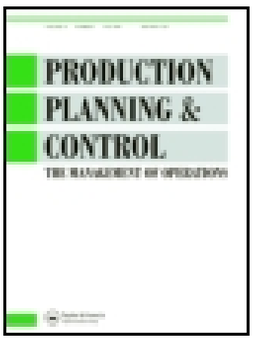

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The impact of servitization and digitization on productivity and profitability of the firm: a systematic approach

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ABSTRACT

We propose a new systematic method to answer the research question: 'What is the financial and economic impact of servitizing the firm, digitising the firm, and combined servitization and digitization strategy?' Our method quantifies servitization, digitization and their synergy by analysing their relationship with firm financial and economic outcomes. The method is applied to the British publishing industry. Using text-mining and econometric analysis of secondary data, 258 UK book publishers (93% of the market share) are analysed over a period of 10 years (1,508 observations). Firms are categorised as servitized (S-firms), digitized (D-firms), digitized and servitized (DS-firms) and pure (P-firms) that are neither servitized nor digitized (control group). We detect no significant difference in terms of productivity and profitability between P-firms and D-firms. Although we find evidence of a servitization paradox, both S-firms and DS-firms show greater productivity than P-firms. Profitability of DS-firms is greater than that of P-firms, but profitability of S-firms is lower than that of P-firms. The research improves on the existing methodology employed to examine the impact of servitizing or digitising the firm and provides a means to measure how servitization and digitization impact on the productivity and profitability of a firm within a specific context.

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Servitization; digitization; servitization paradox; publishing industry

Introduction

Servitization is a strategic transition a firm adopts to create additional value through services, usually in addition to core-products (Vandermerwe and Rada 1988; Kowalkowski, Gebauer, and Oliva 2017). Manufacturing firms are progressively following a servitization strategy by integrating services into their offerings (Neely 2008; Kowalkowski, Gebauer, and Kamp 2017). The servitization literature is progressing towards an understanding of the complex relationship between the integration of the firm's core-products and customer-oriented services (e.g., Kohtamäki et al. 2013), and how together they generate additional value (Vandermerwe and Rada 1988; Brax and Visintin 2017). Servitization formulates a new paradigm for competition as servitized firms offer complete packages encompassing a combination of goods and services to capture additional value (Baines et al. 2017); develop capabilities and barriers that differentiate and lock-out competitors in the industry; influence product sales through customer-oriented services; retain customers; and generate and maintain higher profit margins (Gebauer, Fleisch, and Friedli 2005; Olivia and Kallenberg 2003; Kowalkowski, Gebauer, and Oliva 2017; Story et al. 2017; Kamp and Parry 2017).

Servitization is not without downside risk. Servitized firms are found to have higher labour costs as they tend to face significant investment requirements and have complex management and operational issues (Neely 2008; Valtakoski 2017; Benedettini, Swink, and Neely 2017; Böhm, Eggert, and Thiesbrummel 2017). Servitized firms suffer from numerous challenges and modified risks that hinder their ability to recoup investments and reduce predicted returns. In some cases, though firms pursue service to add revenue, actual returns are lower than those achieved by pure manufacturing firms - an experience referred to in the literature as the *servitization paradox* (Gebauer, Fleisch, and Friedli 2005; Neely 2008).

Given the benefits and drawbacks of servitization, this paper seeks to answer the research question: 'What is the financial and economic impact of servitizing the firm, digitizing the firm, and combined servitization and digitization strategy?'

Servitization is not an end state, but rather describes a process of changes in the particular business model employed by a firm. Business models provide the design of the value-creation, delivery and capture mechanism (Teece 2010). The term *digitization* describes the dematerialisation of physical products (Vendrell-Herrero et al. 2017). Digitization is a transition where traditional production processes are enhanced or replaced by digital technology leading to the implementation of new business activities, increased competitiveness and new distribution channels (Amit and Zott 2001). Digitization, therefore, describes a firm's transition to utilise digital technology in order to implement its business activities and generate revenue. (BarNir, Gallaugher, and Auger 2003). Technological innovation, via digitization,

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changes a firm's business model and facilitates alternative value-creation and capture streams (Zott, Amit, and Massa 2011; Coreynen, Matthyssens, and Van Bockhaven 2017).

Digitization is closely linked to servitization (Lerch and Gotsch 2015). Digital technologies provide opportunities for firms to servitize (Ardolino, Saccani, and Penna 2015) as digitization via the introduction of electronic-business (e-Business) models allows firms to further create, deliver and capture additional value (Veit et al. 2014). Digitized firms disrupt traditional distribution networks to gain and maintain competitive advantage (Amit and Zott 2001). Utilizing digital technology enables servitized firms to mitigate servitization challenges and risks, and successfully reap the benefits of servitization (Ardolino, Saccani, and Penna 2015).

By utilising digital technologies to deliver products and services it has been proposed that firms are able to maintain competitiveness in a fast-innovating environment, reduce the resource requirements found with servitization and provide advanced services (Kryvinska et al. 2014; Schroeder and Kotlarsky 2015; Baines et al. 2017). The positive interaction of digitization and services enables firms to reshape their service-related activities and processes (Sklyar et al. 2019). However, the relationship between servitization, digitization and business outcomes such as productivity, profitability and competitiveness remain underexplored in the literature particularly due to the lack of data and empirical methodology, capable of fully separating the effects of servitization and digitization. This paper addresses this apparent gap in the literature.

