How digital technologies associate with customer-service business models in manufacturing SMEs

35th annual IMP conference August 28-30, 2019 in Paris

Keywords: Digital technologies, digitization, digital relational capabilities, business models, product and service, SME

Abstract

New digital technologies enable industrial firms to offer new combinations of products and services based on various customer-service business models. Within the interaction approach there has been a call for better understanding of how digital technologies affect business relationships. There has also been a call for better understanding how business models can be understood within a relational and network approach. This paper contributes with new understandings of how digital technologies may introduce new relational capabilities to support new business models in customer-service models in SMEs. Based on a quantitative survey including 152 Danish manufacturing SMEs this study examines the prominence of three customer-service business models and their association with firms' use of different types of digital technologies.

1.0 Introduction

Within industrial firms there is a movement towards using digital technology to offer new combinations of products and services based on new business models (Iansiti & Lakhani 2014). This suggests that value creation is not only based on business models internal to the firm, but also business models based on firms being able to build and create value through relationships to e.g. customers, suppliers and network (Storbacka et al. 2012). Digitalization is assumed to change firms' business models (Storbacka et al. 2012, Amit and Zott 2012) and thus how they create and capture value through the relationships to other firms in the network (Möller and Rajala 2007). Therefore, informed knowledge of the role played by digital technologies in building relational capabilities that can transform existing business models is of high value.

So far, the search on how digital technologies transform relationships between firms and e.g. their customers have been dominated by studies of relationships to end-users and consumers. Much less attention has been devoted to how digital technologies transform relationships in a business-to-business context (Obal and Lancioni, 2013). This research has been especially scant in a SME context. Although some studies within supply chain and operation management have investigated digitalization in SME under the headline of industry 4.0 (e.g. Moef et al, 2018; Müller et al., 2018; Stentoft et al., 2019), the understanding of how digitalization affects SMEs relationships and value creation is not well understood.

Bankvall et al. (2017) propose to distinguish between two types of business models: firm-centric and network-embedded which can be analyzed, with reference to Håkansson and Snehota (1995), at three levels namely firm, relationship and network. This study investigates how digitalization affects customer-service relationships in SME business models at the relationship level. We thereby answer to a call for better understanding how digital technologies affect the relationships between firms in networks (Pagani and Pardo 2017) and a call for understanding how business models can be used within an interaction approach (Bankvall et al. 2017).

We follow the European Union definition of a small and medium-sized enterprise (SME) with less than 250 employees, a total turnover which do not exceed EUR 50 million and total balance sheet of no more than EUR 43 million (EU Commission, 2015).

The understanding of how digital transformation affect competitive advantages differ significantly. Some see the existing competitive structures as dominating the competitive landscape in a digital age (Porter and Heppelmann 2014) while others see digital technology transform the way firms compete in a fundamental way towards a network-centric view (Koch and Windsperger 2017). The digital transformation can be defined as "the digitization of previously analog machine and service operations, organizational tasks, and managerial processes" (Ianstiti & Lakhani 2014, p. 93). Another, and more far-reaching definition is offered by Koch and Windsperger 2017, p. 5) "the socio-technological process of applying digital technology across industries and contexts in ways that affect and shape their underlying infrastructures for the creation, storage, and distribution of content, applications, and services".

Both definitions encompass relevant elements which will be viewed as complementary here. The first definition draw attention to digitization of previous analog machine and service operations, organizational tasks, and managerial processes. This adhere to the aim of this study to investigate how digital technologies associate to specific business models in SMEs. The second definition draw attention to a network centric understanding which correspond with the view of Bankvall et al. (2017) who talks about network centered view on business models.

Affordance of digital technology is an important concept to understand how digital technology is used in practice in SMEs business models. Technology affordance refers to "an action potential, that is what an individual or organization with a particular purpose can do with a technology or information system" (Majchrzak and Markus 2012, p. 832 – here quoted from Koch and Windsperger 2017, p. 4). We will use a digital technology affordance approach and relate specific digital technologies to specific customer service models we investigate.

Many authors have argued, under various labels and approaches, that with increasing use of digital technology firms' capability to relate or connect to actors in their network, e.g. customers and suppliers, is of significant and increasing importance for firms' competitive advantage (Pegani and Pardo 2017, Ianstiti and Lakhani 2014; Porter and Heppelmann 2014; Storbacka et al. 2012;).

