The operational dilemma in data-driven development of advanced services in a manufacturing company

Chen, Kuan-Lin; Møller, Charles

Published in:
Proceedings of The 37th International Conference of the System Dynamics Society

Publication date:
2019

Document Version
Early version, also known as pre-print

The operational dilemma in data-driven development of advanced services in a manufacturing company

Kuan-Lin Chen*, Charles Møller

Aalborg University, Center for Industrial Production, Department of Material and Productions
Fibigerstræde 16, Aalborg Ø 9220, Denmark (E-mail: klc@mp.aau.dk)

ABSTRACT

When developing transformational business strategies, managers often make a decision with limited pieces of evidences and decide on where to go based on a hunch. Servitization is one of the typical examples of a transformational journey with many uncertainties. The aim of this paper is to study the complexity that arises from the ongoing trend – servitization that manufacturing firms are pursuing after. Managers, who are developing transformational business strategies, are struggling in dealing with pressures from both outside in and inside out environments. In this research work, we intend to investigate how manufacturing firms can respond to the transformation challenges coming from servitization using a data-driven approach. We aim to explore the drivers and constraints of taking a data-driven approach of developing advanced services in transforming the organization toward servitization paradigm. This research work is built on two previous studies: 1) a case study, to understand the behaviors of the product-centric thinking of the organization from the management perspective, and 2) an iterative design science research (DSR) experiment, to induce those invisible interactions of taking the initiations in implementing the data-driven approach. Those organizational behaviors, emerging from developing advanced services, are captured and demonstrated in the causal loop diagram. It also reveals several attribution errors of thwarting their efforts to extend the operational focus, such as the innovation delay and isolation inertia. These are critical to understanding in this emerging dynamic situation that managers are facing when they commit to their bold decision on pursuing advanced services in servitization context. Two potential contributions to knowledge are in the operations focus of servitization and in applying system dynamics method into the emerging needs of handling the challenges toward the dual-focused product-service operations.

Keywords: operational dilemma, system behavior, servitization, advanced services, case study

- Purpose

When developing transformational business strategies, managers often make a decision with limited pieces of evidences and decide on where to go based on a hunch. Servitization is one of the typical examples of a transformational journey with many uncertainties (Ziaee Bigdeli et al., 2017). Servitization paradoxes are periodically discussed in the operations domain (Brax, 2005; Kastalli & Looy, 2013; Visnjic et al., 2012). This phenomenon is about the firms who are putting the significant efforts in pushing value-added services through and do not receive the net positive returns as they expected, e.g. in relative of financial consequences and/or increasing the customers bases.

One of the reasons that managers would take such a bold approach is because of the pressure from the external environment. In this case, the incentive is coming from the developments of the Internet of Things (IoT) and the Internet of Services (IoS). Manufacturing firms, who can service their smart products in the markets, have an opportunity to develop advanced service (Iansiti & Lakhani, 2014; Porter & Heppelmann, 2014, 2015). Which would be: *"an outcome focused on capability delivered through performance of the product"* (Baines & Lightfoot, 2013). In other words, to gain competitive advantage (Porter, 1985) the firms want to develop advanced services, that fulfills two prerequisites: first, the firms need to respond to the pressure from external markets such as innovative business models developed by competitors. In addition, they are required to have both the ability to develop advanced services (Baines & Lightfoot, 2013), associated with their smart products, and to utilize their own internal resources in order to execute faster and better than their competitors. Similar arguments are also found in the servitization literature. British researchers claimed that four emerging key forces: 1) organizational maturity and readiness; 2) organizational commitment and capability; 3) market pull; and 4) ecosystem structure and organization positioning; are affecting the progression of such transformation that manufacturing firms are facing (Ziaee Bigdeli et al., 2017). Our previous work, has been built up from such considerations, arguing that the operation of manufacturing firms is extending toward a dual-focused product-service operations (Chen & Møller, 2018) and that the data-driven approach is one of the ways forward. However, it requests a new configuration of a traditional manufacturing company. Neither the processes, nor the work tasks are visible to the teams involved in such transformation. We therefore intend to investigate this phenomenon and find out how manufacturing firms respond to this transformation challenges coming from a data-driven approach to servitization. The aim is to suggest better approaches (managerial propositions) to cope with such complex problem, where there is pressures from both the outside in and inside out environments. We intend to shed light on the research stream of the operations focus on servitization, and to contribute to the body of knowledge using a system dynamics (SD) approach to provide an understanding of the problem.

