., & Kocher, D. (2020). An Industry/Academic Perspective on Customer Success Management. *Journal of Service Research, 23*(1), 3-7. doi: 10.1177/1094670519896422

Jie-xiong, C. (2010). An Empirical Test of the Effect of Manufacturing Service-orientation on Corporate Performance: A Comparison between Chinese and American Enterprises. *JOURNAL OF BUSINESS ECONOM ICS*(04), 33-41. doi: doi: 10.19571/j.cnki.1000-2154(2010)04-0033-09

Jinghua, L., Jianglu, M., & Qingyun, Q. (2019). Selling Fish or fishing？Exploratory Case Study of Value Co-creation of Servitizaiton. *Science of Science and Management of S.& T, 40*(07), 43-60. doi: doi: doi: 10.19571/j.cnki.1002-0241(2019)07-0043-18

Jinghua, L., Li, L., & Qianlan, L. (2019). Business model innovation of servitization of the manufacturing industry: A resource-based perspective. *Science Research Management, 40*(03), 74-83. doi: DOI:10.19571/j.cnki.1000-2995.2019.03.008

Kamalaldin, A., Linde, L., Sjödin, D., & Parida, V. (2020). Transforming provider-customer relationships in digital servitization: A relational view on digitalization. *Industrial Marketing Management, 89*, 306-325. doi: 10.1016/j.indmarman.2020.02.004

Kohtamäki, M., Einola, S., & Rabetino, R. (2020). Exploring servitization through the paradox lens: Coping practices in servitization. *International Journal of Production Economics*, 107619. doi: https://doi.org/10.1016/j.ijpe.2020.107619

Korhonen, H. M. E., & Kaarela, I. (2011). CORPORATE CUSTOMERS' RESISTANCE TO INDUSTRIAL SERVICE INNOVATIONS. *International Journal of Innovation Management, 15*(3), 479-503. doi: 10.1142/S136391961100343X

Kowalkowski, C., Kindström, D., & Gebauer, H. (2013). ICT as a catalyst for service business orientation. *Journal of Business & Industrial Marketing, 28*(6), 506-513. doi: 10.1108/JBIM-04-2013-0096

Lafuente, E., Vaillant, Y., & Vendrell-Herrero, F. (2017). Territorial servitization: Exploring the virtuous circle connecting knowledge-intensive services and new manufacturing businesses. *International Journal of Production Economics, 192*, 19-28. doi: https://doi.org/10.1016/j.ijpe.2016.12.006

Laine, T., Paranko, J., & Suomala, P. (2012). Using a business game concept to enhance servitization: a longitudinal case study. *Managing Service Quality: An International Journal, 22*(5), 428-446. doi: doi:10.1108/09604521211281369

Lenka, S., Parida, V., & Wincent, J. (2017). Digitalization capabilities as enablers of value co-creation in servitizing firms. *Psychology & Marketing, 34*(1), 92-100. doi: 10.1002/mar.20975

Lerch, C., & Gotsch, M. (2015). Digitalized Product-Service Systems in Manufacturing Firms: A Case Study Analysis. *Research-Technology Management, 58*(5), 45-52. doi: 10.5437/08956308X5805357

Li, J. H., Lin, L., Chen, D. P., & Ma, L. Y. (2015). An empirical study of servitization paradox in China. *Journal of High Technology Management Research, 26*(1), 66-76. doi: http://dx.doi.org/10.1016/j.hitech.2015.04.007

Li, J. H., Zhu, W. J., Lin, L., Ma, L. Y., & Huang, Q. B. (2015). Manufacturer–user dependence, relationship learning and manufacturer servitisation in China. *International Journal of Technology, Policy and Management*, 311-331. doi: 10.1504/IJTPM.2015.072792

Lilong, Z., Jiang, W., & Xiaoyong, Z. (2012). The connotation, types and research framework of service innovation strategy in manufacturing enterprises. *Foreign Economics & Management*(09), 59-65. doi: 10.19571/j.cnki.1000-2995.2017.05.003

Lin, F.-J., & Lin, Y.-H. (2012). The determinants of successful R&D consortia: government strategy for the servitization of manufacturing. *Service Business, 6*(4), 489-502. doi: 10.1007/s11628-012-0157-7

LIU Jian-guo. (2012). Pattern and Path of Transformation of Manufacturing Sterilization. *Journal of Technical Economics & Management*(07). doi: 1001-292X(2012)07-0121-04

Luoto, S., Brax, S. A., & Kohtamäki, M. (2017). Critical meta-analysis of servitization research: Constructing a model-narrative to reveal paradigmatic assumptions. *Industrial Marketing Management, 60*, 89-100. doi: https://doi.org/10.1016/j.indmarman.2016.04.008

Luz Martin-Pena, M., Diaz-Garrido, E., & Maria Sanchez-Lopez, J. (2018). The digitalization and servitization of manufacturing: A review on digital business models. *Strategic Change-Briefings in Entrepreneurial Finance, 27*(2), 91-99. doi: 10.1002/jsc.2184

Lyytinen, K., Yoo, Y., & Jr, R. J. B. (2016). Digital product innovation within four classes of innovation networks. *Information Systems Journal, 26*(1), 47-75. doi: 10.1111/isj.12093

