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**How do servitization challenges affect business performance
in servitized firms with different strategic focuses? – An
empirical study based on companies adopting servitization in
the UK**

By

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**A thesis submitted in partial fulfilment of the requirements for
the degree of
Doctor of Philosophy in Engineering**

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The University of Warwick, Department of WMG

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Table of Abbreviations

| | |
|--------------------|--|
| ABS | Association of Business School |
| AVE | Average Variance Extracted |
| BM | Business Model |
| BP | Business Performance |
| BSREC | Biomedical & Scientific Research Ethics Committee |
| B2B | Business to Business |
| B2C | Business to Customer |
| CA | Cronbach's Alpha |
| CB-SEM | Covariance-based Structural Equation Modelling |
| CFA | Confirmatory Factor Analysis |
| CIMO | Context, Interventions, Mechanism & Outcome |
| CM | Customer Management |
| CNA | Citation Network Analysis |
| CR | Composite Reliability |
| DP | Development Process |
| FB | Financial Benefit |
| IS | Integrated Solution |
| IS Provider | Integrated Solution Provider |
| LCM | Life Cycle Management |
| MB | Marketing Benefit |
| OS | Organisational Structure |
| PLS-SEM | Partial Least Square Structural Equation Modelling |
| PS Supplier | Product Supplier Providing Generic Services |
| PSS | Product Service System |
| RM | Risk Management |
| SB | Strategic Benefit |
| SLR | Systematic Literature Review |
| TOC | Theory of Constraints |

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Recently, I read an article on the *nature.com*, entitled 'Done is better than perfect: overcoming PhD perfectionism'. The key message from the author is '*Your PhD will only get finished when you make a conscious decision to stop. It may not be perfect, or even complete; but there's nothing better than a submitted thesis.*' By the time I read the article, I was in the stage of finalising the thesis and kind of going back forth to improve it as much as I could. I thought this is an interesting thought to share in this thesis, and I do believe that completing a thesis is not an end of my research as I could always carry it on in different ways.

I had a mixed feeling about my PhD journey, which has been a combination of panic, frustration and stress in the first two years, and gradually became interesting, productive and proud towards the end. This journey was indeed a life-changing experience, and I will only remember the good part of it.

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DECLARATION

This thesis is the original work of the author, submitted to the university of Warwick in support of the application for the degree of Doctor of Philosophy. Also, this thesis has not been submitted in whole or in part as consideration for other degree qualification at this or any other university.

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ABSTRACT

Servitization challenges have gained enormous attention from both academics and practitioners, as an increasing number of product-centric companies are actively seeking business growth by adopting a servitization strategy. Although prior studies investigate servitization challenges from multiple aspects, the performance implication of the challenges remains unclear. Moreover, the interplay between the challenges and different servitized businesses needs an in-depth investigation.

The aim of this research project is to explore the impacts of servitization challenges on business performance and how they are different in servitized businesses with different strategic focuses. In so doing, a three-step methodology was used. First, a systematic literature review (SLR) was conducted on the servitization challenges, leading to the establishment of a theoretical model illustrating the underlying relationship between servitization challenges (described as organisational structure (OS), business model (BM), development process (DP), customer management (CM) and risk management (RM)), its benefits (in terms of strategic, financial and marketing) and the firm's performance. Following this, a sequential explanatory mixed method was adopted, in which the quantitative (survey) (2nd step) and the qualitative (case study) (3rd step) studies were conducted in a sequential manner. The quantitative survey plays a dominant role that aims to validate the theoretical model with the engagement of managerial representatives from UK-based servitized companies. After this, a qualitative case study was carried out, as a supplement, to further explain the survey findings and explore how servitization challenges manifest differently in servitized businesses with different strategic focuses.

This study generated two key findings:

- 1) The findings demonstrate that the servitized companies overcoming organisational structure (OS) and business model (BM) challenges have positive impacts on the firm's performance, while the impact of the other challenges is unsupported.
- 2) The study suggests that the manifestation of servitization challenges is different in servitized business with different strategic focuses. Particularly, those companies with the intention of supporting the customer's operation through integrated solutions face more challenges.

Overall, this study contributes to the advancement of servitization research by illustrating the performance implication of servitization challenges, and further advances our understanding of how different servitization types interact with the challenges.

1 INTRODUCTION

1.1 Chapter overview

This chapter provides a high level introduction to this doctoral thesis. It starts with a snapshot (section 1.2) of the project, which briefly introduces the research problem, aim, questions and methodological design. Following this, a summative table is embedded in this chapter to highlight the key elements of the thesis. Finally, the structure of the remainder of this thesis is presented (section 1.3).

1.2 A snapshot of this research project – research problem, aim, questions and design

Over past decades, there has been an industry trend that product-centric companies in developed countries attempt to integrate services, products, technologies and customer management (CM) to create better value for business customers (Bustinza et al., 2015). This trend is conceptualised as ‘servitization of manufacturing’ (Vandermerwe & Rada, 1988), which is driven by the changing needs of the market and, more importantly, the company’s intention to overcome the low-cost competition from developing regions (Neely, 2008). Given that servitization represents a broad selection of companies that integrate service and products, several research streams have stemmed from different literature in order to investigate the resultant offerings of servitization, such as support services (Goffin & New, 2001), product-service systems (PSS) (Tukker, 2004) and integrated solutions (Brady et al., 2005). These terms are broadly used by scholars to make a clear distinction among the various offerings provided by servitized companies.

The research progress in this area has been advanced steadily with contributions from multi-disciplinary research communities, mainly service marketing, service operations, and operations management (Baines et al., 2017). The understanding of servitization benefits has reached a consensus among scholars and practitioners, as it helps companies to secure a leading position in the market (strategic benefits) by generating stable revenues (financial benefits) and maintaining a long-term relationship with customers (marketing benefits) (e.g. Baines et al., 2010; Mathieu, 2001b). However, the challenges involved in the adoption of servitization require more research attention, as product-centric companies face various challenges in moving towards servitization and providing value in use for business customers.

Recent research investigates servitization challenges from different angles, and scholars have acknowledged that adopting a servitization strategy requires substantial changes in different parts of the businesses that may turn into significant managerial

issues (e.g. Lenka et al., 2018; Martinez et al., 2010). For instance, some researches focus on the BM evolvement of product-centric companies when shifting towards servitization, such as Kindström and Kowalkowski (2014) who explored the key elements of service innovation in product-centric companies through the lens of a BM, and identified a set of key resources and capabilities that are necessary for the company to support servitization. Barquet et al. (2013) adopt the concept of a BM canvas proposed by Osterwalder and Pigneur (2010) in their work that identifies the necessary changes in the business transformation, and concluded that providing complex service offerings triggers changes in most parts of the business. In addition, other studies investigate challenges from different perspective, such as the customer relationship (Kreye, 2017b) and DP (Burton et al., 2017). Servitization risks have attracted enormous attention since Neely (2008) emphasised that there are potential financial risks associated with servitization due to the fact that costly investments in business transformation may offset financial returns and destabilise financial performance. More recently, Benedettini et al. (2017) examined the likelihood of bankruptcy in servitized firms through the analysis of documented financial data, in which their conclusion indicates that simply expanding the service range does not necessarily increase the chance of business survival as the company needs to consider other firm-level contextual factors. In addition, scholars have sought to investigate the risks from an operational perspective. Nordin et al. (2011) conducted a study on the risks (operational and financial) of providing services (in terms of customization, bundling and range), and concluded that each of the services is associated with the different levels of risks. Hou and Neely (2017) focused on the risks of outcome-based contracts, in which they explored financial and operational risks from five dimensions (complexity, dynamism, capability, alignment and dependency) through multiple case studies. As a conclusion, they provided a resultant framework that demonstrates a comprehensive view of the risks of the outcome-based business.

Although prior studies have generated extensive findings on servitization challenges, they are mostly fragmented and focus on isolated issues (Baines et al., 2017; Raddats et al., 2018). This indicates a lack of comprehensive understanding of the servitization challenge and thus provides minimal practical implications to practitioners (Nudurupati et al., 2016). From a practical perspective, senior management should consider challenges from all aspects in order to achieve the successful adoption of servitization. More importantly, the impacts of servitization challenges on the realisation of its benefits and the overall firm performance remain unclear in the current literature, which forms the first research gap that the author seeks to address in this study.

Given that servitization is a broad context, containing variations at the offering and strategy levels, scholars have proposed many typologies to classify the different types of servitization. The majority of existing typologies are established based on the service offerings, such as Baines and Lightfoot (2013) classify services into the base, intermediate and advanced; Tukker (2004) argues that PSS can be adopted to different customer needs, such as product-oriented, solution-oriented and result-oriented. A few typologies have been developed according to the service strategy adopted by the product-centric companies, in which a known typology by Raddats and Kowalkowski (2014) classifies companies as the service doubter, pragmatist or enthusiast, based on how the firm uses services as a differentiation factor. This implies that a servitization strategy could be adopted in different ways in order to be incorporated within the business objective and, therefore, it is important to make a distinction between different servitization types when looking into the challenges (Raddats et al., 2018; Ziaee Bigdeli et al., 2018). Given that prior studies mainly focus on the advanced product-service provision, such as outcome-based contract (e.g. Barquet et al., 2013; Hou & Neely, 2017; Ng & Nudurupati, 2010), the interplay between servitization type and the associated challenges needs in-depth investigation, which forms the second research gap that the author seeks to address in this study.

To address these research gaps, this study aims *to explore the impacts of servitization challenges on business performance and how they are different in the servitized businesses with different strategic focuses*. The following RQs are supplementary for achieving the research aim (RA).

RQ1: How do servitization challenges affect the realisation of servitization benefits (strategic, financial, and marketing) leading to superior business performance?

RQ2: How are the challenges different in businesses with different strategic focuses (IS providers vs. PS suppliers)?

To answer the two RQs, this project adopts a three-step research methodology that consists of a systematic literature review (SLR), a quantitative survey and a qualitative case study. Through the SLR, a theoretical path model (Figure 2-6 in section 2.6.3) is established reflecting the author's hypothetical assumptions on the relationship among servitization challenges, associated benefits and overall business performance. This model includes nine constructs: five challenges (organisational structure (OS), business model (BM), development process (DP), customer management (CM) and risk management (RM)), three benefits (strategic benefits, financial benefits and marketing benefits) and one business performance. This model also underpins the empirical study, where a mixed-research method is conducted that starts from the

quantitative phase, as a dominant part, followed by the qualitative phase as complementary. This methodological design is termed a *sequential explanatory design* (Creswell & Plano-Clark, 2011) and is underlined by pragmatism as the overarching research philosophy in this study. Specifically, the quantitative phase is primarily conducted to answer the first RQ by validating the path model through a web-based survey. The quantitative data analysis is carried out following a standard procedure of partial least squares structural equation modelling (PLS-SEM), and the main output of this phase is a basic conceptual model (Figure 4-4 in section 4.6) which is established based on the data analysis results. This model illustrates the findings of the hypothesis testing which demonstrates how identified challenges affect its relevant benefits leading to an improved business performance. Furthermore, the qualitative phase is built upon the quantitative findings to further explain and explore the results through a multiple case study. The qualitative data analysis is conducted using the template analysis approach, and the findings help in addressing the two RQs. It firstly explains the unsupported relationship in the quantitative result, and then further explores how servitization challenges manifest in different types of servitized businesses. A refined conceptual model (Figure 6-2 in section 6.4) is developed based on the integrated findings of the two phases to highlight the novel contribution of this study.

This study contributes to the theory advancement in the servitization research area from three aspects. First, it develops a comprehensive view of servitization challenges by considering all variations of challenges in the existing literature through a standard SLR. Second, to the best of the author's knowledge, it is the first to examine the performance implications of various servitization challenges using a quantitative-dominant method, which uncovers the underlying relationship among the servitization challenges, its benefits and business performance. Third, it further advances the current understanding of how the challenges exhibit in different servitized businesses, through a multiple case study.

Table 1-1 serves as a preview of this thesis, which summarises some key elements covered in this document. The next section details the structure of the remainder of this thesis.