- Design/methodology/approach

This empirical study takes place in a Danish manufacturing firm that embarked on its servitization journey in 2017. The study is designed and developed to delineate the product-centric thinking of the organization as a system. Over several iterative engagements, such as interviews and design science research (DSR)(Hevner et al., 2018), managers' beliefs and organizational behaviors when approaching data-driven servitization are conceptualized in order to depict the existing boundaries of the system. Through those engagements, we are able to understand the problems in a socio-technologic perspective and to construct the mental models of the organization we are researching.

This research work is built on two previous studies. First, a traditional case study method is used to understand the behaviors of the product-centric thinking of the organization from the management perspective. We conduct interviews with four executive officers and eight senior managers in order to explore their beliefs and their deals on initializing the tasks relevant to servitization. The case analysis aims at understanding the existing work processes, including the existing interaction flows and tasks of identifying e.g. the

potential customers for the upselling, as the system boundary. Second, we use a design science research (DSR) approach to induce those invisible interactions of taking the initiations in implementing the data-driven approach. The aim of our design engagements is to discover the hidden working processes from the bottom of operational aspect. We intend to probe those hidden information behind the scenes of the running organization system. There are, for instance, those information, which are been using out of the default collaboration processes and not setting up in the existing enterprise information system yet. Through those iterations of DSR activities, we are able to confirm the hidden links (of information and process flows) behind the scenes of the running system. An example, from developing a new plan of upselling products and services, demonstrates the need for a new collaboration pattern between Business Development, R&D, IT, and the Sales teams. Only if do so, the servitization paradox, the gaps between servitization efforts and expected returns, can be eliminated and the wanted competitive advantage can be brought up.

- Findings

In this research work, we intend to investigate how manufacturing firms can respond to the transformation challenges coming from servitization using a data-driven approach. The empirical data are collecting through two experiments. Those organizational behaviors, emerging from developing advanced services, are captured and demonstrated in the causal loop diagram. It also reveals several attribution errors of thwarting their efforts (Repenning & Sterman, 1999) to extend the operational focus be a dual-focused product-service operations (Chen & Møller, 2018), such as the innovation delay and isolation inertia. Those feedbacks are appearing when the data-driven approach is taking initiations in the developing process. These are critical to understanding in this emerging dynamic situation that managers are facing when they commit to their bold decision on pursuing advanced services in servitization context.

- Research limitations/implications

The aim of this study is to look behind the visible behaviors of an organization. Those behaviors are influencing by managers' beliefs over time and becoming part of organization inertia. In this case, we are looking into those attribute errors, which are caused manufacturing firms to struggle on revising their vision during the learning phase (Mintzberg & Westley, 1992). Two experimental studies are made in a representative case company in order to gain empirical insights from both managerial and operational perspectives. Although this case study with a clear set of propositions (Yin, 2014) can shape images of representative scenario that manufacturing firms may fall into this identified dilemma, it is a limitation in this study. The future work should investigate manufacturing firms, who are taking a data-driven approach toward developing advanced services, in order to verify whether findings from this study would generalize elsewhere.

- Practical implications

The objectives of using SD to construct the case firm's existing system are twofold. First, it provides a visual understanding of the hidden development forces (e.g. information flow and critical decision points). Furthermore, it catches the essential interactions,

determining the behaviors within the organization. Consequently, we are able to simulate and to analyze the existing organizational behaviors comprehensively in order to suggest better-fit managerial propositions to managers, who are dealing with the complex problem of transforming an organization in servitization context.