This paper develops a method that can explore the implications of digitization and servitization of a firm's offering (in isolation as well as jointly). Our approach assesses the impact of servitization and digitization on the financial and economic performance of the firm. The approach is scalable and transferable to other industries and contexts, which is the main contribution of our paper to the existing literature. We primarily build on previous work undertaking such quantitative analysis done by Neely (2008) and Benedettini, Neely, and Swink (2015). The methodology proposed here is different from that employed by Neely (2008) in a number of ways. The process of coding a company descriptor is replaced by an automated text-mining procesdure based on keyword lists. Examination of the process of business change is broadened to cover servitization and digitization. The unit of analysis is also different. Instead of focussing on the general manufacturing sector, we have developed the methodology by focussing specifically on the book publishing industry in the UK and Ireland. This sector is known to have firms which have moved from physical product manufacturing to employing digital technologies in order to provide and support an extensive range of physical, digital and service offerings. The sector is clearly defined in SIC codes and significant amounts of data are available, representing 93% of the market in 2015. Neely's (2008) classifications of 'pure manufacturers' or 'servitized manufacturers' is adapted and extended within the context of publishing industry to include 'pure publishers' (P), 'digitized publishers' (D), 'servitized publishers' (S) and, 'digitized and servitized publishers' (DS). Instead of a deep focus on a single year's data for all firms, 10 years of data per firm is extracted to create an unbalanced panel. A different analysis is employed using a multinomial logit regression clustered at the publisher level that shows how P firms differ from S, D and DS firms. To answer the research question, a simple robust methodology utilizes a non-parametric comparison of means between groups.

The work addresses research gaps identified by Lightfoot, Baines, and Smart (2013) regarding the 'value in use' and the 'value co-creation' in the context of servitization; Hua, Cheng, and Wang (2011) on whether the publisher should digitize; and Baines et al. (2009) in providing a method to overcome part of the challenges in adopting servitization. Vendrell-Herrero et al. (2017) analysed the context of book publishing focussing on consumer demand, but did not address the impact on the book publisher, leaving the question 'what is the financial and economic impact of (i) servitizing, (ii) digitising, as well as (iii) a combined servitization and digitization strategy?' open. Using a unique dataset we look for differences between P, S, D, and DS firms starting from the initial expectation that S and D firms would exhibit better business outcomes compared to P firms. Since digitization should simplify servitization and contribute to servitization, we also expect to see DS firms perform better compared to P firms and possibly to S and D firms, although the relationship between DS and S and D firms is less clear. These hypotheses are tested using econometric analysis.

The paper is structured as follows. We begin with a critical literature review on servitization, value, business models and digitization. We then present the proposed systematic approach. Results are summarised and followed by a discussion of our findings including the implications for theory and practice. Finally, the paper closes with conclusions, limitations and identification of horizons for the future work.

Literature review

Servitization topology

Knowledge of servitization is continuously expanding (Sousa and da Silveira 2017), but research gaps remain leaving opportunities to develop knowledge and encompass different industries (Baines et al. 2016). The manufacturing industries, particularly in the business-to-business (B2B) area, are increasingly being servitized due to the perceived benefits (Olivia and Kallenberg 2003). Product manufacturers are transitioning to focus upon offering an integrated product-service to create additional value. This aligns with the service ecosystem perspective as suggested by Vargo and Lusch (2011) when the system adapts its value proposition to context changes. Yet, the heterogeneity of value propositions makes their nature and role remains unclear (Frow et al. 2014). This challenge contributes to some servitized firms moving back towards a pure manufacturing offer, suggesting greater knowledge is needed as to the impact of service transitions (Kowalkowski, Gebauer, and Oliva 2017; Raddats et al. 2017). Understanding the degree of servitization is

challenging and servitization measures are inconsistent making assessment and comparability of servitization difficult (Calabrese et al. 2019).

Servitization decisions are driven by perceived financial, strategic and marketing benefits (Gebauer, Fleisch, and Friedli 2005; Oliva and Kallenberg 2003; Mathieu 2001). The financial benefit of servitization is a result of service propositions that provide a more stable source of revenue, allowing firms to generate and maintain higher profit margins (Gebauer, Fleisch, and Friedli 2005). Wise and Baumgartner (1999) suggest some sectors allow firms to generate up to two times more revenue from services than from new products. The offer of simple product-related services does not necessarily benefit a firm as research suggests a diverse offer of product-related and unrelated services is better (Benedettini, Swink, and Neely 2017). The financial benefit of servitization reduces the traditional risks of competing purely on price and quality, which are becoming more and more difficult to address; and service-integrated products are less price-sensitive (Malleret 2006; Vandermerwe and Rada 1988).

Service is significantly important in industrial markets where customers demand tailored solutions to complement products in return for customer loyalty (Mathieu 2001). Customers seek advantages including: value, convenience, long-term relationships and an overall bespoke service (Vandermerwe 2000). Therefore, product-complementing services help firms to create relationships with customers that influence the creation and maintenance of stable revenue streams (Baines et al. 2009). Servitization literature provides robust evidence that servitized firms tend towards greater profitability than their non-servitized counterparts (e.g. Kastalli and Van Looy 2013; Neely 2008; Lee, Yoo, and Kim 2016; Crozet and Milet 2017). However, there is a body of literature suggesting that a servitization paradox (failure of servitization investments to manifest into higher returns) exists in manufacturing contexts (see, e.g. Li et al. 2015; Neely, Benedettini, and Visnjic 2011). Benedettini, Neely, and Swink (2015) show that the servitization paradox primarily happens in contexts where servitization has increased demand chain risks for the firm. In the context of publishing industry where demand chain risks may or may not have pronounced effects, we start work with an expectation that the impact of servitization on profitability will be generally positive.

In this paper we identify firms with service strategies as S-firms. The literature proposes a relationship between servitized firms and the ability to generate higher revenue and profit margins, leading to the first hypothesis:

H1a: *Servitized firms are more financially profitable than pure product firms.*

H1b: *Servitized firms are more productive than pure product firms.*

While **H1a** is intuitive, **H1b** requires further explanation. It may seem that moving from a pure product strategy to a servitization strategy would put additional strains on productive forces within the business. However, Bascavusoglu-Moreau and Tether (2011) show, using a large-scale longitudinal dataset, that if servitization is conducted successfully it should lead to increased productivity because a diversification of business offerings allows companies to address productivity challenges more efficiently. Since our classification of companies is based on text-mining techniques, businesses that are unsuccessful in their implementation of servitization are unlikely to use servitization-related language in their company descriptors. Therefore, our expectation is that, in line with the previous literature, servitized businesses will have higher productivity than non-servitized firms.