Table 1-1 Summary of key elements of this thesis

| |
|--|
| Research aim |
| To explore the impacts of servitization challenges on business performance and how they are different in the servitized businesses with different strategic focuses |
| Research questions |
| <i>RQ1: How do servitization challenges affect the realisation of servitization benefits (strategic, financial, and marketing) leading to superior business performance?</i> <i>RQ2: How are the challenges different in businesses with different strategic focuses (IS providers vs. PS suppliers)?</i> |
| Research design |
| <p><i>Step 1: Systematic literature review (SLR)</i></p> <ul style="list-style-type: none"> • A theoretical model (Figure 2-6 in section 2.6.3) is developed as a guiding framework for the empirical study to be built upon <p><i>*Step 2: Quantitative study</i></p> <ul style="list-style-type: none"> • Web-based survey (96 valid responses) • Unit of data collection: senior management/decision makers working in UK servitized companies (extra selection criteria applied) • Data analysis: partial least squares structural equation modelling (PLS-SEM) (Hair et al., 2016) <p><i>*Step 3: Qualitative phase</i></p> <ul style="list-style-type: none"> • Multiple case studies (13 interviews) • Unit of data collection: survey participants who have signed up for the interview • Data analysis: Template analysis (King, 2012) along with coding techniques (Saldaña, 2015) <p><i>(*The empirical study adopts an sequential explanatory design that is underlined by the pragmatic research approach)</i></p> |
| Final research output |
| A refined conceptual model (Figure 6-2 in section 6.4) is developed that captures primary insights from both the quantitative and qualitative studies. |

1.3 Structure of the thesis

Following this introductory chapter, Chapter 2 presents the theoretical framework that underpins this study. It starts with the review of key concepts in this study by introducing the basic definition of servitization, support services, Product Service System (PSS) and Integrated Solution (section 2.2). Next, the benefits of servitization are reviewed (section 2.3) following by an SLR on servitization challenges. The SLR is conducted following a standard procedure, which presents the detailed methodology, descriptive analysis and thematic analysis in a sequential manner (section 2.4). This supports the identification of the research gap, aim and questions, which are restated and reinforced in the LR chapter (section 2.5). To answer the two RQs, the SLR results are presented in two separate sections, and each provides a theoretical basis for answering the two RQs respectively. Section 2.6 demonstrates the development of theoretical hypotheses and the path model (this supports answering RQ1), and Section 2.7 presents a proposed typology for classifying servitized businesses with different strategic focuses (this supports answering RQ2).

Chapter 3 begins with the justification of the chosen research philosophy, where the author reviews the two common philosophical stances – positivism and interpretivism, and suggests that pragmatism would be an appropriate alternative, considering the nature of this study is practice oriented (section 3.2). Next, following a pragmatic approach, the adoption of a mixed method (sequential explanatory design) is justified in this study, where the quantitative phase (survey) is a priority and the qualitative phase (case study) is supplementary (section 3.3). After a general overview of the mixed method, two research phases are detailed in two separate sections (sections 3.4 & 3.5), which provide details of the research design, data collection, analysis and methodological rigour.

Chapter 4 presents the survey findings (quantitative phase), which begin with a recap of the theoretical model developed in the LR chapter to remind the reader about it (section 4.2), and then moves onto the results of data analysis. The author first examines the sample size (section 4.3), and continues by presenting the results of the descriptive analysis (section 4.4) and statistical analysis (section 4.5). The former shows the categorical information of survey participants to demonstrate their suitability for this study, and the latter reveals the results of hypothesis testing.

Chapter 5 provides the case study findings (qualitative phase), where the author primarily recaps the proposed typology in the literature review chapter to clarify the mechanism employed for classifying the participating companies into two groups – IS

providers and PS suppliers (section 5.2). After this, the findings of within-case analyses are presented in section 5.3, followed by a cross-case analysis in section 5.4.

Chapter 6 synthesises the findings of the two phases and discusses them with reference to the extant literature. Given that this study is quantitative survey dominant, the discussion chapter is structured around the relationship among the servitization challenges, benefits and business performance, and the qualitative findings are embedded in the discussion.

Chapter 7 provides a formal conclusion of this research project. It begins with a summary of key findings (section 7.2), and then discusses theoretical contributions (section 7.3) and managerial implications (section 7.4). Last, the limitations of this study are reflected upon, which leads to the development of a few suggested avenues for future research (section 7.5).

1.4 Chapter summary

This chapter provided a brief introduction to this research project by introducing the research gap, aim and questions, in which a tabulated table is provided to summarise key elements of this study. In addition, the detailed structure of this thesis is presented to provide a synopsis of the document.

2 LITERATURE REVIEW

2.1 Chapter overview

The purpose of this chapter is to provide a theoretical foundation that underpins this research project. Given that the main context of this research is servitization, this chapter starts by searching for proper definitions of servitization and its relevant concepts (section 2.2) to provide the reader with a clear understanding of terminologies used in this study. After this, the next two sections focus on the literature around the servitization benefits (section 2.3) and challenges (section 2.4) to review what has/has not been discovered in existing studies. This supports the existence of research gaps and leads to the development of an RA and two supplementary RQs (section 2.5). Finally, the last two sections (sections 2.6 & 2.7) form a theoretical basis towards each RQ respectively. Figure 2-1 illustrates the structure of this chapter.

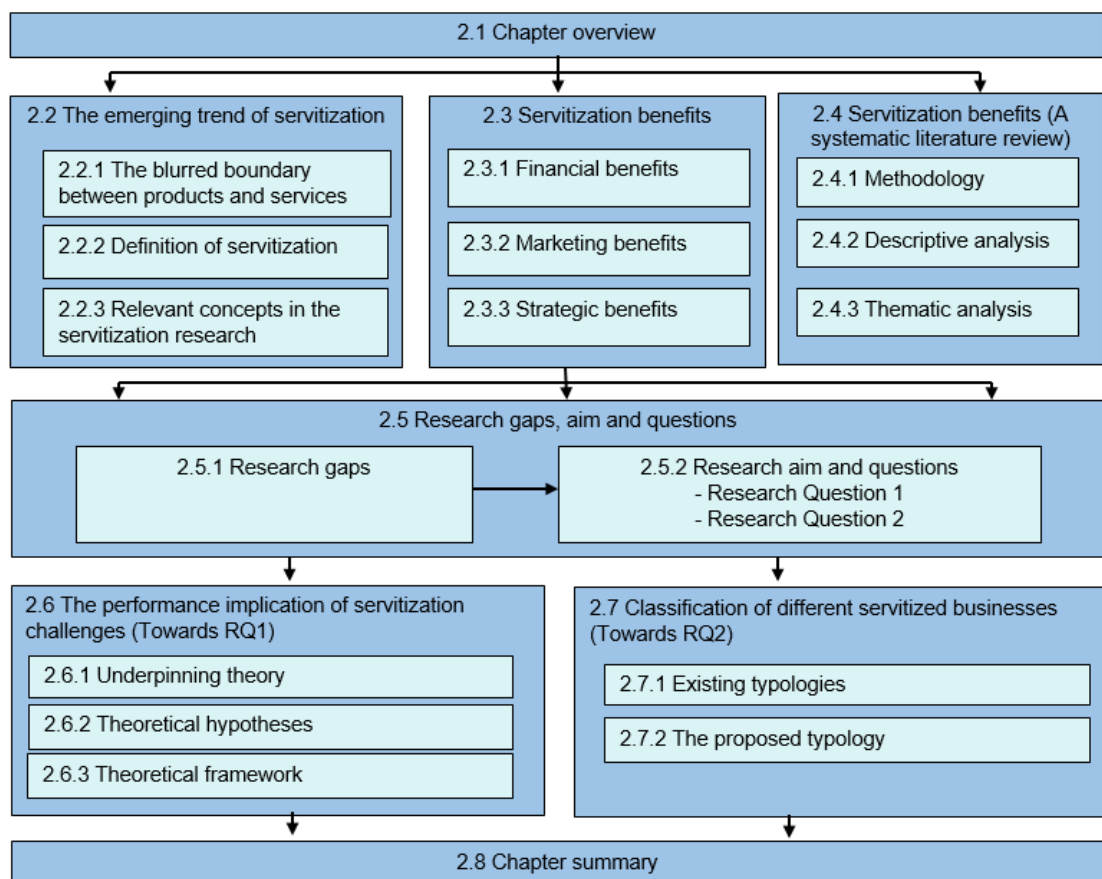


Figure 2-1 The structure of the literature review chapter

2.2 The emerging trend of servitization

2.2.1 The blurred boundary between products and services

There are two fundamental business concepts in the manufacturing context – products and services – whose definitions have been clearly distinguished and shared by the wider community over past centuries.

Adam Smith (1776), the world-famous economist, gave the earliest definition of the product. He asserted that the product retains the key characteristic of exchangeability, and that its ownership can be quantified and exchanged in the market place. Later on, Senior (1836) defined the product from a concrete view, where he claimed that the product is made by tangible materials and the dimension is measurable. The two definitions were adopted for nearly a century, until Hill (1999) summarised the key elements of the product, in which it is an independent entity and its physical attributes could be preserved over its lifetime. This closed the debate on the product definition. However, on the other hand, the debate on defining the service is still ongoing, where the concept has evolved as the economy developed. Yet a set of service attributes has been identified in the current literature, reflecting its differences from the product (Fitzsimmons & Fitzsimmons, 2000; Parry et al., 2011).

- **Intangibility:** Services are predominantly performance of actions rather than physical objects that can be perceived through the physical senses
- **Heterogeneity:** The service performance is subject to variability as its delivery relies on human interactions
- **Simultaneity of production and consumption:** Services are produced and consumed at the same time
- **Perishability:** Services cannot be saved or stored as products, they have to be consumed during the production

Since the late 19th century, the boundary between products and services has been gradually vanishing in the manufacturing industry, as most companies have realised that providing products is not enough to survive both in the business-to-business (B2B) and business-to-customer (B2C) markets. Particularly the rising global supply chain has led to a more competitive market, where product-centric companies in developing countries gained more businesses through the advantages of low cost labour and materials (Neely, 2008). To survive the competition, product-centric companies in developed regions need to reposition themselves by moving beyond product manufacture and expanding service portfolios to create more value for customers (Penttinen & Palmer, 2007).

Figure 2-2 illustrates the evolution of product and service definitions over the past 240 years, where an emerging trend of 'servitization' is reflected throughout the timeline. Since Smith (1776) first introduced his definition of the product, the work since then has been focused on distinguishing products and services from different dimensions (Hicks & Hart, 1942; Say & Biddle, 1851; Senior, 1836; Shostack, 1977), until Levitt (1969), a well-known professor in the Harvard Business School, stressed that there is a declining trend in product demand as customers tend to look for an integrated system of products and services. His famous quote '*people don't want to buy a quarter-inch drill. They want a quarter-inch hole*' has been widely referred to when introducing the notion of servitization. It implies that the boundary between products and services has vanished. From 2000 onwards, plenty of researches were carried out by looking into different aspects of servitization in order to advance our understanding of the area.