- Originality/value

The current body of servitization literature mainly consist of description research, deliberating rationales and possible directions manufacturing firms shall respond to servitization. Only a few normative research, which addresses from value chains perspective (Burton et al., 2017; Rymaszewska et al., 2017); and correlate narrowly with a product service system perspective (Tukker, 2004). The aim of this paper is to study the complexity that arises from the ongoing trend – servitization that manufacturing firms are pursuing after. Managers, who are developing transformational business strategies, are struggling in dealing with pressures from both outside in and inside out environments. We intend to explore the drivers and constraints of taking the data-driven approach of developing advanced services in transforming the organization toward servitization paradigm. Two potential contributions to knowledge are in the operations focus of servitization and in applying system dynamics method into the emerging needs of handling the challenges toward the dual-focused product-service operations (Chen & Møller, 2018). First, the insights, we gain from the sensitive analysis through SD, will shed light on normative research in servitization domain. Of which, we intend to suggest the better-fit managerial propositions for managers, who are dealing with many uncertainties when developing servitization strategy. Second, this particular research work can also be the evidence that SD supports policy making in developing the operations focus of transformation challenge in servitization context. We, specifically, refer to the extension of operations focus toward the dual-focused product-service operations (Chen & Møller, 2018).

Baines, & Lightfoot. (2013). *Made to Serve : How manufacturers can compete through servitization and product service systems* (1st ed.). Wiley.

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

Burton, J., Story, V. M., Raddats, C., & Zolkiewski, J. (2017). Overcoming the challenges that hinder new service development by manufacturers with diverse services strategies. *International Journal of Production Economics*, *192*(December 2015), 29–39. https://doi.org/10.1016/j.ijpe.2017.01.013

Chen, K. L., & Møller, C. (2018). A thousand-miles journey begins with the very first step: The case of a product-centric manufacturing firm transformation towards servitization. *Under Review on CIRP Journal of Manufacturing Science and Technology*, 1–25.

Hevner, A., Brocke, J., & Maedche, A. (2018). Roles of Digital Innovation in Design

Science Research Roles of Digital Innovation in Design Science Research, (December). https://doi.org/10.1007/s12599-018-0571-z

Iansiti, M., & Lakhani, K. R. (2014). *Digital ubiquity How connections, sensors, and data are revolutionizing business*. *Harvard business review, ISSN 0017-8012, Vol. 92, Nº 11, 2014* (Vol. 92). Graduate School of Business Administration, Harvard University. Retrieved from https://dialnet.unirioja.es/servlet/articulo?codigo=5544176

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

Mintzberg, H., & Westley, F. (1992). Cycles of organizational change. *Strategic Management Journal*, *13*(2 S), 39–59. https://doi.org/10.1002/smj.4250130905

Porter, M. E. (1985). *Competitive Advantage - Creating and Sustaining Superior Performance*. *FreePress*. https://doi.org/10.1182/blood-2005-11-4354

Porter, M. E., & Heppelmann, J. E. (2014). How Smart, Connected Product Are Transforming Competition. *Harvard Business Review*, (November), 64–89. https://doi.org/10.1017/CBO9781107415324.004

Porter, M. E., & Heppelmann, J. E. (2015). How Smart, Connected Products Are Transforming Companies. *Harvard Business Review*, 19.

Repenning, N. P., & Sterman, J. D. (1999). *Getting Quality the Old-Fashioned Way: Self-Confirming Attributions in the Dyanmics of Process Improvement*. *The Quality Movement and Organizational Theory* (Vol. 1). Newbury Park, CA: Sage. Retrieved from https://dspace.mit.edu/bitstream/handle/1721.1/2653/SWP-3952-37733566.pdf

Rymaszewska, A., Helo, P., & Gunasekaran, A. (2017). IoT powered servitization of manufacturing – an exploratory case study. *International Journal of Production Economics*, *192*, 92–105. https://doi.org/10.1016/j.ijpe.2017.02.016

Tukker, A. (2004). Eight types of product-service system: Eight ways to sustainability? Experiences from suspronet. *Business Strategy and the Environment*, *13*(4), 246–260. https://doi.org/10.1002/bse.414

Visnjic, I., Neely, A., & Wiengarten, F. (2012). *Another Performance Paradox?: A Refined View on the Performance Impact of Servitization*. *SSRN*. https://doi.org/10.2139/ssrn.2117043

Yin, R. K. (2014). *Case Study Research : design and methods / Robert K. Yin*. (R. K. Yin, Ed.) (5. ed.). Thousand Oaks, Calif. : Sage.

Ziaee Bigdeli, A., Baines, T., Bustinza, O. F., & Guang Shi, V. (2017). Organisational change towards servitization: a theoretical framework. *Competitiveness Review*, *27*(1), 12–39. https://doi.org/10.1108/CR-03-2015-0015