To do so there is a need to link the digital affordance concept to an understanding of how firms relate in a network. Ngugi et al. (2010) have developed an understanding of relational capabilities used to understand innovation between SME suppliers and large customers. The concept is useful for this investigation and will form the basis for developing an understanding of digital relational capability used in this study to link digital technologies to customer-business models. Others have

also developed an understanding of relational capabilities by specifying task and departments involved (Möller and Törrönen 2003, p. 115).

Ngugi et al. (2010) define, with reference to Håkansson and Ford (2002), relational capabilities as: "Relational capabilities explain what firms in relationships can do for each other, the functions they will conduct, and the width and importance of these functions ".

Johnsen and Ford (2006) have found that four types of capabilities are critical for development and management of relationships between SME suppliers and large customers. These capabilities are technological capability, human capability, managerial systems-based capability, and cultural interaction capability. Storbacka et al. (2012) make a distinction between firm internal and external resources and capabilities while others argue the distinction between internal and external is blurred because of technology and how firms relate in networks (Ngugi, Johnsen and Erdelyi 2010). To understand how SMEs make use of digital technology in developing their business models we propose an understanding of the role of digital relational capabilities will be important.

This paper investigate how digital technologies are associated with the concept of business models. The understanding of the concept of business model is not agreed upon in the literature (Blankvall et al. 2017; Foss and Saebi 2017). We will define business models as management's hypotheses about what customers want and how the firm can best organize to create, deliver and capture value (Teece, 2010). This paper not only investigate business models, but also investigate how business models are transformed or innovated by use of digital technology. This point to business model innovation which can be defined as "designed, novel, and nontrivial changes to the key elements of a firm's BM and/or the architecture linking these elements." (Foss and Saebi 2017, p. 216).

Foss and Saebi (2017) propose a framework for investigating business model innovation consisting of antecedents, business model innovation & outcome plus moderating and mediating factors.

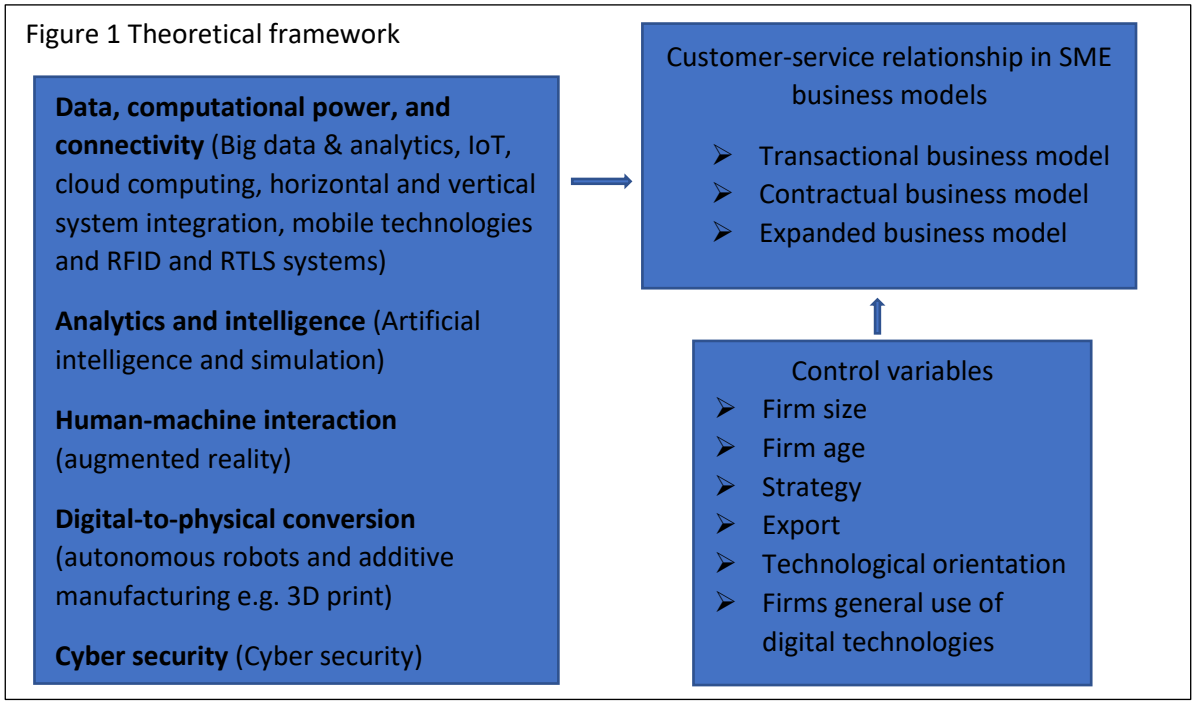
The business model innovation consists of two elements namely novelty and scope. Novelty refer to degree of innovation and is described as whether the business model is new to the firm or new to the industry. The scope element refers to whether business models are modular or architectural (Foss and Saebi 2017, figure 3 p. 217).