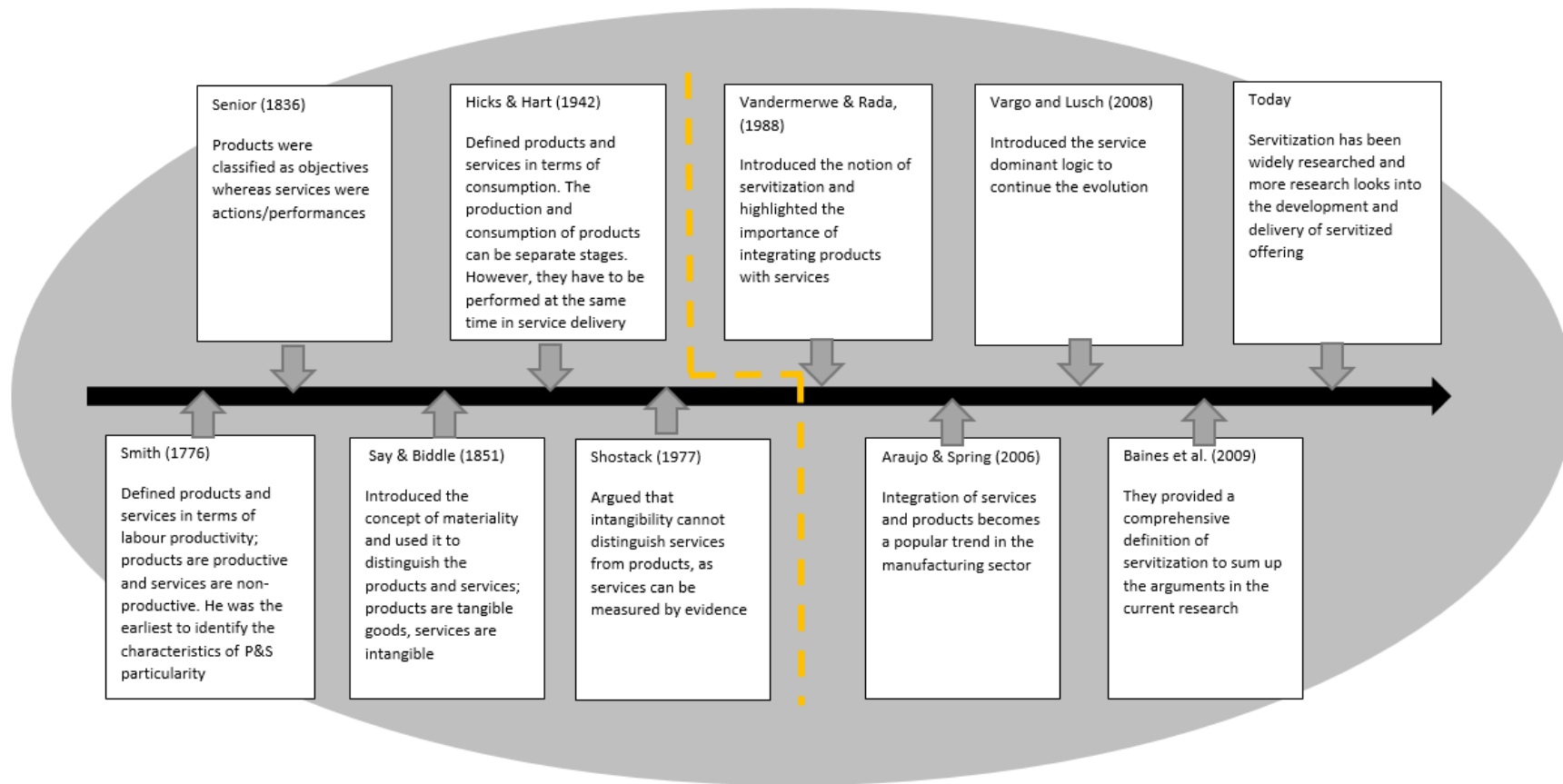


Figure 2-2 The emerging trend of servitization

2.2.2 Definition of servitization

The concept of servitization was first coined by Vandermerwe and Rada (1988) who defined it as a comprehensive offering that fulfils customer demand through a 'bundle' of products, services, knowledge, support and self-service to achieve value adding within the offering. Building on this, the conceptualisation has evolved with contributions from different scholars. Table 2-1 is a summary of different viewpoints.

Table 2-1 Definitions of servitization

| Author(s) | Definitions of Servitization |
|-----------------------------|---|
| Vandermerwe and Rada (1988) | "Market packages or 'bundles' of customer-focussed combinations of goods, services, support, self-service and knowledge" |
| Robinson et al. (2002) | <i>Moving towards servitization</i> "goes beyond the traditional approach of providing additional services but considers the total offer to the customer as an integrated bundle consisting of both the goods and the services" |
| Desmet et al. (2003) | "A trend in which manufacturing firms adopt more and more service components in their offerings" |
| Lewis et al. (2004) | "Any strategy that seeks to change the way in which a product functionality is delivered to its markets" |
| Ren and Gregory (2007) | "A change process wherein manufacturing companies embrace service orientation and/or develop more and better services, with the aim to satisfy customer's needs, achieve competitive advantages and enhance firm performance" |
| Neely (2008) | "Servitization involves the innovation of an organization's capabilities and processes so that it can better create mutual value through a shift from selling product to selling Product Service Systems (PSS)" |
| Baines and Lightfoot (2009) | "Servitization is the innovation of an organisation's capabilities and processes to better create mutual value through a shift from selling product to selling Product Service Systems (PSS)" |

The definition given by Baines and Lightfoot (2009) has been widely adopted, implying that a consensus has been reached among scholars. To build on this definition, the servitization is defined as follows in this thesis to reflect the author's understanding.

Servitization is an overarching strategy that is adopted by the product-centric company to align its business objective to the customer needs, through which the company delivers value-in-use for business customers through an integration of products, services, technologies and customer interactions.

As servitization has been growing rapidly in the industrial sector, an increasing number of researches have been conducted which looked into different aspects of servitization (Lightfoot et al., 2013). In the servitization literature, various research streams were

further developed to explore different types of industrial offerings, such as support services (Goffin & New, 2001), Product Service System (PSS) (Goedkoop et al., 1999; Mont, 2002; Tukker, 2004) and Integrated Solution (IS) (Brady et al., 2005; Davies, 2004; Storbacka, 2011). The following section provides a brief introduction to the concepts in order to illustrate their relevance to the servitization research.

2.2.3 Relevant concepts in the servitization research

2.2.3.1 Support services

Support services refers to add-on services that support the functional use of products, such as repair, overhaul and maintenance (Baines & Lightfoot, 2013; Goffin & New, 2001). These services are offered in parallel with products to facilitate the product sales process, including before sales (demonstration), during sales (finance) and after-sales (warranty and maintenance) (Spring & Araujo, 2009).

Support services represent the most common form of servitization in product-centric companies. A study by Wiesner et al. (2015) found that there are four types of interactions between product and service life cycle management (LCM) in product-centric companies. Type A refers to the condition in which service LCM is entirely dependent on the product LCM, meaning any changes in the product LCM have a significant effect on the service LCM. Type B is entirely opposite to type A as the service plays a dominant role in the business, and any changes to the service can affect the product. Type C refers to the close alignment between the product and service LCM, in which they are equally important and the interaction happens only when it is necessary. Type D represents an integrative form of product and service, in which LCM involves the highest level of interactions between them. In the light of this, the support services mainly refer to types A and C in real businesses, depending on different types of companies, as some of them would keep the product business as the core part and some companies would increase the service business to an equivalent portion as the product business. Type B refers to service-dominant businesses that use products as a mean of value realisation. Last, type D demonstrates a more complex product service provision, such as the Product Service System (PSS) and Integrated Solution (IS).

2.2.3.2 Product Service System (PSS)

The PSS has grown into a critical research stream in servitization research, which is driven by enormous attention being given to sustainable production and consumption. It is argued that PSS is beneficial to the circular economy as it significantly contributes to financial, social and environmental development (Annarelli et al., 2016). With this in

mind, it is defined as 'a system of products, services, supporting networks and infrastructure that is designed to be: competitive, satisfy customer needs and have a lower environmental impact than traditional business models' (Mont, 2002).

Table 2-2 summarises the extant definitions of PSS that highlight three key characteristics: system integration, value proposition and ecological sustainability (Annarelli et al., 2016). In terms of system integration, it reflects the nature of servitization of bundling products and service into an integrated system (Meier et al., 2010; Tukker, 2004). With respect to the value proposition, scholars have stressed that PSS offers better value than traditional products/services, as it can directly address customers' needs (Goedkoop et al., 1999; Manzini et al., 2001) through greater interactions between the product and service LCM to provide an outcome/result agreed by both the company and customer (Wiesner et al., 2015). From an environmental perspective, the PSS could reduce the negative commercial effects on the environment by improving in-use efficiency and through prolonging the life of products (Manzini et al., 2001; Tukker, 2015).

Table 2-2 The definitions of PSS

| Author(s) | Definitions of PSS |
|-------------------------|--|
| Goedkoop et al. (1999) | "A marketable set of products and services capable of jointly fulfilling a user's need. The PSS is provided either by a single company or by an alliance of companies. It can enclose products (or just one) plus additional services. It can enclose a service plus an additional product. And product and service can be equally important for the function fulfilment." |
| Manzini et al. (2001) | "A business innovation strategy offering a marketable mix of products and services jointly capable of fulfilling clients' needs and/or wants - with higher added value and a smaller environmental impact as compared to an existing system or product." |
| Tukker (2004) | "A system consisting of tangible products and intangible services designed and combined so that they jointly are capable of fulfilling specific customer needs." |
| Baines et al. (2007) | "A market proposition that extends the traditional functionality of a product by incorporating additional services." |
| Meier et al. (2010) | "An Industrial PSS is characterized by the integrated and mutually determined planning, development, provision and use of product and service shares including its imminent software components in Business-to-Business applications and represents a knowledge-intensive sociotechnical system." |
| Annarelli et al. (2016) | "PSS is a business model focused toward the provision of a marketable set of products and services, designed to be economically, socially and environmentally sustainable, with the final aim of fulfilling customer's needs." |

2.2.3.3 Integrated solutions (IS)

The solutions literature is another important research stream in servitization research, which has gained increasing attention in the marketing domain, in which scholars have looked into the concept from two aspects: 1) customer/business solution in a B2C context (Storbacka, 2011; Storbacka et al., 2009, 2013; Tuli et al., 2007); and 2) integrated solution in a B2B context (Brady et al., 2005; Davies, 2004; Visintin, 2012; Windahl & Lakemond, 2006, 2010). Table 2-3 shows extant definitions of the solution from key authors in the research area. Although the definitions are varied, depending on authors' beliefs, two similarities are identified from the list: 1) the nature of the solution is similar to the PSS, as it embraces the notion that an integrated system of products, services, knowledge and CM provides better value for customers; 2) the solution can be tailored to meet different customers' needs, which helps to address the operational challenges through customizable solutions.

Given that this study mainly focuses on the B2B context, the definition by Storbacka (2011) is adopted, which defines the integrated solution (IS) as 'a longitudinal relational process, during which a solution provider integrates goods, service and knowledge components into unique combinations that solve strategically important customer specific problems, and is compensated on the basis of the customer's value-in-use'.

Table 2-3 The definitions of solutions

| Author(s) | Definitions of solutions |
|-----------------------------|---|
| Galbraith (2002) | "A recent trend in business strategy is to offer solutions to customers instead of stand-alone products. The companies following a solution strategy bundle their products together and add software and services." |
| Brady et al. (2005) | The manufacturers shift their "strategic focus" from providing individual products or services to providing solutions. |
| Sawhney (2006) | "I define a solution as an integrated combination of products and services customized for a set of customers that allows customers to achieve better outcomes than the sum of the individual components." |
| Tuli et al. (2007) | "A set of customer-supplier relational processes consisting of customer requirements definition, customization and integration of products and services, their deployment and post-deployment customer support, all of which are aimed at meeting customers' business needs." |
| Nordin & Kowalkowski (2010) | "A bundle of products, services, and software, which can solve customer-specific problems, and are relatively broad and complex offerings focused not only on technical integration but also on the total usage context." |

2.2.3.4 *Servitized offerings/companies*

The servitized offering has been used as a general term to represent the provision of product-service combinations. The relevant concepts discussed in the previous sections are covered by this terminology, meaning the servitized offering in this thesis refers to the support services (e.g. maintenance, overhaul, repair and service contract), PSS and IS. In the light of this, the servitized company in this thesis refers to the product-centric companies that have shifted towards servitization, and they provide a broad range of servitized offerings, including support services, integrated solutions, PSS or mixed offerings.

To help the reader understand the idea of PSS and IS, Table 2-4 provides some real life examples from different sectors. The 'Power by the hour' offered by Rolls Royce is a predominant industry example, in which the airline pays for the flying miles delivered by aero engines for a fixed price, and the provider is taking full responsibility for aero engine and supplementary services, including, but not limited to, the maintenance, repair and overhaul. Adopting this BM creates more benefits and challenges to the provider, which are discussed in the following sections.

Table 2-4 Real life example of IS/PSS (Ahamed et al., 2013; Davies, 2004; Leoni, 2015)

| Company | Integrated solution/PSS |
|---------------------|---|
| Rolls Royce | 'Power by the hour': Aero engines are leased to the customers for an agreed contractual period during which the company is fully responsible for the operation of the engines. |
| Xerox International | 'Pay per paper' offering: Products are sold guaranteeing a fixed price per copy from products/processes designed for remanufacturing. |
| MAN Truck and Bus | 'Fixes the cost per kilometre': The company shifted the BM from a truck manufacturer to a solution provider through the Total Cost Ownership (TCO) approach to deliver a tailored bundle of products and services to meet business customers' requirements. |
| Alstom Transport | Transport solutions (e.g. train availability): 'Total Train Life Management' comprises both products and services to ensure the availability of the train. |

2.3 Servitization benefits

A wide consensus has been reached among academics and industrial practitioners that adopting a servitization strategy reinforces the competitive advantage of the product-centric company (Gebauer et al., 2011; Raddats et al., 2016; Slack, 2005). Particularly, offering servitized offerings creates an additional channel for generating stable revenues (financial benefits) (Brax, 2005; Malleret, 2006; Oliva & Kallenberg, 2003), establishes long-term relationships with business customers (marketing benefits) (Mathieu, 2001a; Penttinen & Palmer, 2007), and secures a leading position in the competitive market (strategic benefits) (Fang et al., 2008; Fischer et al., 2012; Martinez et al., 2010; Matthyssens & Vandenbempt, 2010). The following sections look into these benefits in turn.