Mennens, K., Van Gils, A., Odekerken-Schröder, G., & Letterie, W. (2018). Exploring antecedents of service innovation performance in manufacturing SMEs. *International Small Business Journal, 36*(5), 500-520. doi: 10.1177/0266242617749687

Miles, I., Andersen, B., Boden, M., & Howells, J. (2003). Service production and intellectual property. *International Journal of Services Technology and Management, 1*(1), 37-57. doi: 10.1504/IJSTM.2000.001564

Neely, A. (2008). Exploring the financial consequences of the servitization of manufacturing. *Operations Management Research, 1*(2), 103-118. doi: 10.1007/s12063-009-0015-5

Oliva, R., & Kallenberg, R. (2003). Managing the Transition from Products to Services. *International Journal of Service Industry Management, 14*, 160-172. doi: 10.1108/09564230310474138

Opresnik, D., & Taisch, M. (2015). The value of Big Data in servitization. *International Journal of Production Economics, 165*, 174-184. doi: https://doi.org/10.1016/j.ijpe.2014.12.036

Pagoropoulos, A., Maier, A., & McAloone, T. C. (2017). Assessing transformational change from institutionalising digital capabilities on implementation and development of Product-Service Systems: Learnings from the maritime industry. *Journal of Cleaner Production, 166*, 369-380. doi: 10.1016/j.jclepro.2017.08.019

Paiola, M., Schiavone, F., Grandinetti, R., & Chen, J. (2021). Digital servitization and sustainability through networking: Some evidences from IoT-based business models. *Journal of Business Research, 132*, 507-516. doi: https://doi.org/10.1016/j.jbusres.2021.04.047

Parida, V., Sjödin, D., & Reim, W. (2019). Reviewing Literature on Digitalization, Business Model Innovation, and Sustainable Industry: Past Achievements and Future Promises. *Sustainability, 11*(2), 1-18. doi: 10.3390/su11020391

Parida, V., Sjödin, D. R., Lenka, S., & Wincent, J. (2015). Developing Global Service Innovation Capabilities: How Global Manufacturers Address the Challenges of Market Heterogeneity. *Research-Technology Management, 58*(5), 35-44. doi: 10.5437/08956308X5805360

Paschou, T., Rapaccini, M., Adrodegari, F., & Saccani, N. (2020). Digital servitization in manufacturing: A systematic literature review and research agenda. *Industrial Marketing Management, 89*, 278-292. doi: https://doi.org/10.1016/j.indmarman.2020.02.012

Pohlmann, A., & Kaartemo, V. (2017). Research trajectories of Service-Dominant Logic: Emergent themes of a unifying paradigm in business and management. *Industrial Marketing Management, 63*, S0019850117300056.

Porter, M. E., & Heppelmann, J. E. (2015). How Smart, Connected Products Are Transforming Companies. *Harvard Business Review, 93*(10), 96-+. doi: <Go to ISI>://WOS:000360949400034

Qi, Y., Mao, Z., Zhang, M., & Guo, H. (2020). Manufacturing practices and servitization: The role of mass customization and product innovation capabilities. *International Journal of Production Economics, 228*, 107747. doi: https://doi.org/10.1016/j.ijpe.2020.107747

Rabetino, R., Kohtamäki, M., & Gebauer, H. (2017). Strategy map of servitization. *International Journal of Production Economics, 192*, 144-156. doi: https://doi.org/10.1016/j.ijpe.2016.11.004

Reiskin, E. D., White, A. L., Johnson, J. K., & Votta, T. J. (1999). Servicizing the Chemical Supply Chain. *Journal of Industrial Ecology, 3*(2-3), 19-31. doi: 10.1162/108819899569520

Romeo Bandinelli, & Valentina Gamberi. (2012). Servitization in oil and gas sector: outcomes of a case study research. *Journal of Manufacturing Technology Management, 23*(1), 87-102. doi: 10.1108/17410381211196302

Rust, R. T., & Huang, M.-H. (2014). The Service Revolution and the Transformation of Marketing Science. *Marketing Science, 33*(2), 206-221. doi: https://doi.org/10.1287/mksc.2013.0836

Saccani, N., Visintin, F., & Rapaccini, M. (2014). Investigating the linkages between service types and supplier relationships in servitized environments. *International Journal of Production Economics, 149*, 226-238. doi: https://doi.org/10.1016/j.ijpe.2013.10.001

Santamaría, L., Jesús Nieto, M., & Miles, I. (2012). Service innovation in manufacturing firms: Evidence from Spain. *Technovation, 32*(2), 144-155. doi: http://dx.doi.org/10.1016/j.technovation.2011.08.006

Shah, S. A. A., Jajja, M. S. S., Chatha, K. A., & Farooq, S. (2020). Servitization and supply chain integration: An empirical analysis. *International Journal of Production Economics, 229*, 107765. doi: https://doi.org/10.1016/j.ijpe.2020.107765