The aim of the paper is to investigate how digital technologies are associated with customer service-business models in manufacturing SMEs.

The paper makes use of elements of the framework proposed by Foss and Saebi (2017) to investigate business model innovation in the sense we investigate the association between the digital technology (antecedents) and business models (business model innovation) – see the theoretical model 1 in next section. This is done by identifying and investigating, in an explorative manner, which specific digital technologies are associated with three customer-service business models used by manufacturing SMEs.

2.0 Theoretical framework

The theoretical model in this paper is displayed in Figure 1. The model illustrates how digital technology has been grouped into five sub-categories where the specific digital technologies are shown in brackets. The group of digital technology is related to three specific business models.



2.1 Digital technologies

There exist various definitions of digital technology. Ianstiti & Lakhani (2014) argues that three elements make the foundation for digital transformation. (1) Digital signals can be transmitted perfectly – unlike analog signals; (2) Digital signals can be replicated infinitely; (3) Once investments in network infrastructure have been made the page can be communicated to the incremental consumer at zero (or almost zero) marginal cost. Or in short "exact replication infinite times at zero marginal cost" Ianstiti and Lakhani (2014, p. 92). The third element seems to relate to end-users and consumers rather than to a business-to-business context.

Koch and Windsperger (2017, p. 4) argue digital technology can be distinguished from previous technology by three elements: (1) digital computers have both a processing and storage unit integrated in the same digital device – following the Von-Neumann-Architecture - which make digital devices able to perform multiple functions; (2) data homogenization is a characteristic by digital signals and make the fundamental difference to analog signals. Analog signals are closely linked to analog devices i.e. vinyl records, VHS tapes, photographic films and paper books. Digital data can, regardless of content, be stored, transmitted, processed and displayed by the digital device, because data and medium are separated; (3) The self-referential character refer to firms' participation in digital innovations depend on access to and use of digital technology. Thus, greater availability of digital technology results in faster creation and availability of digital devices, networks, services and the speed of diffusion is helped by lower entry barriers for new innovators.

3.0 Method

3.1 Data collection. The data in this paper was collected through a questionnaire-survey about the use of digital technologies used for business development for manufacturing SMEs with 10-250 employees. The relevant firms were found by using the Danish company data base "Bisnode". The database made it possible to search for firms within the chosen size and types of industries. The

search resulted in 3.400 firms at a cross list which was reduced to 2.632 firms after a cleansing process. All firms were contacted by telephone by students hired by University of Southern Denmark. The person how took the phone was asked to direct the student to the person responsible for business development. If they agreed to answer the survey, a link to the questionnaire-survey was sent by e-mail to the respondent. The questionnaire was distributed to SMEs in April and May 2018. 736 firms agreed to attend the questionnaire-survey and out of these 152 had provided full and useful answers leading to a response rate at 20.6 percent.

3.2 Measures.

3.2.1 Dependent variables. The business models were found in the literature (Iansiti and Lakhani 2014) and are the dependent variables in this study. We asked "To which degree do you offer the following service concepts in relation to your physical products? Respondents were asked to which degree (five-point Likert scale) the firm makes use of each of the three business models:

Sale with no service agreement. Service is to repair or maintain based on customer request. Business model is sale of product and service payment based on use of service by customer.

Sale with service contract. Service is delivered based on a contract with obligations about specific service deliverance for the supplier and payment for the customer.

Sale with extended service contract. Service is based on a contract where the supplier makes continuing surveillance and optimizing of product at customer based on data collection e.g. through sensors or other types of measurements; the customer is continuing advised about how to optimize the performance of the product. The business model is based on product sale and a service- and advisory contract with focus on surveillance, maintenance and process optimizing customers product.