2.3.1 Financial benefits

From a financial perspective, there are several benefits that have been identified in the current literature. First, expanding service business in product-centric companies creates an additional revenue stream in addition to the existing product business (Mathieu, 2001a; Raddats et al., 2016). Second, the service revenues are more stable, considering the regular market demand, which helps companies to survive the stagnating product business (Eggert et al., 2011). This is because the service demand is often regular and some servitized offerings, such as PSS and IS, are contracted on a long-term basis that contributes to the stability of financial performance (Malleret, 2006). Third, generating more service revenues balances the impact of economic cycles on the product business, such as leveraging expensive production costs caused

by fluctuating prices for raw materials and potential increases in labour costs (Gebauer & Fleisch, 2007).

2.3.2 Marketing benefits

Marketing benefits are generally understood as providing servitized offerings, allowing the company to engage with customers on a long-term basis (e.g. Fang et al., 2008; Malleret, 2006). Customer engagement enables the company possessing a solid understanding of its customers' operational challenges and to respond to them effectively, which contributes to an increased level of customer satisfaction (e.g. Brax & Jonsson, 2009; Martinez et al., 2010). To provide solution-oriented servitized offerings, some companies engage with customers as value co-creators, which potentially builds a cooperative brand image for engaging with more business customers in future business development (Brax & Jonsson, 2009; Malleret, 2006).

2.3.3 Strategic benefits

Apart from the financial and marketing benefits, it is evident that servitization provides strategic benefits to the product-centric business (Baines & Lightfoot, 2009; Eloranta & Turunen, 2015). Scholars claim that providing servitized offerings allows the company to be differentiated from rivals as service elements are unique, human dependent and hard to be imitated (Gebauer & Fleisch, 2007; Gebauer et al., 2006; Oliva & Kallenberg, 2003). Moreover, given that product manufacturers in developing countries have massively expanded with low-cost competitive advantage in the global supply chain, companies in the developed regions must escalate the value chain to overcome the low-cost competition (Baines & Lightfoot, 2009; Gebauer & Fleisch, 2007). This provides better value for customers and, more importantly, establishes some barriers for competitors in the same market (Mathieu, 2001b; Raddats & Easingwood, 2010; Vandermerwe & Rada, 1988). In addition, engaging customers in the servitized business and collaborating with them would advance the technical development through iterative feedback (Brax & Jonsson, 2009) and allow the company to better understand the product performance through customer interactions (Goffin & New, 2001). These benefits are beneficial for business survival in the fierce competition that directly contributes to overall firm performance (Zhang & Banerji, 2017).

Table 2-5 summarises the formal constructs and indicators of servitization benefits.

Table 2-5 Summary of servitization benefits

| | Servitization benefits | References |
|--------------------|---|--|
| Financial benefits | Creates additional sources of revenue | Johnstone et al. (2009), Malleret (2006), Mathieu (2001b) Oliva & Kallenberg (2003), Penttinen & Palmer (2007), Raddats et al. (2016), Slack (2005) |
| | Generates sustainable income | Brax & Jonsson (2009), Eggert et al. (2011), Gebauer, (2008) Malleret (2006), Oliva & Kallenberg (2003), Raddats et al. (2016), Raddats & Easingwood (2010), Slack (2005), Spring & Araujo (2009) |
| | Balances the effects of economic cycles on the product business | Gebauer (2008), Gebauer & Fleisch (2007), Johnstone et al. (2009), Raddats & Easingwood (2010), Slack (2005) |
| Marketing benefits | Responds to the business customer needs (B2B) | Brax & Jonsson (2009), Martinez et al. (2010), Oliva & Kallenberg (2003), Raddats & Easingwood (2010) |
| | Gains sufficient knowledge on customers and increases customer satisfaction | Brax & Jonsson (2009), Johnstone et al. (2009), Mathieu (2001b), Vandermerwe & Rada (1988) |
| | Retains long-term relationship with customers | Fang et al. (2008), Johnstone et al. (2009), Malleret (2006), Mathieu (2001b), Penttinen & Palmer (2007); Slack (2005) Vandermerwe & Rada (1988) |
| | Creates a corporate brand image | Brax & Jonsson (2009), Malleret (2006) |
| Strategic benefits | Retains sustainable competitive advantage | Gebauer (2008), Martinez et al. (2010), Matthyssens & Vandenbempt (2010), Oliva & Kallenberg (2003), Raddats et al. (2016) |
| | Product differentiation | Cusumano et al. (2015), Johnstone et al. (2009), Malleret (2006), Martinez et al. (2010), Mathieu (2001b); Matthyssens & Vandenbempt (2010), Oliva & Kallenberg (2003), Raddats et al. (2016), Vandermerwe & Rada (1988) |
| | Sets barriers for competitors | Fang et al. (2008), Mathieu (2001b), Raddats & Easingwood (2010), Vandermerwe & Rada (1988) |
| | Overcomes low-cost competition | Fischer et al. (2012), Visnjic & Van Looy (2013) |
| | Gathers feedback for further development of technical expertise | Brax & Jonsson (2009), Goffin & New (2001) |

Although adopting servitization provides the product-centric companies with various benefits, the extant research indicates that the business transformation involves different types of challenges which may be preventing the expected benefits (e.g. Alghisi & Saccani, 2015; Burton et al., 2017). To understand servitization challenges, an SLR is conducted in the next section to explore the formal construct of the challenges and its performance implication, which then establishes theoretical grounds for achieving the RA of this study. Through the SLR, the existence of the research gaps that are reinforced later in this study are supported. More importantly, a theoretical framework that underpins the empirical study is developed as a key result of the SLR.

2.4 Servitization challenges – A systematic literature review

To gain a complete understanding of the challenges, an improved SLR procedure is adopted to analyse the existing literature and understand ‘what is known and not known’ in the servitization research (Denyer & Tranfield, 2009). The following sections present the SLR methodology and the results of the descriptive and thematic analyses.

2.4.1 Research methodology

A rigorous SLR approach is used to locate all existing papers that are potentially relevant to the topic. Figure 2-3 illustrates a standard procedure based on Denyer and Tranfield (2009) with an integration of a citation network analysis (CNA) (Van Eck & Waltman, 2010) to discover the knowledge flow of the servitization literature.

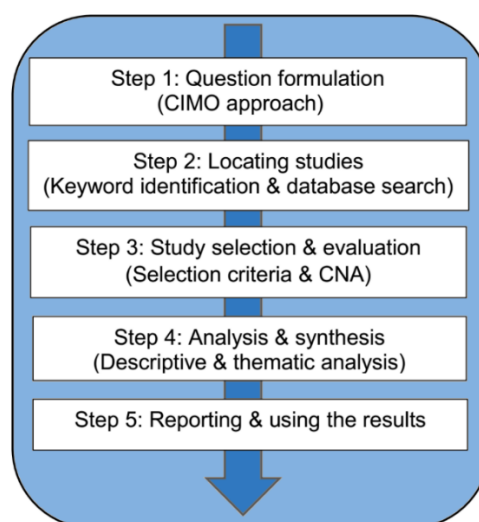


Figure 2-3 Improved five step SLR procedure (Zhang & Banerji, 2017, p. 218)

2.4.1.1 Step 1: Question formulation

The ‘CIMO’ (context, intervention, mechanism and outcomes) approach was adopted to facilitate the question formulation. According to the CIMO logic, the main context (C) of this study is the challenges facing the product-centric companies during the adoption of a servitization strategy. Within this context, the interventions (I) are the implications of servitization challenges for firm performance, and the mechanism (M) of interest is the exploration of main constructs and indicators of the challenges. The expected outcome (O) of this SLR is an established theoretical framework for guiding the empirical study. Two general questions are proposed to guide the SLR:

1. How can servitization challenges be defined?
2. How do they affect the realisation of servitization benefits (strategic, financial, and marketing) leading to improvement in business performance?

2.4.1.2 Step 2: Locating studies

The search engine and search strings were determined in advance to locate relevant studies on the topic. Three reliable databases were used: ProQuest, Scopus, and ScienceDirect. They are widely acknowledged as world-leading academic sources in servitization research (Annarelli et al., 2016; Eloranta & Turunen, 2015; Lightfoot et al., 2013; Nudurupati et al., 2016), which should provide sufficient coverage of the topic.

The keywords were identified using the 'brainstorm' approach. A set of 20 keywords were identified initially and then they were reduced to eight key terms (Table 2-6) after several pre-tests on the search results. Overall, 1187 papers were located for further evaluation using the defined key terms and search engines shown in Table 2-6. A citation network, shown in Figure 2-4, was constructed using the search results to identify the papers that would contribute significantly to this research area, and extend the reading list through a 'snowballing' approach (identifying relevant references in key papers). Each node in the citation network represents a single paper, the bigger the size, the more important the paper. The importance of the paper is determined by its citation frequency, which the big node indicates that the paper is highly referenced in the existing literature. This effectively detects the leading scholars in the research community. The line and distance between circles show the linkage among papers – the closer the distance, the stronger the connection. The different colours indicate the cluster of studies based on the bibliography coupling links (multiple items citing the same study), illustrating an overview of connections among papers. This helps to understand how the servitization research has evolved over time.

Table 2-6 Search strings and results (Zhang & Banerji, 2017, p. 218)

| Search engine | Key terms | Additional criteria | Result |
|---------------------------------------|---|---|------------|
| ProQuest (654 initial search) | (servitization* OR servitisation* OR servicing* OR servicing*) AND (challenge* OR difficulty* OR barrier* OR obstacle*) | Search in all fields, full-text available, peer-reviewed, English, 1994-2016 (the earliest available year is 1994), search from all databases | 230 |
| Scopus (119 initial search) | (servitization* OR servitisation* OR servicing* OR servicing*) AND (challenge* OR difficulty* OR barrier* OR obstacle*) | Article title, abstract & keywords, journal article, English, 1988-2016 | 46 |
| ScienceDirect (414 initial search) | (servitization* OR servitisation* OR servicing* OR servicing*) AND (challenge* OR difficulty* OR barrier* OR obstacle*) | Search in all fields, article only, 1988-2016, search in all journals | 355 |
| Total: (1187 initial search) | | | 631 |

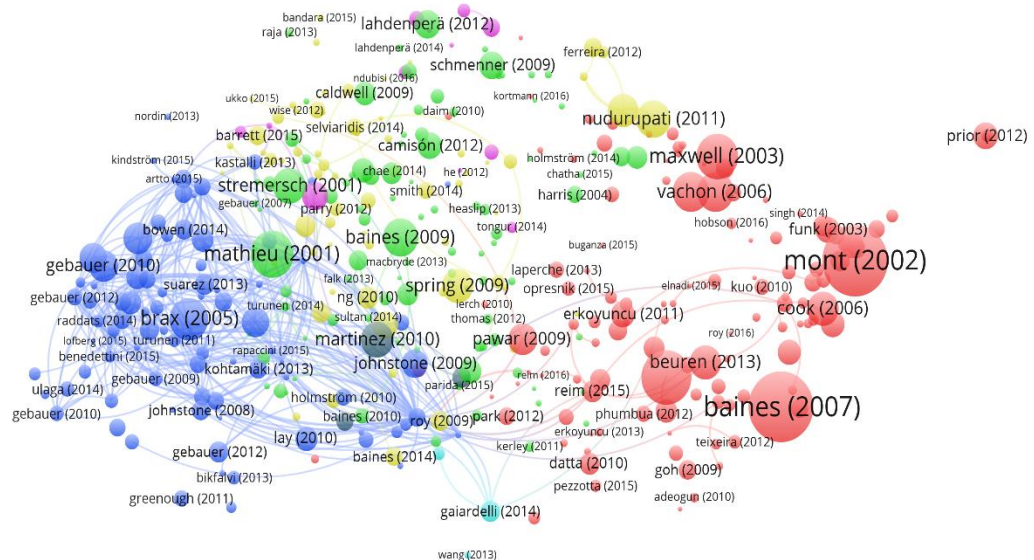


Figure 2-4 Citation network (Zhang & Banerji, 2017, p. 219) (N=1187)

2.4.1.3 Step 3: Study selection and evaluation

To narrow down the coverage, a set of additional search criteria, as shown below, were used to screen high quality papers, and the paper number was reduced to 631 (see Table 2-6).

- Theme — the papers had to be related to the servitization of manufacturing or service provision of product-centric companies in a B2B context;
- Time range — the papers had to be published in the period 1988-2016;
- Language — the papers had to be written in English;

- Journal type — the papers had to appear in peer-reviewed journals and be available in full-text.

In addition, a set of subject matter selection criteria, shown in Table 2-7, as proposed by Wong et al. (2012) was applied in the full paper review, in which the paper was categorized according to the primary research method and the research focus. Besides, each paper was assessed (ranked from 0 – absence, to 3 - high) with respect to the key contribution, theory, methodology, and data analysis (Wong et al., 2012). In total, 48 papers were used for the final analysis.