Digitization

The term 'digitization' defines the fundamental transition a firm undertakes to carry out its business activities and generate revenue through utilising digital technology to maintain competitiveness in a fast innovating environment (Veit et al. 2014; BarNir, Gallaugher, and Auger 2003). Digitization is different from servitization because servitization is a process of gaining new revenue streams from services (e.g. Smith, Maull, and Ng 2014; Baines et al. 2016) whilst digitization is the adoption of digital technologies (Veit et al. 2014; BarNir, Gallaugher, and Auger 2003). The use of digital technology provides the potential to experiment with new channels of distribution that are more efficient at capturing value (Amit and Zott 2001; Bustinza et al. 2015). Digitization is, therefore, associated with developing new capabilities for the firm (BarNir, Gallaugher, and Auger 2003; Vendrell-Herrero et al. 2017).

Digitization describes the change of analogue data into digital data and digitalisation describes how a domain changes with digital infrastructure, though the words are often used interchangeably (Brennen and Kreiss 2016). In this paper for ease of argument we use digitization to refer to the joint construct. digitization develops the firms' business model because incorporating digital technologies changes one or all of the mechanisms employed to deliver, capture and create value (Teece 2010; BarNir, Gallaugher, and Auger 2003). In this paper business models that utilise digital technologies are named D-firm models. Digital technology is becoming adopted widely in many industries including media, retail, financial services and logistics (Veit et al. 2014). Publishing firms' business models are changing because of digitization, giving rise to new hybrid approaches that embody traditional elements of business models alongside digital technologies that capture value efficiently (Tian, Martin, and Deng 2008). Consequently, evolving digital technologies such as the Internet, smartphones and tablets are creating opportunities for firms to become more productive at lower cost (Øiestad and Bugge 2014). However, BarNir, Gallaugher, and Auger (2003) state that firms do not automatically gain benefits from digitization. Rather, the benefit is dependent on variables such as the firm's age and size. Firm size and age correlate with the availability and flexibility of resources and vulnerability to industry competitors, which subsequently affects the digitization of firms (BarNir, Gallaugher, and Auger 2003).

The exploitation of digital technologies increases the firm's likelihood of succeeding with servitization (Ardolino, Saccani, and Penna 2015). Digital technology supports servitization by utilising new product and service delivery. Traditional physical supply chain operations are disrupted by delivering what once was a physical object in a digital form, such as, for example, music delivered as a digital stream instead of as a physical CD. Digital service delivery is the ability to monitor or provide service through digital means, which reduces resource requirements and lowers cost (Kryvinska et al. 2014).

Service provision and the role of digital technologies can be independent, but there is a strong relationship between the two constructs (Gago and Rubalcaba 2007). Schroeder and Kotlarsky (2015) note that digital resources are strategically valuable to a firm as digital technology offers enhanced ability to provide advanced services, which complement a firm's servitization strategy. Additionally, provision of traditional services such as problem diagnostics, repair, maintenance, complaint management, invoicing etc., can be enhanced by the introduction of digital technologies. Digital channels are used to support service provision and to mitigate risks that are found in servitized firms, but the relationship between these two elements remains under-developed (Ardolino, Saccani, and Penna 2015). In this paper firms that combine digital and service strategies are named DS-firms.

Øiestad and Bugge (2014) and Chesbrough (2007) elaborate on how technological change requires businesses to have the capability to develop and adapt their business model. Organisations are often required to experiment with novel business models, a process that carries a significant risk. Through a case study analysis of Norwegian book publishers, Øiestad and Bugge (2014) find some firms experimenting with new business models that exploit new technologies to capture value. However, traditional approaches to business are well understood and so most firms choose not to innovate and retain their established approach. These traditional product-only firms are labelled P-firms. They are firms where the potential of servitization and digital media is yet to be realized.

As a result of digitization, a body of academic literature examining e-Business models has developed (Zott, Amit, and Massa 2011; Teece 2010). Timmers (1998) defines 10 types of e-Business models used by European commercial firms. Van Der Vorst et al. (2002) examine e-Business models in the food industry and conclude that e-Business models improve the efficiency of established supply chains and create new dynamic networks. Morris, Schindehutte, and Allen (2005) state that there is a lack of insight with regard to the conditions and context that make a particular business model appropriate, which is hindering the progression of business model knowledge. Based on this, the following two hypotheses were developed:

H2a: *Digitized firms are more financially profitable than pure product firms.*

H2b: *Digitized firms are more productive than pure product firms.*

Servitization paradox and digital synergy

The servitization paradox refers to firms that generate less than the predicted return on investment used to increase service offerings (Gebauer, Fleisch, and Friedli 2005). An investigation into 30 manufacturing companies, conducted by Gebauer, Fleisch, and Friedli (2005) illustrates the drivers of the servitization paradox, which include high labour costs, substantial investment requirements and an increased service offering. These factors trigger challenges that managers often fail to interpret adequately or do not have the correct mind-set to manage (Gebauer, Fleisch, and Friedli 2005). Subsequently, firms fail to realise the financial benefits described by Vandermerwe and Rada (1988). Neely (2008) conducts a study of firms from around the world and finds that servitized manufacturing firms increase their revenues, but they generate lower net profits in comparison to pure manufacturing firms. Consequently, servitization impedes the firm's ability to make additional investments and to recoup expected returns. The servitization paradox is, therefore, more likely to be observed in larger manufacturing firms which find it difficult to gain the servitization benefits and manage higher incremental operating costs than their smaller counterparts (Neely 2008).

Servitized manufacturing firms experience fewer of the traditional risks that are faced by pure manufacturing firms (Malleret 2006). However, Benedettini, Neely, and Swink (2015) find that servitization introduces modified risks that greatly affect firms who offer simple services. For such firms, risks often outweigh the benefits as described by Vandermerwe and Rada (1988). Unless these new risks are mitigated, servitized firms struggle to profit from offering services and face an increased level of bankruptcy risk. Manufacturing firms which go through servitization, modify the levels and types of risks to which they are exposed (Benedettini, Neely, and Swink 2015). These modified risks are a result of the varying demand levels for simple services (demand chain services), however, complex services (product support and solutions services) are more resistant to bankruptcy risks (Benedettini, Neely, and Swink 2015).