3.2.2 Independent variables. The respondents were also asked "To which degree do you apply the following technologies in your company?" by ticking off on a 5-point Likert-scale for 12 specific digital technologies inspired by McKinsey Digital (2015), Ruessman et al. (2015), Salkin et al. (2018) and Sauncedo-Martínez et al. (2018). The 12 technologies where grouped into 5 group of digital technologies based on McKinsey Digital (2015), Salkin et al. (2018) and Sauncedo-Martínez et al. (2018). The five groups of digital technologies (with specific digital technologies in brackets) are Data, computational power, and connectivity (Big data & analytics, IoT, cloud computing, horizontal and vertical system integration, mobile technologies and RFID and RTLS systems); Analytics and intelligence (Artificial intelligence and simulation); Human-machine interaction (augmented reality); Digital-to-physical conversion (autonomous robots and additive manufacturing e.g. 3D print); Cyber security (Cyber security).

Using linear regression analysis, we then examine how each of the identified group of digital technologies associate with the three business models. The result of the regression analysis is displayed in table 1.

3.2.3 Control variables. We control for firm size measured by number of employees, and we control for firm age measured in years since founding. The control variables also include to which degree the firm pursue a low cost or a proactive strategy or the export measured as percentage of turnover. Finally, we also controlled for technological orientation measured as the firms skills to

collect new knowledge and firms general use of digital technologies measured by firms indication of how they make use of digital technology in general.

Table 1. Regression analysis

	Transactional business model, business model 1	Contractual business model, business model 2	Expanded business model Business model 3
(Intercept)	3,983***	1,221**	0,075
P4Firm_Size	-0,003	0,000	0,000
P4Firm_Age	-0,022	-0,038**	-0,030**
P4LowCostStrat	-0,065	0,093	-0,001
P4ProactiveStrat	-0,233	-0,074	-0,029
P4Export	-0,003	-0,003	0,000
Technological orientation	0,506***	0,251	0,196
Firms general use of digital technologies	-0,097	0,011	0,079
DT1_DatComCon	-0,017	0,512**	0,664***
DT2AnaInt	-0,108	-0,098	0,109
DT3HumMachInt	0,164	-0,066	0,127
DT4DigPhysCon	-0,293*	-0,106	-0,167
DT5Cyber	0,047	0,011	0,062
N	152	151	149
Likelihood Ratio Chi-Square	11,896	20,142*	48,080***
Akaike's Information Criterion (AIC)	572,349	512,692	450,660

***) p < .001; ** p < .01; *) p < .05; #) p < .10

4.0 Results.

Table 1 presents the results from the regression analysis and show to which degree groups of digital technologies are associated with the three business models. The main result is that one of the five described group of technology, “data, computational power, and connectivity” is found to be significant associated with two of the customers-service business models for manufacturing SMEs. The result show business model 2 and 3, the contractual and the expanded business models are significant related to what may be called the relational or connectivity group of digital technology. The first transactional business model is not confirmed to be significant associated with any of the digital technology groups. Business 2 and 3 are neither significant associated with other of the digital technology groups. The background variable firm age shows a significant association between the older the firm the less likely it is they use digital technologies. We will interpret this as the younger the firm is the more likely the firm possesses capabilities to make use of digital technology in to transform their customer-service business models.

The results do not show that the other groups of digital technologies are associated with the three business models. This may be explained by newer digital technologies or that the technologies are narrower and thus used by fewer of the SMEs.

Business model 1 is not found to be positively associated with any of the investigated digital technologies compared to business model which may be explained by this business model was used before digital technology was introduced to the market.

5.0 Discussion

The results can be interpreted as supporting the assumption about various customer-service manufacturing SME business models draw on various combinations of digital technologies which are based on various digital relational capabilities. Though SMEs on average (with significant exceptions) can be viewed as slower to adapt digital technology this paper contributes with an empirical investigation of how manufacturing SMEs have adapted specific digital technologies to transform their customer-service business models. We suggest digital relational capabilities may be an important concept to use to understand how digital technologies are used to firms to relate to other parties in the network. We suggest digital relational capabilities may be defined as capabilities to develop and design the architecture of digital technologies, systems and business models that connect firm internal functions with external parties, explain the functions they will conduct, and the importance of these functions for value creation. The study some limitations e.g. more respondents may give a better picture of the use of newer or less used digital technologies.

6.0 Conclusion

The paper has contributed with results showing that digital technologies are associated to a relational perspective on business models as illustrated in the theoretical model. The paper contributes with empirical results of the investigation of customer-service business models for manufacturing SMEs which show that a specific group of digital technology, labelled relational digital technology, is associated with transformation of their business models. This add valuable new knowledge about SMEs use of digital technology in customer-service business models. This point to developing a concept of digital relational capabilities to better understand how SMEs adapt digital technologies to make business models which relate to customers and other parties.

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