Sirmon, D. G., Hitt, M. A., Ireland, R. D., & Gilbert, B. A. (2011). Resource Orchestration to Create Competitive Advantage: Breadth, Depth, and Life Cycle Effects. *Journal of Management, 37*(5), 1390-1412. doi: doi: 10.1177/0149206310385695

Sjödin, D., Parida, V., & Kohtamäki, M. (2019). Relational governance strategies for advanced service provision: Multiple paths to superior financial performance in servitization. *Journal of Business Research*. doi: https://doi.org/10.1016/j.jbusres.2019.02.042

Sun linyan, Li Gang, Jiang Zhibin, Zheng Li, & He Zhe. (2007). Service-Embeded Manufacturing: Advanced Manufacturing Paradigm in 21st Century. *China Mechanical Engineering*(19), 2307-2312. doi: 10.3321/j.issn:1004-132x.2007.19.010

Tan, K. H., Ji, G., Chung, L., Wang, C.-H., Chiu, A., & Tseng, M. L. (2019). Riding the wave of belt and road initiative in servitization: Lessons from China. *International Journal of Production Economics, 211*, 15-21. doi: https://doi.org/10.1016/j.ijpe.2019.01.027

Tian, J., Coreynen, W., Matthyssens, P., & Shen, L. (2021). Platform-based servitization and business model adaptation by established manufacturers. *Technovation*, 102222. doi: https://doi.org/10.1016/j.technovation.2021.102222

Tim Baines, Howard Lightfoot, & Palie Smart, S. F. (2013). Servitization of manufacture: Exploring the deployment and skills of people critical to the delivery of advanced services. *Journal of Manufacturing Technology Management, 24*(4), 637-646. doi: 10.1108/17410381311327431

Ting, X., Hua, L., & Peng, Y. (2014). Influencing for Service Innovation in Manufacturing Firms. *Chinses Journal of Management, 11*(04), 591-598. doi: 10.3969/j.issn.1672-884x.2014.04.017

Tronvoll, B., Sklyar, A., Sörhammar, D., & Kowalkowski, C. (2020). Transformational shifts through digital servitization. *Industrial Marketing Management, 89*, 293-305. doi: https://doi.org/10.1016/j.indmarman.2020.02.005

Valtakoski, A. (2017). Explaining servitization failure and deservitization: A knowledge-based perspective. *Industrial Marketing Management, 60*, 138-150. doi: https://doi.org/10.1016/j.indmarman.2016.04.009

Vandermerwe, S., & Rada, J. (1988). Servitization of business: Adding value by adding services. *European Management Journal, 6*(4), 314-324. doi: https://doi.org/10.1016/0263-2373(88)90033-3

Vendrell-Herrero, F., Bustinza, O. F., Parry, G., & Georgantzis, N. (2017). Servitization, digitization and supply chain interdependency. *Industrial Marketing Management, 60*, 69-81. doi: https://doi.org/10.1016/j.indmarman.2016.06.013

Visnjic Kastalli, I., & Van Looy, B. (2013). Servitization: Disentangling the impact of service business model innovation on manufacturing firm performance. *Journal of Operations Management, 31*(4), 169-180. doi: http://dx.doi.org/10.1016/j.jom.2013.02.001

Wan, Q., Rongping, M., & Minglu, L. (2012). The influential factors of manufacturing firms' servitization based on service innovation. *Science Research Management*(10), 64-71. doi: CNKI:SUN:KYGL.0.2012-10-007

Wen, X., & Zhou, X. (2016). Servitization of manufacturing industries based on cloud-based business model and the down-to-earth implementary path. *The International Journal of Advanced Manufacturing Technology, 87*(5), 1491-1508. doi: 10.1007/s00170-014-6348-8

Westerman, G. (2016). Why Digital Transformation Needs a Heart. *MIT Sloan Management Review, 58*(1), 19-21. doi: http://mitsmr.com/2cmzay6

Zambetti, M., Pinto, R., & Pezzotta, G. (2019). Data lifecycle and technology-based opportunities in new Product Service System offering towards a multidimensional framework. *Procedia CIRP, 83*, 163-169. doi: https://doi.org/10.1016/j.procir.2019.02.135

Zancul Eduardo de, S., Takey Silvia, M., Barquet Ana Paula, B., Kuwabara Leonardo, H., Cauchick Miguel Paulo, A., & Rozenfeld, H. (2016). Business process support for IoT based product-service systems (PSS). *Business Process Management Journal, 22*(2). doi: 10.1108/BPMJ-05-2015-0078

Zhou, D., Yan, T., Zhao, L., & Guo, J. (2020). Performance implications of servitization: Does a Manufacturer's service supply network matter? *International Journal of Production Economics, 219*, 31-42. doi: https://doi.org/10.1016/j.ijpe.2019.05.019

Zhu, H., & Madnick, S. E. (2009). Finding new uses for information. *MIT Sloan Manage Review, 50*, 17-21. doi: https://www.proquest.com/scholarly-journals/finding-new-uses-information/docview/224959779/se-2?accountid=47701

Zhu, J., & Yan, L. (2013). Analysis of the Development of Manufacturing Servitization Concepts. *Value Engineering*(06), 135-136. doi: CNKI:SUN:JZGC.0.2013-06-073