Table 2-7 Subject matter selection criteria (Wong et al., 2012)

| Paper type | Must contain |
|------------------------|--------------------------------------|
| Conceptual/theoretical | Challenges and arguments |
| Empirical | Challenges and empirical evidence |
| Methodological | Causal relationship among challenges |

2.4.1.4 Step 4: Analysis and synthesis

The descriptive and thematic analyses were conducted subsequently as described in the following sections. The former used a deductive approach in that the paper was classified according to year, methodology, research theme and country, while the latter followed an inductive approach to identify key contracts and indicators of the challenges. Specifically, the thematic analysis identifies and clusters emerging challenges of servitization using the qualitative coding techniques. The selected papers were reviewed and coded according to the emerged themes, where challenging factors were firstly identified and then categorised into a series of challenging constructs. For instance, regarding the organisational structure (OS) challenges, we identified the challenging factors such as inter-departmental collaboration and change of mindset according to the current literature and used them as codes to analyse the selected papers. With the coded papers, we identified all the relevant challenging factors and clustered them into different types of challenges.

2.4.1.5 Step 5: Reporting and using the results

The results of the SLR have been published in the form of a journal paper in 2017 in *Industrial Marketing Management (IMM)*, which provides its earliest access to both academic and industrial audiences. In addition, this SLR comprises a key part of this Literature Review chapter that constitutes a theoretical foundation of this doctoral thesis.

2.4.2 Descriptive analysis

The resultant publications cover the time range from 1988 to 2016 (see Figure 2-5), as the concept was initially coined in 1988. In the first 10 years, the research mainly focused on the conceptualisation but little research focused on the challenges. Later the topic started to capture attention from 1999 to 2007 with a few publications per year. Until 2008, relevant publications were increased for two years and reached their first peak (seven publications per annum) in 2010. However, a declining trend appeared and the annual average dropped to two publications. This might be as researchers reached a bottleneck period followed the boom period in the previous year, especially 2009 and 2010. After that, the trend bounced back in 2013 and a repetitive trend has been maintained to 2016. This time horizon implies that the research on servitization challenges went through two phases. First, from 2008 to 2010, the extant research focuses on generic challenges facing servitized businesses. Two, mostly acknowledged, publications by Baines and Lightfoot (2009) and Martinez et al. (2010) explored the challenges from a broad viewpoint using a qualitative study. Second, since 2013, scholars have directed their attention towards the isolated challenges to gain a deeper understanding of different areas.

With respect to methodological choice, the qualitative research method was dominant in this area, where more than half the publications adopted the literature review (25%), case study (38%) and interview (21%) as the main research methods. This indicates that this research area has remained at an exploratory stage, which signifies a lack of theory advancement. To move forward, a quantitative research approach is necessary to further advance the research area by verifying the established theory (Kowalkowski et al., 2017).

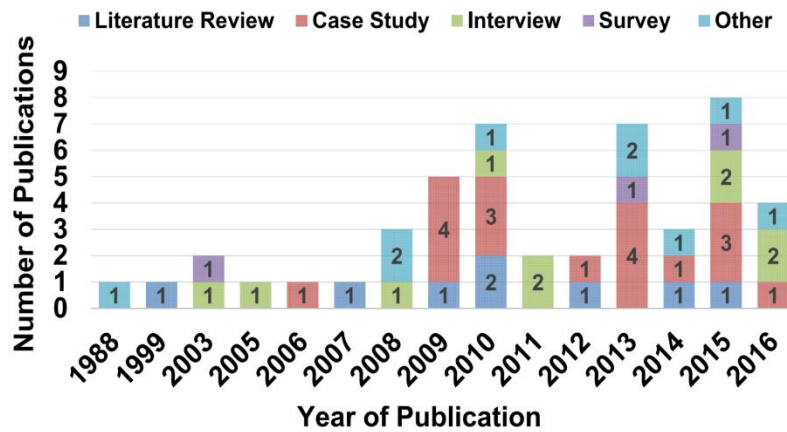


Figure 2-5 Analysis of papers based on publication year and research methods (n=48) (Zhang & Banerji, 2017, p. 220)

Table 2-8 classifies the paper according to the ABS (Association of Business Schools) journal type, which includes 28 different journals. This shows the diversity of research interest on the topic. About half of the journals are in the category of Operations and Technology Management, showing a strong focus on operations management and technological innovation. However, *Industrial Marketing Management* in the marketing domain made the most contributions, in which eight papers were published. This journal focuses on the theoretical and empirical studies within the B2B industrial market, which is in line with the servitization research that looks into how servitized companies are competing through integrated offerings to survive in the global market and increase customer loyalty (Brax, 2005; Johnstone et al., 2009; Oliva & Kallenberg, 2003).

Table 2-8 Analysis of papers according to the ABS journal type (n=48) (Zhang & Banerji, 2017, p. 221)

| Journal type | No. of publication | References |
|---|--------------------|---|
| Operations and technology management | 23* | |
| International Journal of Operations and Production Management | 5 | Benedettini et al. (2015), Durugbo & Erkoyuncu (2016), Johnstone et al. (2009), Pawar et al. (2009), Reim et al. (2015) |
| Journal of Service Theory and Practice | 2 | Brax (2005), Nudurupati et al. (2016) |
| Proceedings of the Institution Of Mechanical Engineers part b: Journal of Engineering Manufacture | 2 | Baines et al. (2007), Baines, Lightfoot, & Kay (2009) |
| Business Process Management Journal | 1 | Trkman et al. (2015) |
| Journal of Manufacturing Technology Management (formerly "Integrated Manufacturing Systems") | 2 | Baines & Lightfoot (2009), Martinez et al. (2010) |
| Journal of Operations Management | 1 | Kastalli & Van Looy (2013) |
| Production Planning and Control | 1 | Alghisi & Saccani (2015) |
| Supply Chain Management: an international journal | 1 | Finne et al. (2013) |
| Operations Management Research: advancing practice through theory | 1 | Neely (2008) |
| Advances in Decision Sciences | 1 | Mo (2012) |
| CIRP Journal of Manufacturing Science and Technology | 1 | Datta & Roy (2010) |
| International Journal of Electronic Business Management | 1 | Lin et al. (2014) |
| Journal of Cleaner Production | 1 | Tukker (2015) |
| Journal of Engineering Design | 1 | Isaksson et al. (2009) |
| Research-Technology Management | 1 | Parida et al. (2014) |
| The Journal of High Technology Management Research | 1 | Li et al. (2015) |
| Marketing | 12* | |
| Industrial Marketing Management | 8 | Barquet et al. (2013), Benedettini et al. (2017), Kowalkowski et al. (2015), Matthyssens & Vandenbempt (2008), Raddats & Easingwood (2010), Salonen (2011), Storbacka (2011), Valtakoski (2017) |
| Journal of Business and Industrial Marketing | 2 | Kindström & Kowalkowski (2014), Zarpelon Neto et al. (2015) |
| Journal of Business-to-business Marketing | 1 | Homburg et al. (2003) |
| Journal of Marketing | 1 | Fang et al. (2008) |
| Sector studies | 7* | |
| Journal of Service Management (formerly IJSIM) | 5 | Hypko et al. (2010), Matthyssens & Vandenbempt (2010), Ng & Nudurupati, (2010), Nordin et al. (2011), Oliva & Kallenberg (2003) |
| Service Business | 1 | Finne et al. (2013) |
| The International Journal of Advanced Manufacturing Technology | 1 | Meier et al. (2010) |
| General management | 3* | |
| European Management Journal | 2 | Malleret (2006), Vandermerwe & Rada (1988) |
| Harvard Business Review | 1 | Wise & Baumgartner (1999) |
| International business | 2* | |
| Journal of East European Management Studies | 1 | Demeter & Szász (2013) |
| Journal of Applied Management and Entrepreneurship | 1 | Kinnunen & Turunen (2012) |
| Strategy | 1* | |
| Strategic Change | 1 | Barnett et al. (2013) |

Note*: The **bold number** indicates the total number of papers in each category.

With respect to the geographical distribution, scholars across five regions have contributed to the research. Overall, 89% of publications developed by authors are located in European countries, especially the UK. This is in line with the identified industrial trend that product-centric companies in developed countries are actively seeking opportunities to move up the value chain by adopting a servitization strategy, which offers local scholars more opportunities to work with industrial practitioners to understand their practical challenges. The rest of the publications were contributed by other countries, mainly the US, China and Brazil.

2.4.3 Thematic analysis

Through the SLR, five key challenges are identified and discussed in turn with reference to the current literature.

2.4.3.1 Organisational structure (OS)

OS refers to the management structure of roles and responsibilities within an organisation to support the implementation of the business strategy (Burgelman & Doz, 2001).

In the servitization research, the organisational literature mainly focuses on how the internal business structure is reconfigured to support the transformation. There are several challenges that have been explored in this area. First, the *shift of mindset (OS1)* from a product-oriented to a customer-oriented organisation is a critical challenge, as the value proposition offered by the company is changed from mainly supplying pure products to providing a bundle of products, services and knowledge (e.g. Kowalkowski et al., 2015; Martinez et al., 2010). This implies a significant change in the overarching strategy, internal process, design thinking and firm capabilities (Galbraith, 2002), as the 'goods-dominant logic' primarily focuses on the physical product as a core value carrier, whereas the 'service dominant logic' embraces that the value is delivered by 'doing something for customers' (Vargo & Lusch, 2008). However, servitizing companies often struggle to deal with employees' resistance to change that is caused by an unstable internal structure, ambiguous system, underdeveloped capability and low level of employee engagement (Bailey & Raelin, 2015; Bravo et al., 2015). A recent study by Lenka et al. (2017) highlights that there are four types of resistance in the servitized business: 1) the strategic resistance relates to the changes of overall business strategy and operation model; 2) the structural resistance links to the changes of OS and development of service business; 3) the culture resistance relates to the shift from selling product-centric offerings to solution-centric offerings; 4) the procedure resistance is due to the changes of extant DPs within the organisation to support the development of servitized offerings. This indicates that the servitization resistance at

both the organisational and individual level could significantly prevent the shift of business culture, which has grown into an OS challenge.

Second, *communication (OS2)* is vital to transmitting the concept and benefits of servitization to external customers and internal employees (Baines, Lightfoot, & Kay, 2009; Mathieu, 2001a). Given that servitized offerings are complex in nature, it is important that the provider retains effective communications with customers to promote value co-creation. However, prior studies emphasise that the communication is often not clear and insufficient, such as the customer needs to speak to several business units in the provider's side to obtain a clear understanding of the offering as the sales team may not be able to demonstrate the value of the offering (Alghisi & Saccani, 2015; Brax, 2005). Regarding the internal communication, a new 'language' should be developed to facilitate the understanding of servitization and servitized offerings, as employees may be confused about the concept of the 'service contract' and 'integrated solution' (Alghisi & Saccani, 2015; Baines et al., 2009). This would help employees from a manufacturing background to understand the servitization strategy, and especially enrich their understanding of how services and products are interacted in terms of their development and delivery.

Third, retaining *service expertise (OS3)* is vital to the servitized company, as the adoption of a servitization strategy requires a strong service mentality and professional skills to establish and maintain a stable customer relationship (Homburg et al., 2003). Given that the performance of servitized offerings is dependent on the service personnel, the lack of a service mentality and professional behaviour have negative impacts on the customer relationship and can certainly affect the cooperative reputation of the company (Brax, 2005).

Last, the *intra-departmental collaboration (OS4)* has been an obvious challenge as most servitized companies struggle to balance the product and the service business, where many conflicts emerge due to their different characteristics. Conflicts among the product and service orientations are manifested in the management of product and service business divisions (Kowalkowski et al., 2015; Storbacka et al., 2013; Windahl & Lakemond, 2010), which may result in a lower level of internal synergy when companies strive to achieve an outstanding performance in both areas (Lenka et al., 2018).

2.4.3.2 Business model (BM)

The BM has emerged as an important concept in the servitization literature as it helps scholars to understand the business logic of how servitized companies develop and deliver better value through an integrated system (Shafer et al., 2005; Teece, 2010). Osterwalder and Pigneur (2010) conceptualised the idea of BM as a set of core business areas, comprised of the customer segments, value proposition, key resources, key activities, key partners, customer relationship, channel, cost structure and revenue stream. The BM challenges in servitized businesses are viewed through the lens of the BM canvas (Osterwalder & Pigneur, 2010), from which we understand the challenges in the different areas.