Reviewing business models and digitization literature, specifically the relationship of digitization and servitization, it is proposed that there is a strong relationship between the two constructs (Gago and Rubalcaba 2007). Sklyar et al. (2019) suggests that the syngergy between digitization and servitization leads to positive results. Previous research suggests that the interactions between digitization and servitization is strategically valuable and mitigates risks associated with servitization that negatively affects net profit (Schroeder and Kotlarsky 2015; Neely 2008). Hence, the following set of hypotheses was developed:

H3a: *Digitized and servitized firms are more financially profitable than pure product firms.*

H3b: *Digitized and servitized firms are more productive than pure product firms.*

It could be assumed that DS-firms will perform better in terms of profitability and productivity compared to both

D-firms and S-firms. However, previous literature is limited when exploring the relative performance of S-firms, D-firms and DS-firms is concerned. A very recent paper suggests that in the context of sustainable manufacturing, servitization can only be successful when complimented by digitization (Opazo-Basáez, Vendrell-Herrero, and Bustinza 2018). This provides some evidence that DS-firms should perform better than S-firms. However, the relationship between D-firms and DS-firms remains underexplored. This might be due to the fact that it is quite difficult to identify digitized firms which have not been servitized.

Research context: book publishing

Existing servitization research has tended to focus on small sample studies in the manufacturing industry (Lightfoot, Baines, and Smart 2013, Sawhney, Balasubrahmania, and Krishnan 2004; Gebauer and Friedli 2005; Ward and Graves 2007; Johnstone and Dainty 2008; Visnjic Kastalli and Van Looy 2013; Baines and Lightfoot 2014; Smith, Maull, and Ng 2014). There are efforts to expand the generalisability of servitization knowledge to other industries (Baines et al. 2009; Lightfoot, Baines, and Smart 2013; Myrthianos et al. 2014; Øiestad and Bugge 2014; Sultan 2014; Viljakainen and Toivonen 2014). Several studies also examine the creative industries. Myrthianos et al. (2014) investigate the negative financial consequences of the servitization of the music industry during a phase of technological disruption, the move from physical record sales to digital goods and music streaming services (Bustinza et al. 2013; Parry, Bustinza, and Vendrell-Herrero 2012). Reported results demonstrate that local firms' profits decrease more than multinational firms during the servitization process (Myrthianos et al. 2014). Viljakainen and Toivonen (2014) suggest that firms in the publishing industry are servitizing and adopting new competitive strategies (digital media and services) by integrating services and core-product offerings. Viljakainen and Toivonen (2014) find that the increased competition and diminishing revenue from sales of products lead to publishing firms (i) exploring customer-oriented service offerings, (ii) increasing the range of platforms offering their product, (iii) developing customised content and (iv) providing B2B solutions. Vendrell-Herrero et al. (2017) show that digital intermediaries have changed the nature of book publishing supply chains by taking ownership of the customer relationship, seising power and revenue within the market.

Viljakainen, Toivone, and Aikala (2013) notes that publishers are utilising new service offers to differentiate themselves from an increasing number of global competitors. Some of these service offerings include: content conversion service; digital distribution of out-of-print books; ebook rental; distribution channel solutions; subscription services; bespoke marketing; and merchandizing services (Tian and Martin 2011; Tian, Martin, and Deng 2008). However, publishers who digitize are still experimenting with alternative business models, mainly e-Business models or hybrid models, and are yet to fully utilise the benefits of digital technology (Øiestad and Bugge 2014).

Research from the publishing sector expands current knowledge of contemporary business models and servitization and provides a different context than manufacturing (Baines et al. 2009).

Categorisation of book publishers

Following the topology of firms identified in the previous literature, we distinguish between pure (product) firms (P-firms), servitized firms (S-firms), digitized firms (D-firms), as well as digitized and servitized firms (DS-firms). In this paper we use an example of the UK publishing industry, however, the proposed topology is universal and could be applied to other industries. We describe what we mean by P-firms, S-firms, D-firms, and DS-firms in the context of the UK publishing industry below.

Pure publishers

The processes of commissioning, producing and distributing books are part of the traditional work of the printed book supply chain (Tian and Martin 2011). Pure publishers (P-firms) do not offer digitized products or additional services to the customer that go beyond a business model of physical book publishing, Their economic activities (revenue streams) are within the boundaries of publishing physical books, where associated key partners in the process include: authors, publishers, printers, agents, retail stores, and wholesalers (Øiestad and Bugge 2014). We distinguish P-Firms from other firms by exclusion, meaning that if the firm does not show evidence of servitization or digitization, then it is classified as a P-Firm.

Digitized publishers

Digitized publishers (D-firms) have similar characteristics to P-firms but offer additional spectrum of activities. Tian, Martin, and Deng (2008) summarise the characteristics of digitized publishers as follows: digitized firms support advanced infrastructures that publish digital books in various formats and distribute these books via domestic and global channels to the customer along with their existing traditional offerings. D-firms offer digital content that is integrated with, or provided as an addition to, digital books. D-firms use the internet as their primary communication channel to facilitate all processes including payment (focussing on e-commerce business models). Examples of keywords that identify D-firms include: *e-book publishing, digital content provision, and digital apps*. D-firms are distinguished from S-firms as they show evidence of digitization but not servitization.

Servitized publishers

The primary difference between the prior two categories and S-firms is the provision of services. Following Vandermerwe and Rada (1988) definition of servitization, firms that are categorised as servitized publishers (S-firms) offer physical books and additional services that are integrated with the core offering. The main characteristics are the offering of a combination of products and services to customers and/or

business partners in an attempt to create new distribution channels, capture new revenue streams and differentiate the firm from competitors. Services offered include re-production of out-of-print books on demand, subscription services, bespoke marketing and content conversion (Viljakainen, Toivone, and Aikala 2013). Examples of keywords that identify S-firms include: *services, warehousing & distribution services, bespoke illustration and translation & conversion service*. S-firms are distinguished from D-firms by only showing evidence of servitization but no digitization.

Digitized and servitized publishers

Digitized and servitized publishers (DS-firms) combine the characteristics of D and S-firms and offer digital and physical products and/or services. The utilization of digital technology and the provision of services can be independent, justifying the previous categories. In the book publishing industry, firms leverage technology to support their products and services (Yoo et al. 2012). Specific to a service offering, digital technology assists in creating new channels for service offerings and value capture. Examples of these digital services include e-book rental, digital distribution of out-of-print books on demand, digital format conversion, and online community fora. Identification requires keywords for both D & S-firms. We classify DS-firms when there is evidence for both digitization and servitization as defined above.

