Journal of Cleaner Production 166 (2017) 369–380

Contents lists available at ScienceDirect

Journal of Cleaner Production

journal homepage: www.elsevier.com/locate/jclepro

Assessing transformational change from institutionalising digital capabilities on implementation and development of Product-Service Systems: Learnings from the maritime industry

Aris Pagoropoulos [a, *], Anja Maier [b], Tim C. McAloone [a]

[a] Department of Mechanical Engineering, Technical University of Denmark, Denmark
[b] Department of Management Engineering, Technical University of Denmark, Denmark

ARTICLE INFO

Article history:
Received 1 February 2017
Received in revised form
4 July 2017
Accepted 3 August 2017
Available online 8 August 2017

Keywords:
Product-Service Systems
Digitization
Customer
Maritime industry

ABSTRACT

Digitization is rapidly reshaping industries and economic sectors. It enables novel Product-Service Systems (PSS) that transform customer/supplier relationships and introduces new value propositions. However, while opportunities for novel types of PSS arise, it is not clear how digitization and the institutionalisation of digital capabilities, particularly within the customer organisations, may affect implementation of PSS, potentially leading to transformational changes in the customer organisation. This paper examines one such potential transformational change from three complementary viewpoints – the resource based, the dynamic, and the relational viewpoint. It does so through action research study in the context of the maritime industry, which is particularly attractive for PSS offerings. The research methodology comprised a two-step action research process, focusing on both digitization and PSS development and implementation. The main findings are that rather than facilitating procurement to co-development of PSS, institutionalisation of digital capabilities facilitated development of PSS by stakeholders internal to the company, and strategic co-development with external stakeholders. The new digital capabilities circumvented cost barriers associated with the procurement of services from external stakeholders, supported process standardisation - to the expense of process innovation-, and transformed the network that delivered PSS by closing opportunity gaps for externally procured services. Furthermore, the uptake of digital capabilities highlighted the importance of cost estimation in making the customer more responsive to threats and opportunities.

1. Introduction and research gap

In a challenging and globalised market, companies strive to enhance their competitive advantage, in order to survive and eventually expand. To support their competitiveness and profitability, companies contemplate the development and procurement of Product-Service Systems (PSS). A PSS is a delivery system for advanced services, similarly to what a manufacturing system is to a product (Settanni et al., 2015) and is defined as "*an integrated bundle of products and services which aims at creating customer utility and generating value*" (Boehm and Thomas, 2013). The research community has used a number of synonymous terms and concepts to describe the shift from a product orientation to a service orientation that PSS advocate, including "servitization" (Baines et al., 2009a,b), "service infusion" (Eloranta and Turunen, 2015), "integrated solutions" (Brady et al., 2005) and "service transition" (Fang et al., 2008).

In achieving this transition, digitization is central to PSS. Digital capabilities are critical enablers for service delivery (Chesbrough and Spohrer, 2006) and an important element of various successful PSS business models such as the 'engine by hour of flight' from Rolls Royce, and the Retail-Care offering for refrigerators by Danfoss (Tan et al., 2010). Digital capabilities allow PSS supply chains to be responsive (Ardolino et al., 2016; Johnson and Mena, 2008), thus facilitating PSS implementation and delivery.

Despite their promise and natural affinities, the combination of digitization and PSS does not constitute a guaranteed path to success. A growing body of literature warns against the risks from servitization (Neely, 2009; Valtakoski, 2016), the low returns from services (Suarez et al., 2013; Gebauer et al., 2005; Kastalli and Van

* Corresponding author.
E-mail address: aris.pagoropoulos@gmail.com (A. Pagoropoulos).

http://dx.doi.org/10.1016/j.jclepro.2017.08.019
0959-6526/

Looy, 2013), the lack of fundamental demand for specific PSS (Pagoropoulos et al., 2017a) and the inability of PSS to successfully transform the business landscape (Pagoropoulos et al., 2016). Moreover, the interplay between digitization and PSS is far from obvious. From their development (Tan et al., 2010; Wang et al., 2011; Mougaard et al., 2012; Kuo, 2011; Garetti et al., 2012) and procurement processes (Bratt et al., 2014; Howard et al., 2016), to operation (Kuo and Wang, 2012; Kuo, 2011; Garetti et al., 2012), and associated consumer practices (Santamaria et al., 2016), PSS are complex and digitization adds yet another level of complexity and abstraction (Coreynen et al., 2016). Such an increase in complexity can lead to high life cycle costs for the engineered system (Suh, 2003, p.25), when not enough is known about how manufacturers can effectively leverage digital means to increase their service offerings (Lerch and Gotsch, 2015; Coreynen et al., 2016).

We argue that the same knowledge limitation can also apply to the customer perspective. The customers' perspective and engagement is important for the successful development and adoption of a PSS (Tuli et al., 2007; Valtakoski, 2016; Coreynen et al., 2016), as integrated solutions of products and services are shaped by customer network identity goals, goal management approaches, and constraints (Epp and Price, 2011). As a result, literature on PSS and related fields suggest that, for PSS to succeed, intensive collaboration with customers is necessary (Story et al., 2016; Valtakoski, 2016).