From an overall perspective, the BM of a servitized company requires significant *modifications (BM1)* to facilitate the shift from selling physical products to servitized offerings (Kastalli & Van Looy, 2013; Kindström & Kowalkowski, 2014; Parida et al., 2014). As highlighted in OS challenges, the co-existence of the product and service orientations may trigger more internal conflicts that stem from the contradictory nature of the two businesses (Lenka et al., 2018). For instance, the product development and technological development are key to the product business, where the customer relationship is transactional-oriented. On the other hand, service innovation and human interactions are critical in the service business, where the customer relationship is relational-oriented. To combine both elements in a single BM, the company faces a huge challenge in addressing the conflicts (Ferreira et al., 2013). The following challenges specifically relate to different parts of the BM.

Value proposition (BM2) in a servitizing company changes from supplying physical goods where the product is a critical differentiation element, to providing the servitized offerings where the value in use is a critical differentiation element. The change of value propositions requires a solid understanding of customers' operational needs and challenges as servitized offerings provide a direct solution to customers' operational issues. However, if the provider is lacking in a clear understanding of customers this could result in the situation where the offered value proposition does not match the customers' needs (Barnett et al., 2013; Brax, 2005; Pawar et al., 2009). A prior study investigated this issue and the conclusion explains that the employees, who have been working in the product-centric company, need to take some time to reshape their role from a product supplier to a solution provider (Martinez et al., 2010), which clashes with their original understanding of value in a product-centric culture (Brax, 2005; Gebauer et al., 2012).

To support the delivery of servitized value propositions, the company needs to reconsider the *resource (re)alignment (BM3)* internally (Parida et al., 2014). This helps to restructure the firm's resources, integrating them to enhance the internal capabilities in order to support the value creation for customers and the transformation of the BM (Huikkola et al., 2016). From an operational perspective, establishing a service department's needs requires the recruitment of skilled professionals (Zarpelon Neto et al., 2015) For instance, Ulaga and Kohli (2018) emphasise that a product-centric sales force is a major barrier to moving towards servitization as selling products and services/solutions require different skillsets and individual traits, and the existing sales team may be resistant to the changes of sales mentality and approach. However, it is unrealistic that companies should double the sales force to support both areas, thus leveraging the resources to achieve operational efficiency is challenging (Barquet et al., 2013).

The *costing (BM4) and pricing (BM5)* mechanisms in the servitized company are different from those in the product-centric company. The cost of manufactured goods is straightforward and standard, whereas the cost of servitized offerings involves more business functions and assets, for which the calculation method tends to be more complicated. The same applies to the pricing. The servitized offerings are priced based on the actual value rather than the total operational costs, for which the former is higher than the latter (Barquet et al., 2013; Mo, 2012; Nudurupati et al., 2016). This always raises the likelihood of negotiations from the customer's side as their perception of value may be different from the provider's point view. In addition, the lack of an integrated costing and pricing system increases the uncertainties in the two areas, which needs further development to tackle this challenge (Malleret, 2006; Settanni et al., 2014).

Delivering servitized offerings requires a close *collaboration (BM6)* with customers and supplying partners (Bastl et al., 2012), which increases the level of the complexity of the supply chain (Chakkol et al., 2014). Based on the extant research on the servitized supply chain, a few challenges are identified. First, the supplying partner should be able to demonstrate a strong customer-centric mentality and service capability as the value is delivered through a bundled offering (Martinez et al., 2010; Oliva & Kallenberg, 2003). This may require the provider to re-establish the supply chain network as the previous partners in a product-centric business may not be capable of delivering servitized offerings. Second, delivering servitized offerings involves many financial and operational risks (the details are discussed in section 2.4.3.5), and sharing risks through predefined roles and responsibilities can be difficult due to the complexity of the business (Parida et al., 2014; Raddats & Easingwood, 2010). Rönnerberg Sjödin et

al. (2016) claim that delivering servitized offerings increases the level of role ambiguities among the actors involved in the business, which makes it difficult to identify the risk owner in the business and therefore affects the supplier relationship.

2.4.3.3 Development process (DP)

The DP is essential in the product-centric company that turns the conceptual design into the physical deliverable (Cooper & Edgett, 2012).

During the servitization, the companies face challenges in redeveloping the DP to *integrate (DP1)* services and products, as addressing the conflicting nature of two areas requires significant changes to the overall DP in order to bring them together (Baines & Lightfoot, 2009; Gebauer et al., 2010b). The traditional product DP comprises the stages from idea generation to manufacturing through iterative testing and prototyping (Cooper & Edgett, 2012), where the process lacks emphasis on the design, test and launch phases (Lightfoot & Gebauer, 2011). On the other hand, the service development takes a different approach that requires a structured process, a high level of customer engagement, where simply modifying the product DP is not adequate (Gremyr et al., 2010). Therefore, developing an integrated DP for the servitized offerings should be the top priority (Alghisi & Saccani, 2015; Baines, Lightfoot, & Kay, 2009; Kowalkowski et al., 2015) to build a connection between the new product and service development (Burton et al., 2017). However, the introduction of the integrated process that brings together these two different processes with different orientations may cause friction and prevent shifting towards servitization (Lenka et al., 2017).

Despite the integrated process, *a set of design tools, methods and techniques (DP2)* is necessary to facilitate the entire DP. Although the previous research proposed some design methods, there is no such holistic method that has been normalized and adopted in real practice (Baines et al., 2007; Nudurupati et al., 2016). Tukker (2015) pinpoints that a large number of studies have looked at the design aspect of servitized offerings, such as gathering customer feedback and assessing the commercial value of the offering, which neglects the practical perspective. With respect to the tools and techniques, they are mainly underdeveloped in the existing literature as well as in real practice, and therefore require further advancement (Nudurupati et al., 2016).

In the product-centric business, the *performance measurement (DP3)* is attached to the production cost, specification and delivery efficiency (Baines, Lightfoot, Peppard, et al., 2009), which is not appropriate for the servitized offerings. Unlike the product, the performance of servitized offerings is measured from a comprehensive point of view that considers the value in use as well as the quality of customer interactions (Gebauer

& Friedli, 2005; Ulaga et al., 2006). The extant product performance measurement does not consider the customer satisfaction and assessing the value in use is underexplored, thus a service or solution oriented performance measurement should be further developed to address this issue (Baines, Lightfoot, & Kay, 2009; Macdonald et al., 2011; Martinez et al., 2010).

Given that servitized offerings are driven by customer need, the *customer engagement (DP4)* is key to the DP. This is because the value in the product-centric business ('product-dominant' logic) is determined by the supplier, whereas the value of servitized offerings is mutually agreed by the provider and customer (Windahl & Lakemond, 2010). However, engaging customers in the DP has never been easy due to the existence of CM challenges (as addressed in the next section) (Brax, 2005; Kreye, 2017b). Besides, the intangible benefits of servitized offerings are unable to be demonstrated before consumption, implying the importance of engaging customers and putting together the right design of the offering (Demeter & Szász, 2013).

2.4.3.4 Customer management (CM)

CM focuses on building and retaining long-term relationships with customers. This research project investigates the servitization challenges in the B2B context, hence it focuses on the challenges involved in managing the business customer relationship.

The SLR identified several critical challenges in the servitization literature. First, the providers often find it challenging to match the value proposition to the *customer needs (CM1)*, as they rarely reach a mutual agreement on the perceived value. For example, Tuli et al. (2007) highlight that providers and customers interpret the value of an 'integrated solution' in a different way, i.e. providers perceive it as a bundle of products, services and knowledge to address customers' needs, while customers consider it as a relational process. Typically, the customers value the relational process as it comprises the procedures, methods, mechanisms and interactions that promote the value co-creation (Salonen, 2011). Moreover, Macdonald et al. (2016) reached a similar conclusion, in that customers in the solution business tend to assess value both from a collective and individual level, which imply operational efficiency as well as the relational interaction respectively. These also imply that the providers should work closely with customers to understand their business objectives, processes and challenges in order to meet their needs (Demeter & Szász, 2013; Kinnunen & Turunen, 2012; Matthyssens & Vandenbempt, 2008; Salonen, 2011). Second, the *non-transferrable ownership (CM2)* of products becomes a part of the servitized offerings as the business customers are contracted for access to or the performance of products (Windahl & Lakemond, 2010). In so doing, the customers may find the servitized

offering less appealing to them, as the product is potentially over-used/priced as a part of the offering (Lay et al., 2009) and they retain less control over the contracted period (Baines et al., 2007; Ng & Nudurupati, 2010).

Third, given that the servitized offerings are delivered by human resources, performance reliability is crucial to retain a *long-term relationship (CM3)* with customers. However, the performance of human operations involves many uncertainties that can easily destroy the relationship (Barnett et al., 2013; Homburg et al., 2003; Tukker, 2015). Barber and Strack (2005) claim that a human-intensive business needs to hire the right people, integrate them into the process and make them productive to secure success. Moreover, people management should be integrated as a part of the operational process rather than a simple support function by the human resources department (Barber & Strack, 2005). Furthermore, the relational uncertainties in the servitized business can increase the challenges of maintaining customer relationships, which stem from the provider's inability to 'predict and explain the business customer's actions' (Kreye, 2017b). Yang et al. (2017) claim that the supplier that retains a close relationship with customers is likely to increase conflicts, disagreement and opportunistic behaviour, which are caused by the increased dependence on customers' responsibility and commitment, and their changing demands. To minimize the uncertainty, the provider should be acting strategically in dealing with customers.

The fourth challenge relates to the *value co-creation (CM4)* between the provider and customer, where the value is jointly created through an effective interaction and a high level of strategic integration (Grönroos & Helle, 2010; Vargo et al., 2008). From a practical perspective, the value co-creation process requires both parties to integrate their resources to support the delivery of a servitized offering (Trkman et al., 2015). It is common that the operation team from the provider's side needs to join the customer for a temporary period, when the professionalism of the operation team has a direct impact on the relationship (Finne & Holmström, 2013; Martinez et al., 2010). Moreover, the value co-creation requires the providers and customers to be open-minded and share information that is sufficient to support the operation. However, the existence of 'coopetition' may cause the customer to reject the request for *data sharing (CM5)* as they are concerned that the provider may compete with them in the same market (Kreye et al., 2015; Matthyssens & Vandenbempt, 2008). According to Bengtsson and Kock (2014), the term 'coopetition' combines the concept of 'cooperation' and 'competition', which refers to the situation when more than two business actors cooperate and compete with each other at the same time.

2.4.3.5 Risk management (RM)

According to the SLR results, adopting a servitization strategy involves different types of risk (mainly financial, operational and external), on which the RM has gathered enormous attention (Benedettini et al., 2015; Gebauer & Friedli, 2005; Hou & Neely, 2017; Kreye, 2018b; Nordin et al., 2011; Ziaee Bigdeli et al., 2017).

The research on *financial risks (RM1)* was initiated by Neely (2008) who demonstrated that adopting servitization requires heavy upfront investment to support the business transformation, and this could easily offset the profits in its early development phase. Although the servitization benefits (strategic, financial & marketing) are acknowledged in both theory and practice, the expected financial returns may not be realised (Gebauer et al., 2005; Matthyssens & Vandenbempt, 2010; Neely, 2008). A recent study by Benedettini et al. (2017) examines the likelihood of bankruptcy among the servitized businesses through the meta-analysis of secondary data, and the conclusion shows that providing servitized offerings does not survive the business competition. This is mainly due to the *operational risks (RM2)* involved in the servitization business, where many changes and certainties are triggered in different parts of the business to support the transition (Durugbo & Erkoyuncu, 2016; Kreye, 2018b; Nordin et al., 2011; Reim et al., 2016). The previous discussions on other challenges (sections 2.4.4.1, 2.4.4.2, 2.4.4.3 and 2.4.4.4) support this argument as the challenges that are identified in different areas certainly increase the level of risks (Hypko et al., 2010; Zhang & Banerji, 2017).

Despite the internal risks (financial and operational), the *external risks (RM3)* should be considered, as the external business environment may impose risks beyond the control of the company and can influence the overall business landscape (Everett & Watson, 1998; Sheth & Sisodia, 2005). These risks are varied in nature, such as they are relevant to the technological development, dynamic market trend, globalisation and capital market (Benedettini et al., 2015).

Table 2-9 presents a detailed summary of the formal constructs and relevant indicators of servitization challenges.