Methodology

We propose a new systematic approach based on text-mining and econometric analysis, extending the methodology adopted in previous research by Neely (2008) and Benedettini, Neely, and Swink (2015). The main advantages of our approach over previous research are its replicability and scalability, and the potential to integrate the method into web-based analytical systems. Like previous research, our approach is based on collecting and analysing secondary data from a major publisher of business information, using econometric analysis for hypotheses testing. This allows the research to demonstrate precise relationships between variables providing valid results within the book publishing industry (e.g. Creswell 2014).

Firm data is drawn from the FAME database that offers financial data and company reports of UK and Irish companies (Bureau Van Dijk 2015). We extract the overview (trade description, full overview, history, primary business line) and financial data (Number of Employees per Year, Turnover per Year, Turnover per Employee, Profit per Employee per Year, Return on Assets (ROA), Profit Margin per year) from FAME to build the dataset used in this paper, which include variables not previously considered by Neely (2008). The extracted data contains firm's financial performance over a period of 10 years. The entire population of publishing firms contains 2,850 observations. The panel is unbalanced since for some of the publishers data was missing for some of the years between 2007 and 2016. Some of the reasons behind our inability to collect financial data for a subset of publishers are due to: (i) some companies going out of business as of 2007; (ii) records for several businesses missing in the database; (iii) several records not updated for many years. Our requirement for inclusion of a publisher in the sample is that they have economic, financial and staff data between 2007 and 2016. Analysing data in the panel format rather than a cross-section allows us to capture the dynamic nature of the publishing business. The method does not allow for a longitudinal analysis as the overview text descriptions of the firm are only available for the year when data is extracted from the database. We do not have access to previous descriptors as they are not kept within the database. We contacted the database controller but they were unable to provide past descriptor data. Using financial ratios in the analysis allows for the normalization of values, ensuring that they are comparable between firms of significantly different size and making the inclusion of other controls unnecessary.

Table 1. Keywords and its frequency.

Digitization		Servitization	
Keyword	Frequency	Keyword	Frequency
electronic*	18	service*	56
digit*	15	distri*	67
audio	12	marketing	28
online	10	langua*	19
softw*	6	illust*	17
web*	5	financial*	14
eboo*	4	conference*	6
internet*	4	transl*	5
e-boo*	2	organisation*	5
		organization*	5
		wareh*	4
		subscription*	4
		membership*	4
		event*	3
		conver*	1

A text-mining technique is employed to classify the firms into 4 categories: P-firms, D-firms, S-firms, and DS-firms. The text-mining procedure is applied to the descriptive textual information provided by FAME that includes a business trade summary, full overview, history, and primary business description. A set of keywords is extracted for each type of publisher (Table 1). The extraction is based on semantics and word families based around the words 'digital' and 'service'. The main assumption is that if a specific keyword is mentioned in any of the descriptive fields linked to the firm's record it characterises the firm. For example, the keyword 'digit*' stands for digital, digitalization, digitalization, digitization, etc. Occurrence of the keyword 'digit*' in the description means that the firm is more than just a pure publisher and includes some form of digitization. The keywords include (Table 1): language translation; physical distribution services; digital distribution services; event organisation; digital conversion. This allows us to explore the diverse range of services and identify common services offered by UK book publishers.

To test the hypotheses, return on assets (ROA) is used as a proxy of financial profitability. According to Robinson (1999) ROA is an appropriate measure for assessing a firm's financial performance because it '*indicates management's effectiveness in employing the assets entrusted to them and*

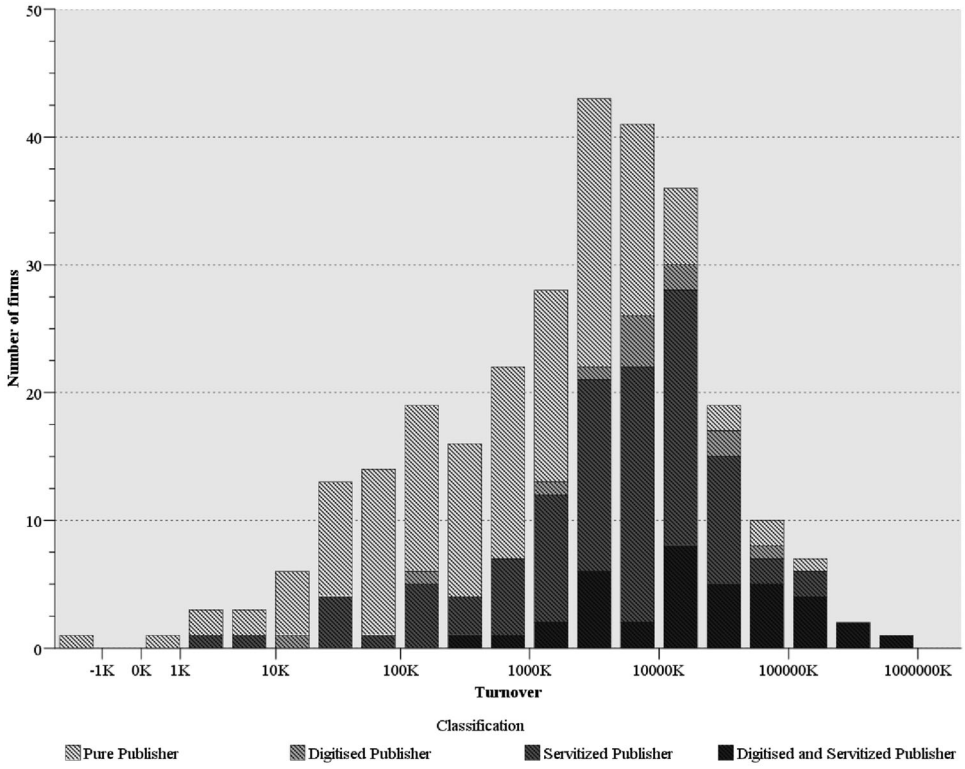

Figure 1. Firm size and classification in 2015.

does not depend on the alternative use of debt versus equity to fund such assets' (p. 169). It is also the second most used measure for efficiency in most empirical studies (e.g. Murphy, Trailer, and Hill 1996). To measure economic performance we use turnover per employee as a proxy for labour productivity (Aranguren et al. 2014; Luo and Bu 2015), allowing us to adjust the economic performance for the size of firms.