Digitization further reinforces the role of collaboration due to the need to communicate across the value chain (Nanry et al., 2015). However, one can identify conflicting views on the role of digital capabilities in shaping PSS business models. On one hand, building digital capabilities can facilitate PSS business models. Adoption and success of PSS business models depends on the customers' prerequisite capabilities such as contracting skills, the existence of flexible budgeting systems, and the existence of analytical skills that can demonstrate the benefits from service strategy adoption (Baines and Shi, 2015; Pagoropoulos et al., 2017a). On the other hand, digital capabilities can also mitigate the need for external assistance. Digital transformation is reshaping the organisation to take advantage of valuable existing strategic assets in new ways (Westerman et al., 2011). Digital transformation is not a one-off application, but a strategic choice towards acquiring and embedding digital capabilities across the supply chain and technologies such as Artificial Intelligence, Internet of Things and Big Data (Pagoropoulos et al., 2017c). And that transformation can preclude the involvement of external stakeholders for value co-creation (Windler et al., 2016) and advocate a 'make' instead of 'buy' decision especially if digital capabilities have an impact on the customer knowledge base (Valtakoski, 2016). As customers ramp up digital capabilities it is not clear how the collaborative network of stakeholders that develop and deliver the PSS is transformed, and how the individual contribution of each stakeholder in the collaborative network is redefined. To address this knowledge gap, this study is conducted within the context of the maritime industry. The maritime industry, due to the long life time of the ships and the existence of multiple non-critical systems presents attractive opportunities for PSS (Aston Centre for Servitization Research and Practice, 2013; Mougaard et al., 2013a,b; Andersen et al., 2013). Building on this opportunity, this study poses the following research question and proposition:

Research Question: *How does the institutionalisation of digital capabilities in the customer organisation affect the implementation of Product-Service Systems in the maritime industry?*

Research Proposition: *The digitization of business processes institutionalises digital capabilities within traditional customer organisations, which in turn reveal opportunities for procurement and co-development of Product-Service Systems.*

The unit of analysis for the research conducted is the change process within an organisation that traditionally procures products and services to support the cost-effective operations of its assets. As such, it covers the entire network of internal and external stakeholders that collaborate to offer a PSS. This study had three main objectives: to implement PSS that address customer needs and achieve business goals, develop the necessary digital tools and capabilities to deliver and support the PSS and understand how digital disruption is shaping power dynamics (Vendrell-Herrero et al., 2016; Lerch and Gotsch, 2015), in particular within collaborative networks that deliver PSS (Mougaard et al., 2012).

We acknowledge that the answer to the research question depends on the perception of change, the evaluated sources of competitive advantage and the research paradigm from which the analysis is conducted (Tronvoll et al., 2013; Eloranta and Turunen, 2015). In this study, the pathway between digital capabilities and PSS is evaluated from three distinct viewpoints, all of which stem from strategic management theory: a Resource-based Viewpoint (RBV) emphasizing the role of resources and capabilities, a Dynamic Capabilities Viewpoint (DCV) encapsulating the evolutionary nature of resources and capabilities, and a Relational Viewpoint (RV) focusing on the network relationships within which the firm is embedded.

In contrast to significant body of PSS and servitization literature that perceives services as an instrument for market positioning by 'going downstream' viewpoint was not examined (Vandermerwe and Rada, 1988), this viewpoint is not examined in this study due to a lack of supply chain repositioning.

The research question follows suggestions from extant literature to examine the need for support towards the customer to develop the resources and capabilities to fulfil the co-creation role (Windler et al., 2016). Moreover, it explores the division of labour between suppliers and customers in PSS (Valtakoski, 2016), and help explore future avenues for customer integration (Coreynen et al., 2016). Lastly, it adopts a novel perspective within PSS by exploring an instance where a service-minded customer can act as a provider and a resource integrator for PSS.

Section 2 reviews prior literature to establish the research proposition that acted as a point of departure for this study. Section 3 introduces the research context and the methodology that was followed. Sections 4 and 5 present the results of the study, and Section 6 discusses the findings and compares them to the literature. Finally, Section 7 summarises the conclusions and presents avenues for future research.

2. Prior literature

2.1. Digitization and PSS

Digitization is transforming existing business models, by unlocking new sources of value from existing technology. Digital transformation is attracting a lot of attention across different industries, as digital advances such as analytics, mobility, social media and smart embedded devices to change customer relationships, internal processes, and value propositions (Westerman et al., 2011). Even in traditional industries such as the automotive, digital technologies that enable connectivity between physical assets are altering user preferences (McKinsey and Company, 2014) and driving new product and service developments (Mosquet et al., 2014). According to the Ellen McArthur foundation this "*increase in connectivity can create significant new sources of value for citizens and economies, whilst also creating new challenges for regulators and policy makers*" (Morlet et al., 2016). Across all industries, various reports highlight the transformational role of digital technologies, that is actively causing companies to re-think their role and value