Table 2-9 Constructs and indicators of servitization challenges

| Constructs | Labels | Indicators | References |
|-------------------------------|--------|---------------------------------|---|
| Organisational structure (OS) | OS1 | Culture change | Alghisi & Saccani (2015), Fang et al. (2008), Finne et al. (2013), Kowalkowski et al. (2015), Lenka et al. (2017), Martinez et al. (2010), Ng & Nudurupati (2010), Nudurupati et al. (2016), Oliva & Kallenberg (2003), Salonen (2011) |
| | OS2 | Communication | Alghisi & Saccani (2015), Baines, Lightfoot & Kay (2009), Brax (2005), Kinnunen & Turunen (2012) |
| | OS3 | Service expertise | Homburg et al. (2003), Lin et al. (2014), Oliva & Kallenberg (2003) |
| | OS4 | Inter-department collaboration | Kowalkowski et al. (2015), Lenka et al. (2018), Storbacka et al. (2013), Windahl & Lakemond (2010) |
| Business Model (BM) | BM1 | Business model modification | Barquet et al. (2013), Ferreira et al. (2013), Kastalli & Van Looy (2013), Kindström & Kowalkowski (2014), Parida et al. (2014), Storbacka (2011), Wise & Baumgartner (1999) |
| | BM2 | Value proposition | Barnett et al. (2013), Brax (2005), Martinez et al. (2010), Pawar et al. (2009), Valtakoski (2017) |
| | BM3 | Resource alignment | Barquet et al. (2013), Lin et al. (2014), Neely (2008), Zarpelon Neto et al. (2015) |
| | BM4 | Costing mechanism | Barquet et al. (2013), Datta & Roy (2013), Malleret (2006), Ng & Nudurupati (2010), Parida et al. (2014) |
| | BM5 | Pricing mechanism | Barquet et al. (2013), Malleret (2006), Mo (2012) |
| | BM6 | Supplier collaboration | Finne & Holmström (2013), Martinez et al. (2010), Ng & Nudurupati (2010), Nudurupati et al. (2016), Oliva & Kallenberg (2003), Parida et al. (2014) |
| Development process (DP) | DP1 | Integrated development process | Alghisi & Saccani (2015), Baines, Lightfoot & Kay (2009), Kowalkowski et al. (2015), Meier et al. (2010), Parida et al. (2014) |
| | DP2 | Tools, methods, and techniques | Baines et al. (2007), Nudurupati et al. (2016), Tukker (2015) |
| | DP3 | Performance measurement | Baines, Lightfoot & Kay (2009), Martinez et al. (2010), Mo (2012) |
| | DP4 | Customer engagement | Brax (2005), Demeter & Szász (2013) |
| Customer management (CM) | CM1 | Matching customer needs | Demeter & Szász (2013), Johnstone et al. (2009), Kinnunen & Turunen (2012), Matthyssens & Vandenbempt (2008), Trkman et al. (2015), Tuli et al. (2007), Valtakoski (2017) |
| | CM2 | Ownership transfer | Baines et al. (2007), Ng & Nudurupati (2010) |
| | CM3 | Long-term relationship building | Barnett et al. (2013), Homburg et al. (2003), Kreye (2017b), Tukker (2015) |
| | CM4 | Value co-creation | Brax (2005), Demeter & Szász (2013), Finne & Holmström (2013), Martinez et al. (2010), Trkman et al. (2015) |
| | CM5 | Information sharing | Kreye et al. (2015), Matthyssens & Vandenbempt (2008) |
| Risk management (RM) | RM1 | Financial risks | Benedettini et al. (2015), (2017), Gebauer et al. (2005), Matthyssens & Vandenbempt (2010), Neely (2008) |
| | RM2 | Operational risks | Alghisi & Saccani (2015), Baines et al. (2007), Baines, Lightfoot & Kay (2009), Barnett et al. (2013), Barquet et al. (2013), Benedettini et al. (2015), Brax (2005), Datta & Roy (2010), Demeter & Szász (2013), Durugbo & Erkoyuncu (2016), Fang et al. (2008), Finne et al. (2013), Homburg et al. (2003), Hypko et al. (2010), Kowalkowski et al. (2015), Li et al. (2015), Martinez et al. (2010), Meier et al. (2010), Mo (2012), Neely (2008), Ng & Nudurupati (2010), Nordin et al. (2011), Nudurupati et al. (2016), Oliva & Kallenberg (2003), Parida et al. (2014), Pawar et al. (2009), Reim et al. (2016), Tukker (2015) |
| | RM3 | External risks | Benedettini et al. (2015), Zarpelon Neto et al. (2015) |

2.4.4 Summary of the SLR section

Overall, this section explored the servitization challenges through a systematic review of the current literature, from which the key constructs and indicators of the challenges were identified. A structured methodology was followed starting from the question formulation, locating studies, study selection and evaluation, analysis and synthesis, reporting and using the results. Besides, the CNA (Figure 2-4) was integrated as part of the SLR procedure to track the knowledge flow of the literature and identify the key publications that are relevant to this study.

The SLR result was analysed descriptively and thematically, and was presented in sections 2.4.2 and 2.4.3. The main descriptive findings show that servitization challenges have attracted enormous attention over the past decades, and a growing trend has been developed along with the timescale. This growth was contributed by scholars from all over the world, particularly the Western countries where the local product-centric companies are seeking opportunities to escalate the value chain by adopting a servitization strategy. The thematic analysis abstracted and organised information using an inductive approach, and the result demonstrated that the servitization challenges can be categorized from five perspectives: OS, BM, DP, CM and RM. In the next section, the research gaps are justified, leading to the formulation of the RA and questions.

2.5 Research gaps, aim and questions

2.5.1 Research gaps

As emphasised in the introduction chapter, this study seeks to address two research gaps in the current literature.

Gap 1: The performance implications of servitization challenges remain under-explored

The challenges of servitization have attracted enormous attention over past decades, and scholars have been actively engaging with industrial practitioners to gain a more complete understanding. The current research looks into those challenges from different perspectives: some look into how the product-centric company reconfigures the OS to support the servitization adoption (Neu & Brown, 2005, 2008; Penttinen & Palmer, 2007); some focus on developing a sales team for the servitized offering (Auguste et al., 2006; Galbraith, 2002); some concern the shift of mindset from a product-centric to a customer-centric organisation (Finne & Holmström, 2013; Martinez et al., 2010); and more recently, other researches investigate the servitization from a risk aspect (Benedettini et al., 2015; Nordin et al., 2011; Reim et al., 2016; Ziaee Bigdeli

et al., 2017) . However, there is a lack of a complete view on the servitization challenges as the existing efforts mostly focus on isolated issues (Baines et al., 2017; Nudurupati et al., 2016). Baines et al. (2017) have revisited the recent status of servitization research, and conclude that the current researches are mainly fragmented and discursive, implying that there is need for looking into the bigger picture in order to understand the challenges facing companies in real life situations. Moreover, the SLR results demonstrate that there is no prior study investigating the impacts of servitization benefits on the associated benefits and overall business performance, which supports the identification of the first research gap.

It is therefore concluded that the impacts of servitization challenges on the realisation of their benefits and overall performance are under-explored, which forms the first research gap in this study.

Gap 2: There is a lack of understanding on how the challenges are varied in different servitized businesses

Given that the servitization literature emerged from a broad industrial context, the scholars have proposed a number of service typologies to distinguish the product and service combinations from various aspects. For instance, some typologies are simply based on the servitized offerings, such as Baines and Lightfoot (2013) who classify the offering into base, intermediate and advanced services, and Tukker (2004) who categorizes the PSS as product-oriented, solution-oriented and result-oriented. The recent studies have moved beyond the basic typology to classify the company according to the service strategy (Gebauer, 2008; Raddats & Kowalkowski, 2014). The recent studies have emphasised that making a distinction between different types of servitized offerings/businesses is important to advance the current understanding, as the company providing different servitized offerings could be substantially different in its business complexity, where they may perceive benefits and challenges at different levels (Burton et al., 2017; Sousa & da Silveira, 2017; Ziaee Bigdeli et al., 2018). However, this research area has received little attention as current studies focus on a single type of servitization, such as performance-based services (Huikkola et al., 2016; Nullmeier et al., 2016).

The second research gap has been identified as a lack of understanding on how the challenges are varied in different servitized businesses.

2.5.2 Research aim and questions

To address the identified research gaps, the following RA is proposed.

To explore the impacts of servitization challenges on business performance and how they are different in the servitized businesses with different strategic focuses.

This RA addresses the identified gaps simultaneously, as the former part focuses on exploring how servitization challenges affect the business performance (addresses the 1st gap) and the latter part investigates how servitization challenges are varied in the different servitized businesses-integrated solution providers (IS providers) and product suppliers providing a generic service portfolio (PS suppliers) (addresses the 2nd gap). Accordingly, two RQs are formulated to achieve the RA and provide guidance on the project.

RQ1: How do servitization challenges affect the realisation of servitization benefits (strategic, financial, and marketing) leading to superior business performance?

RQ2: How are the challenges different in businesses with different strategic focuses (IS providers vs. PS suppliers)?

The first RQ is necessary to understand the impact of servitization challenges on the servitization benefits leading to superior business performance. In section 2.3, the current literature indicates that there are three types of servitization benefits: strategic, financial and marketing. However, the prior study demonstrates that the benefits do not always lead to an outstanding firm performance due to the existence of different challenges in the business (Visnjic & Van Looy, 2013). This implies that the servitization challenges have a direct impact on the benefits as well as the business performance. In the light of this, the first RQ aims to explore the underlying linkage among the servitization challenges, benefits and firm performance.

The second RQ helps to understand how servitization challenges are manifested in different servitized companies. Given that a servitization strategy is adopted by the product-centric company to serve different strategic focuses, it is crucial to distinguish the different types of servitized businesses as they can be significantly different in perceiving the benefits, challenges and overall business performance (Ziaee Bigdeli et al., 2018). Therefore the second question explores the manifestation of the challenges in different types of servitized businesses.

Sections 2.6 and 2.7 present the theoretical framework for addressing RQ1 and RQ2 respectively, upon which the empirical study can be built.

2.6 The performance implication of servitization challenges (Towards RQ1)

The SLR in section 2.4 identified five constructs and relevant indicators of servitization challenges, which underpin the hypothetical relationship between the challenges, benefits and business performance, and lead to the development of a theoretical framework in this section.

2.6.1 Underpinning theory

To support the development of the theoretical framework, a unifying theory – Theory of Constraints (TOC) is employed to explain how and why the proposed relationships are logically constructed.

The TOC is a general theory in operations management that aims to identify the limiting factors (known as ‘constraints’) that hinder the organisation’s capabilities to achieve the business goal, and systematically address these constraints until they are no longer limiting factors (Goldratt & Cox 1984). To identify the constraints, TOC views an organisation as a chain of interdependent functions, departments, processes or resources, where each part of the chain should be examined to identify the weakest one (Gupta & Boyd, 2008). The weakest chain needs to be improved in order to achieve better operational performance as well as generate more profits as the ultimate goal of the business. In light of this, the performance measurement is constituting as a key dimension of the TOC concept (Gupta & Boyd, 2008). From a traditional operational perspective, the performance should be assessed based on the four perspectives: dependability, efficiency, flexibility and quality (Schroeder, 2008). However, these measures only cover the key dimensions of operations while the relevant business dimensions are not fully addressed. In so doing, Cox et al. (2003) proposed a more comprehensive set of measures, which includes the aspect of operations, finance and customer (marketing). This set of measures is in line with the TOC, as the theory emphasises that ‘anything that is produced but not sold is not considered throughput’ (Gupta & Boyd, 2008, P996). This implies that the operation function manufactures products, the marketing sells products and the finance records the product sales in order to be considered as throughputs. This demonstrates how the company could achieve the ultimate business objective (e.g. to make more money) through the departmental collaboration from the TOC perspective. In the light of this, the TOC is served as an underpinning theory in this study, as we seek to investigate how the servitization challenges (constraints) affect the business performance via the relevant benefits (strategic, financial & marketing). In the following section, the hypotheses are discussed in turn.

2.6.2 Theoretical hypotheses

2.6.2.1 *Relationship between servitization challenges and benefits realisation*

Based on the SLR findings, this section formulates the hypothetical relationship between the challenges and benefits, which describes the direct impacts of challenges to strategic benefits (H1a – H5a), financial benefits (H1b – H5b), and marketing benefits (H1c – H5c).