Results and discussion

The sample resulted in 258 UK book publishers with a total turnover of GBP 4,1 billion out of GBP 4,4 billion total for the market in 2015, which represents 93% of the market share in 2015 (source: Publishers Association 2016). The sample is classified using our topology of P-firms, D-firms, S-firms, and DS-firms. Digitization and/or servitization are evident in the UK Book publishing industry, but P-firms remain the largest category in the sample. Findings indicate that a significant percentage (44%) of sampled businesses are P-firms, 37% are S-firms, 15% are DS-firms while only 4% are D-firms. Figure 1 illustrates the distribution of firms relative to size and is colour coded for classification; note Figure 1 is for illustration purposes only, as the turnover shown represents the latest available year in thousands of pounds per year. The full analysis is carried out using the complete data-set.

Figure 1 indicates that smaller firms tend to be P-firms. D-firms, S-firms and DS-firms become more prevalent as the turnover increases. Whilst many P-firms still exist, Figure 1 suggests that publishers increasingly add service to their business offering.

Figure 2 shows a summary of the analysis of financial and economic data sorted by the firm categories using 3 variables: profit margin, ROA, and turnover per employee.

Figure 2 shows that DS-firms appear to have much higher profit margins than firms from any other category. DS-firms are followed by D-firms, S-firms, and P-firms (in descending order). According to ROA, S-firms do better than firms from any other category and DS firms – worse than any other category with D-firms and P-firms showing identical performance. S-firms have the highest turnover per employee, followed by DS-firms while D-firms have the lowest turnover per employee and they are preceded by P-firms.

We conduct a series of non-parametric Mann-Whitney Wilcoxon (MWW) tests to explore to whether and what extent the numbers reported in Figure 2 are statistically significantly different from each other. Results (i.e., probabilities of MWW tests) are reported in Table 2(a-c).

Results of the non-parametric tests suggest that (i) DS-firms supersede P-firms according to 2 of 3 considered performance variables: profit margin and turnover per employee; (ii) S-firms perform better than P-firms according to 1 out of 3 variables: turnover per employee; (iii) D-firms are majorly indistinguishable from P-firms according to their performance.

Additionally, (iv) S-firms perform better than DS-firms in terms of their turnover per employee; yet, they perform worse than DS-firms in terms of ROA.

Of 3 compared variables, turnover per employee appears to be the most accurate measure of performance as it considers the size of the firm. Therefore, we compare how D-firms, S-firms and DS-firms are different from P-firms using a multinomial logit regression. The multinomial logit uses

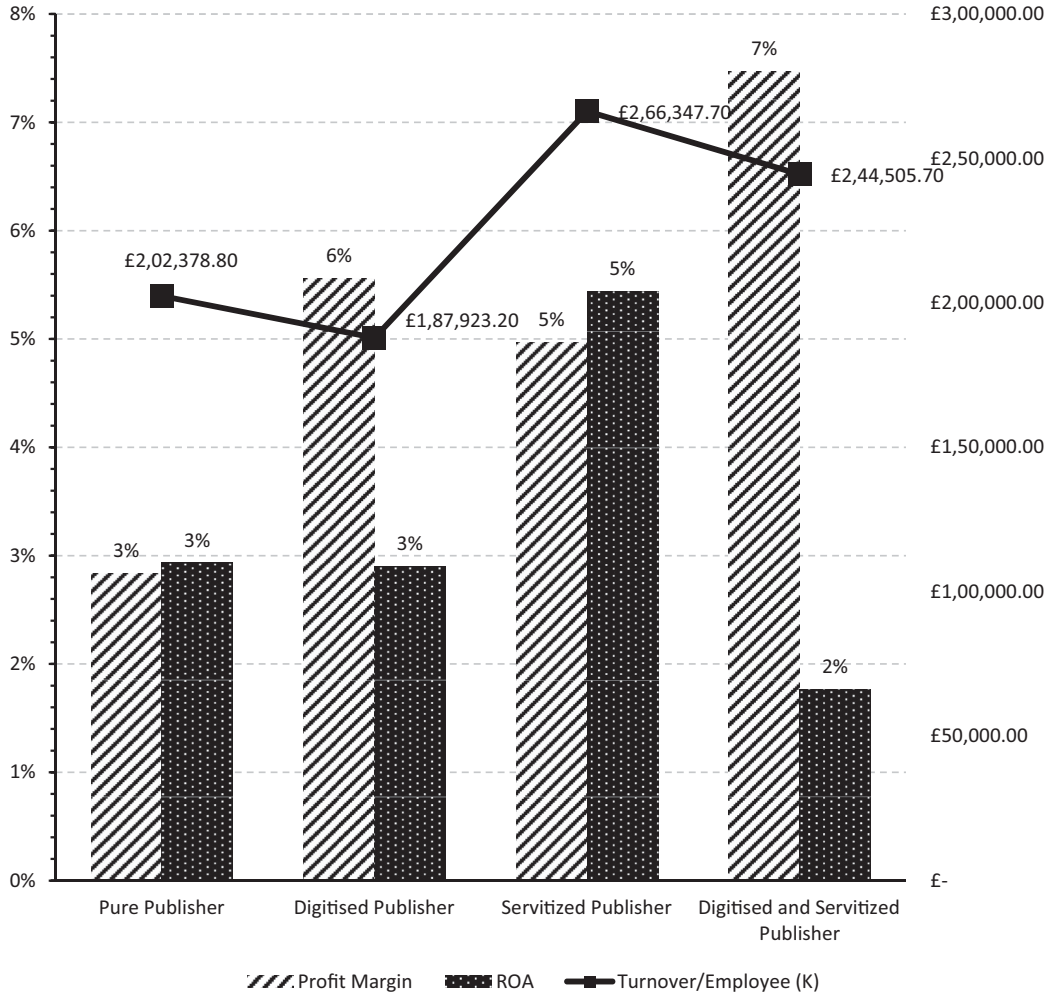

Figure 2. Performance comparison between the four types of publishers.

Table 2. Results of a series of Mann–Whitney Wilcoxon tests (non-parametric pairwise comparison of means between groups).

	D-firm	S-firm	DS-firm	P-firm
(a) Profit margin				
D-firm	–	0.4206	0.5131	0.2648
S-firm	–	–	0.0005***	0.2424
DS-firm	–	–	–	0.0001***
P-firm	–	–	–	–
(b) ROA				
D-firm	–	0.9035	0.086	0.7082
S-firm	–	–	0.0005***	0.5078
DS-firm	–	–	–	0.0490*
P-firm	–	–	–	–
(c) Turnover per employee				
D-firm	–	0.0814†	0.0061**	0.9757
S-firm	–	–	0.0241*	0.0003***
DS-firm	–	–	–	0.0000***
P-firm	–	–	–	–

Notes: †, significant at 0.10 level; *, significant at 0.05 level; **, significant at 0.01 level; ***, significant at 0.001 level

clustered standard errors at the level of the publisher (capturing the panel structure of our dataset), where turnover per employee is the dependent variable and P-firm is a 'base category' to which all other categories of firms are compared. Results of this regression analysis are provided in Table 3. Results of our analysis suggest that both turning a firm into an S-firm or a DS-firm increases turnover per employee.

From the analysis we observe that there is no difference between P-firms and D-firms. However, S-firms and DS- firms outperform P-firms. From these results we can only partly support our original hypotheses: **H1a:** *Servitized firms are more financially profitable than pure product firms [NOT SUPPORTED];* **H1b:** *Servitized firms are more productive than pure product firms [SUPPORTED];* **H2a:** *Digitized firms are more financially profitable than pure product firms [NOT SUPPORTED];* **H2b:** *Digitized firms are more productive than pure product firms [NOT SUPPORTED];* **H3a:** *Digitized and servitized firms are more financially profitable than pure product firms [SUPPORTED] and finally;* **H3b:** *Digitized and servitized firms are more productive than pure product firms [SUPPORTED].*

Servitizing book publishing: a paradox

Evidence from this research in the UK book publishing industry contributes to knowledge by demonstrating that servitization is not a simplistic concept that can be rapidly adopted in different industrial contexts. The work extends that of Neely (2008) and Benedettini, Neely, and Swink (2015) by

Table 3. Multinomial logit regression clustered at the publisher level (P-firm category taken as the base outcome).

	Coef.	Robust std. err.	z	P > z
D-firms				
Turnover per Employee (ln)	0.011815	0.234107	0.05	0.960
Constant	−2.10313	2.768282	−0.76	0.447
S-firms				
Turnover per Employee (ln)	0.297132	0.117677	2.52	0.012**
Constant	−3.29208	1.381024	−2.38	0.017
DS-firms				
Turnover per Employee (ln)	0.442424	0.163233	2.71	0.007***
Constant	−5.91339	1.943945	−3.04	0.002
Number of obs		1,502		
Pseudo R^2		0.014		

Notes: *, significant at 0.05 level; **, significant at 0.01 level; ***, significant at 0.001 level

exploring servitization and digitization as separate entities controlling for the firm size. Gaining the benefits of digitization is dependent on the firm's size, which links to resource availability (BarNir, Gallaugher, and Auger 2003). Empirical analyses show that firms within the book publishing industry are adopting different strategies, with some remaining as pure (traditional) publishers and others adopting different service and digital business models. Empirical evidence demonstrates pure publishers remain the most common firm category in the publishing industry, similar to Øiestad and Bugge (2014) findings.

Whilst there are potential benefits to servitization, transition is not simple. Academics (Benedettini, Neely, and Swink 2015; Benedettini, Swink, and Neely 2017; Kowalkowski, Gebauer, and Oliva 2017; Kowalkowski, Gebauer, and Kamp 2017; Neely 2008; Gebauer, Fleisch, and Friedli 2005) iterate that servitization holds significant modified challenges and requirements that a firm may face, including high labour costs, initial investments and additional resources.

The result from testing hypothesis H1a, *Servitized firms are more financially profitable than pure product firms* (Gebauer, Fleisch, and Friedli 2005; Oliva and Kallenberg 2003; Mathieu 2001), indicates that this does not hold true in the UK book publishing industry. When examining non-digital servitized firms, publishers who offer additional services are not found to achieve higher profitability than traditional publishing firms. The result builds upon the concept proposed by Vandermerwe and Rada (1988) as it shows that services which are non-digital do not create additional value for the firm in terms of profitability, consistent with existing servitization paradox research (Gebauer, Fleisch, and Friedli 2005; Neely 2008**)**. Non-digital servitization benefits are confirmed in terms of productivity only for medium and large firms. Based on the results, the incremental costs of servitization appears to lead to financial and productivity challenges (higher cost of sales, higher average cost of employees and higher working capital per employee), such that the potential benefits are hidden by the costs and challenges faced. This finding complements existing knowledge on the challenges of servitization (Baines et al. 2016).

The finding does not imply that firms should abandon servitization as a strategy in non-digital areas. Value has a variety of connotations and meanings that cannot be objectively determined (Grönroos 2011). Literature on servitization articulates that the servitization of firms is not solely financially driven and there may be strategic and marketing drivers (Oliva and Kallenberg 2003). The strategic and marketing drivers encompass a strategy to grow, differentiate, create barriers against competitors and increase product sales through establishing service related infrastructures and value creating channels for the future of the firm (Gebauer, Fleisch, and Friedli 2005; Opresnik and Taisch 2015). The findings highlight that publishers are offering a diverse range of services and not all firms have the same scope of service offering. This gives them a differentiated position from which they can compete on the market even if it does not yield greater profitability or productivity.

The results demonstrate that there are limitations to using servitization as a growth strategy in the book publishing industry, particularly when considering the results obtained from testing hypotheses H1a&b as well as emphasized by Neely's (2008) findings, which suggest that incremental investment requirements increasingly scale with the scope expansion of service offering. From these results, financial challenges are linked with servitization in the book publishing industry, which may be somewhat mitigated by the digital solutions. Prior studies (e.g. Benedettini, Neely, and Swink 2015) indicate that larger servitized firms struggle to gain servitization financial benefits in comparison to smaller firms because of higher incremental costs from a greater scope of service offering. However, the results of this analysis contrast with current knowledge suggesting that it is the use of digital technologies which create the additional value in service offerings

Our findings contribute to the servitization literature and highlight that firms can benefit from productivity increases when digital solutions and services are developed, whereas smaller firms benefit from digitization alone, which highlights the challenges of servitization. Benedettini, Neely, and Swink (2015) suggests that in the manufacturing industry large firms have the ability to leverage resources, a finding which this work supports. Leveraging resources creates greater capability to tackle the challenges and costs of providing services.

Complementing servitization with digitization

Digitization is an alternative method to leverage, create and capture additional value efficiently, benefiting the firm (Yoo et al. 2012). The findings contribute to the digitization literature by providing empirical evidence to illustrate that digitized firms are benefitting from the transition. The findings of this work are consistent with those of Tian, Martin, and Deng (2008) who studied the Australian publishing industry and discovered hybrid business models in the industry. These business models embody traditional publishing methods mixed with new digital elements and allow Australian publishers to capture value more efficiently and gain higher earnings. Our results confirm these earlier findings that new methods and channels of distributing traditional books are more efficient at capturing value than the traditional service provision.

Current studies show that employing digital technology to support servitization, utilizing new channels to deliver services, leads to a greater chance of success in the market (Ardolino, Saccani, and Penna 2015). However, understanding of the relationship between the two elements (digitization & servitization) remains under-developed. The utilization of digital means to deliver services reduces resource requirements and subsequently lowers or mitigates costs associated with servitization, such as labour costs; which complements Kryvinska et al. (2014) findings. Our research also contributes to the current digitization and servitization literature by suggesting that digitization could be a method to address servitization challenges as digitized & servitized solutions are found to be mutually reinforcing in improving the productivity of larger firms. However, digitization alone is not beneficial for a firms' performance. Therefore, as suggested by Schroeder and Kotlarsky (2015) and Ardolino, Saccani, and Penna (2015), digitization can be seen as a separate element (outside of servitization); but digital technologies play a prominent role in supporting service provision, offering complementary benefits in alleviating and mitigating servitization risks.

Conclusions

This work provides a method for measuring the financial and economic impact of servitization and digitization. The method is based on text-mining followed by econometric analysis. The proposed method builds upon the previous work by Neely (2008) and Benedettini, Neely, and Swink (2015). An advantage of the proposed method is that it could be applied to (unbalanced) panel data collected from publicly available sources. Our dataset contains multiple observations per firm over several years that accounts for outliers, as a single year is often not representative of the overall firm performance.

Our methodology was deployed to answer the research question *'what is the financial and economic impact of (i) servitizing, (ii) digitizing, and (iii) a combined servitization and digitization strategy?'* Following previous studies (e.g. Tian, Martin, and Deng 2008; Øiestad and Bugge 2014; Vendrell-Herrero et al. 2017), this research examines how digital disruption affects Business-to-Business (B2B) interdependencies in the context of the publishing industry.

Our findings cannot support the hypothesis that servitized firms are more financially profitable than pure product firms (**H1a)**. Publishing firms appear to exhibit the servitization paradox observed in other manufacturing studies. However, servitized firms are found to be more productive than pure product firms (**H1b)**. In terms of digitization, we cannot support the hypothesis **(H2a)** that digitized firms are more financially profitable than pure product firms; or (**H2b)** digitized firms are more productive than pure product firms. However, (**H3a)** digitized and servitized firms are shown to be more financially profitable than pure product firms; and (**H3b)** digitized and servitized firms are more productive than pure product firms. Our results also suggest that firms combining both servitization and digitization exhibit higher performance while firms implementing only one do not. Note that our conclusions are based on the correlational analysis and do not imply causal relationships between profitability, productivity, and propensity to adopt digitization, servitization, or both. Essentially, we observe that digitization and servitization (taken jointly) are associated with both higher profitability and productivity; servitization alone is correlated with higher productivity, but not with increased profitability; and digitization alone offers performance outcomes indistinguishable from those achieved by P-firms.

For practitioners, our empirical analysis suggests that servitization is an industry trend that should be followed with full awareness of the potential challenges and risks (as also argued by Benedettini, Neely, and Swink 2015). A servitization strategy has the potential of bringing benefits to the firm in the form greater of productivity. Digitization alone does not seem to significantly benefit the firm. Firms adopting a combination of servitization and digitization strategies are both more profitable and more productive than pure product firms. A similar increase in profit margin is observed in firms combining digitization and servitization.

Servitization is a complex process, which requires that firms understand the pre-requisites of servitization and actively anticipate and respond to the challenges faced by preparing for such challenges and absorbing servitization costs. Our study finds support for the general advantages of digital technologies and the strategic value they can bring to the firm (Ardolino, Saccani, and Penna 2015; Schroeder and Kotlarsky 2015; Kryvinska et al. 2014). The positive interaction of digitization and services (Sklyar et al. 2019) is supported by our results. One of the main empirical contributions of this paper is showing that pursuit of a digitization strategy is insignificant for business performance unless it is done in conjunction with servitization in the context of publishing industry.

Future work needs to address the interplay between digitization and servitization and test these findings in different contexts. Further empirical research is required to comprehensively explore types of risks relating to the firm's new market position and those that develop during the servitization process (Benedettini, Neely, and Swink 2015). Research required includes examination of other ways of creating and capturing value with digital technology as digitization can be complementary to service production and act as a resource for service provision (Cusumano, Kahl, and Suarez 2015). Future research may explore the impact which different forms of offered services have on business performance. It may also carefully study business models used to deliver services to the end consumer. Examination of firm size effects would complement the research work of BarNir, Gallaugher, and Auger (2003) into digitization and that of Neely (2008) who found that the servitization paradox applies mainly to larger manufacturing firms. Text-mining and analysis of narratives related to a business, provided in the annual financial reports of manufacturing firms, would allow researchers to collect longitudinal descriptive textual data to more closely observe changes and their financial

impacts over time. Future research will explore these opportunities.

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