Adopting a servitization strategy requires significant changes in the internal structure at both an organisational and individual level, which increases the level of internal conflicts and the resistance to change (Lenka et al., 2017). As discussed in section 2.4.3.1, the typical OS challenges in the servitizing companies stem from the co-existence of product-orientation and service-orientation, as they are contradictory in nature (Lenka et al., 2018). The typical challenges include the shift of business mindset, communication with stakeholders, retention of service expertise and intra-departmental collaboration, which have a negative impact on the strategic benefits. This is because insufficient management of these issues would cause opposition inside the organisation (Finne et al., 2013; Rönnerberg Sjödin et al., 2016). This implies that the companies that overcoming these challenges could contribute to the achievement of strategic goals. From the financial perspective, adopting a servitization strategy requires heavy financial investment to support the organisational reconfiguration, such as expanding human and physical assets as well as the expansion of the service business division (Neely, 2008; Parida et al., 2014). Meanwhile, adopting a servitization strategy does not secure the expected return and the profits can be easily offset by the operation costs in the early stages (Benedettini et al., 2017; Gebauer et al., 2005). This indeed increases the likelihood of bankruptcy if the company is unable to maintain its financial performance at an appropriate level (Benedettini et al., 2015). In the light of this, the companies could achieve better financial performance if they are able to address the OS challenges. From the marketing perspective, the product-oriented marketing strategy simply facilitates the product sales and market expansion in the product-centric business. However, the servitizing company needs to incorporate the service marketing in order to address a broad perspective, particularly building and maintaining the customer relationship through value co-creation and customer engagement (Vargo & Lusch, 2004a). This is closely aligned with the identified organisational changes, such as the shift of business culture and communication with key stakeholders, which implies that addressing the challenges in the relevant areas can contribute to the realisation of marketing benefits. These arguments suggest that

the servitized companies that are able to overcome OS challenges are likely to achieve the relevant benefits, leading to the formulation of hypotheses 1a, 1b and 1c:

H1: The servitized business overcoming organisational structure (OS) challenges contributes to the realisation of (a) strategic benefits, (b) financial benefits and (c) marketing benefits.

Modifying the overall BM allows the company to redevelop an operational plan to support the implementation of the servitization strategy (Barquet et al., 2013; Kindström & Kowalkowski, 2014; Parida et al., 2014). Through the lens of a BM canvas (Osterwalder & Pigneur, 2010), a few BM challenges are identified in the current literature. The shift of a value proposition from product-centric to customer-centric requires a solid understanding and customers, as well as a system integration of products, services, technologies and knowledge to provide better value to business customers. This certainly increases the level of business complexity as many changes are triggered in the different business functions, which implies that the company could achieve the strategic benefits if they are able to address the relevant challenges (Barnett et al., 2013; Brax, 2005; Pawar et al., 2009; Valtakoski, 2017). In addition, the resource realignment supports the transition of the company's BM and structure reconfiguration by acquiring, and leveraging resources among the product and service departments (Parida et al., 2014). This constitutes an important part of the strategic plan, in which the strategic benefits can be realised if the company is able to effectively utilize the resources (Huikkola et al., 2016). Besides, if the company is able to optimize the resource utilisation across the functional groups to achieve cost efficiency, it would directly improve the financial performance of the organisation, which is directly linked to the financial benefits (Barquet et al., 2013; Lin et al., 2014). The cost and pricing mechanisms are directly linked to the overall financial performance, as they mainly capture the financial input and output of the servitized business. However, the servitized business struggles to price and cost the solution in such a way that the prices are attractive to its business customers while maintaining its profitability during the contracted period (Story et al., 2017). This challenge directly links to the financial benefits. From the supply chain perspective, the servitized business involves a system of integration between customers and suppliers to facilitate value co-creation (Chakkol et al., 2018; Jaakkola & Hakanen, 2013), which has a direct impact on the strategic benefits. In another words, overcoming the challenges of value co-creation potentially helps the realisation of strategic benefits. Moreover, the impact of the collaboration challenge on the finance stems from the revenue sharing with the business partners, where the risk owner is not clear due to the ambiguous roles and responsibilities (Datta & Roy, 2013; Ng & Nudurupati, 2010). Regarding the marketing benefits, the overall

BM assists with the value development and delivery to the customers through demonstrating how the proposed value proposition matches the customers' needs (Osterwalder & Pigneur, 2010). In the light of this, the BM challenges are closely linked to the marketing benefits. In short, the arguments suggest that the servitized companies that are able to address BM challenges are more likely to achieve the servitization benefits, which leads to the development of hypotheses 2a, 2b and 2c:

H2: The servitized business overcoming business model (BM) challenges contributes to the realisation of (a) strategic benefits, (b) financial benefits and (c) marketing benefits.

The DP process facilitates the transition of the conceptual idea to marketable offerings (Cooper & Edgett, 2012). In the servitizing companies, the SLR indicates that an integrated process is necessary to support the development of servitized offerings; however, it is mainly underdeveloped. Meanwhile, companies struggle to re-engineer the process (Baines & Lightfoot, 2009; Gebauer et al., 2010b) and promote the knowledge development across products and services (Burton et al., 2017). Gremyr et al. (2014) empirically investigated the new service DP in the product-centric company, and the results indicate that those companies with the intention of offering integrated solutions face more challenges than those developing services on an *ad hoc* basis. These challenges stem from the lack of competencies and the different innovation modes of product and service development, where the former embraces a radical innovation mode and the latter follows a recombination approach. Given that the DP relates to the overarching service and product strategy, the related challenges have direct impacts on the achievement of strategic benefits. In terms of financial and marketing benefits, the costing process (Malleret, 2006; Settanni et al., 2014) and customer engagement (Bettencourt & Brown, 2013; Demeter & Szász, 2013) are critical to achieving the benefits respectively. Engaging customers allows a better understanding of market needs that facilitate the clarification of design specification and planning of marketing activities (Demeter & Szász, 2013; Lenka et al., 2018). However, the research indicates that the servitized companies face some challenges in these areas, which means that overcoming these challenges is critical to realise the benefits. Despite the process, the development tools, methods and techniques enable the development of servitized offerings, which have indirect impacts on the achievement of strategic benefits. These arguments suggest that the DP is critical in achieving the servitization benefits and the companies that overcome the relevant challenges could achieve better performance, leading to the formulation of hypotheses 3a, 3b and 3c:

H3: The servitized business overcoming development process (DP) challenges contributes to the realisation of (a) strategic benefits, (b) financial benefits and (c) marketing benefits.

Given that the delivery of servitized offerings is often through a long-term contract, relationship marketing plays an important role in the servitized companies, the main purpose of which is to establish and maintain a close relationship with customers to consolidate their loyalty (Berry, 1995). This emphasises the significance of CM in the servitized business, which assists the company in retaining strategic and marketing benefits by 'locking in' customers. However, the servitization literature identified a few challenges in managing the relationship, such as different value perceptions between providers and customers (Tuli et al., 2007), the existence of relational uncertainties (Kreye, 2017b; Yang et al., 2017), and trust and commitments in the value co-creation (Matthyssens & Vandenbempt, 2008), which can have substantial impacts on the achievement of the benefits. Furthermore, the financial performance can also be affected as companies that lack competitive position and strong relationship marketing are unlikely to enjoy the financial benefits (Barney, 1986). These arguments suggest that the servitized companies that are able to address the relevant CM challenges are likely to retain the servitization benefits, leading to the formulation of hypotheses 4a, 4b and 4c:

H4: The servitized business overcoming customer management (CM) challenges contributes to the realisation of (a) strategic benefits, (b) financial benefits and (c) marketing benefits.

Adopting a servitization strategy in the product-centric companies increases the level of risk, which causes the RM to be more challenging. The above discussion of four challenges reflects the complex nature of the servitized business. According to the SLR, it is understood that servitized businesses face both internal and external risks. The internal risks include operational challenges (Kreye, 2018b; Nordin et al., 2011; Reim et al., 2016) and financial challenges (Benedettini et al., 2017; Gebauer et al., 2005), which have direct impacts on the benefits from all aspects. On the other hand, the external risks (Sheth & Sisodia, 2005) that are beyond the control of the company could affect the overall performance as well as making it harder to achieve the benefits (Benedettini et al., 2015). These arguments suggest that an increased level of risks in servitized companies makes it challenging to manage those risks, and overcoming the relevant challenges could contribute to the benefit realisation, leading to the formulation of hypotheses H5a, 5b and 5c:

H5: The servitized business overcoming risk management (RM) challenges contributes to the realisation of (a) strategic benefits, (b) financial benefits and (c) marketing benefits.

This section discussed the formulation of hypothetical linkages among the servitization challenges and benefits based on the result of the thematic analysis in section 2.4.3. The next section focuses on the correlations between the benefits and overall firm performance, which completes the overview of how servitization challenges affect performance via the benefits.

2.6.2.2 Interrelation between servitization benefits and business performance

The correlations among the servitization benefits and their connections to the overall business performance are discussed in turn below.

Based on the literature review, the interrelationship between the servitization benefits is not researched; however, there is a little empirical evidence that potentially confirms the co-existence of three benefits (Baines & Lightfoot, 2013; Raddats et al., 2016). Given that the strategic benefits (SB) refer to the companies that retain a competitive advantage through the adoption of servitization strategy and the delivery differentiated offerings, the SB have a direct impact on the financial (FB) and marketing benefits (MB). When a company has successfully adopted the servitization strategy and overcome the challenges (discussed in section 2.6.2.1) to realise the SB, it is more likely to retain a stable financial performance (FB) and solid customer loyalty (MB), leading to the formulation of hypotheses H6a and 6b:

H6: Strategic benefits (SB) positively influence the (a) financial benefits and (b) marketing benefits.

From the financial perspective, the financial returns are regarded as a key performance indicator of measuring the effectiveness of the business strategy (Neely, 2007a), which implies that higher financial returns indicate an effective realisation of SB. In the servitization literature, the previous studies claim that the FB includes generating stable revenues through an additional channel (Johnstone et al., 2009; Malleret, 2006; Raddats et al., 2016) and balancing the effect of economic cycles (Brax, 2005; Raddats & Easingwood, 2010), which potentially facilitate the achievement of the business strategy and the retention of a competitive position of the company within the global competition. With respect to the MB, part of the sales profits are reinvested in the R&D (research and development) activities to promote the business innovation, which can result in the development of advanced servitized offerings that address customers' needs (Zhang & Banerji, 2017). These arguments suggest that the FB has positive

impacts on the realisation of SB and MB, leading to the formulation of hypotheses 7a and 7b:

H7: Financial benefits (FB) positively influence the (a) strategic benefits and (b) marketing benefits.

The MB mainly refer to the servitized companies managing their relationship with customers on a long-term basis through valuable interactions and close engagements (Malleret, 2006; Penttinen & Palmer, 2007), so that the companies can possess a good understanding of customers' needs and challenges (Brax & Jonsson, 2009; Johnstone et al., 2009). The importance of relationship management is reflected in the definition of servitization, as Baines and Lightfoot (2009) highlight that the servitized offerings are delivered through a bundle of products, services and CM. Ng et al. (2013) investigate the relationship between the relational asset and performance of servitized offerings, and their conclusion shows that the behaviour and information alignments between the provider and customers play an important role. This is because the customer values the relational assets when assessing the performance of the servitization contracts. More recently, Kreye (2017b) has brought more attention to the relational uncertainties in the servitized business from an inter-organisational perspective, and the findings suggest that the provider should address the identified uncertainties (e.g. the lack of trust and insufficient information sharing) in order to improve the quality of value delivery. Although these studies looked into the customer relationship from different angles, they emphasise the importance of this managerial area in the servitized businesses, which also implies that MB can directly affect the achievement of SB and FB (Malleret, 2006; Mathieu, 2001b), leading to the formulation of hypotheses 8a and 8b:

H8: Marketing benefits (MB) positively influence the (a) strategic benefits and (b) financial benefits.

There is an ongoing debate on the relationship between the adoption of a servitization strategy and overall business performance, and the current literature has offered mixed evidence on the relationship. For example, the studies have focused on the firm's value (Fang et al., 2008), sales growth (Kohtamäki et al., 2013b) and financial performance (Gebauer et al., 2010a; Kastalli & Van Looy, 2013; Kohtamäki & Helo, 2015). More recently, Min et al. (2015) investigated the effect of the adoption of a servitization strategy on the business performance of Chinese manufacturing companies, and their findings indicate that adopting the strategy is positively correlated to the marketing performance of the company, but negatively affects the overall financial performance. Although this study focuses on China and the strategic perspective is not fully

addressed in the study, it indicates that there is interplay between the servitization strategy and business performance, and further study is needed to advance our understanding.

Business performance is always regarded as a key topic in operational research, as it reflects the overall organisational efficiency that can be viewed as ‘the time test for any business strategy’ (Venkatraman & Ramanujam, 1986). Understanding how the business performance is measured helps us to improve it. The performance measurement was first introduced in the late 13th century and remained unchanged until the era of the Industrial Revolution (Bourne et al., 2000). From the 19th century onwards, the performance measurement has evolved over several key stages. In the early stage of the Industrial Revolution, the product-centric business mainly used the production cost, particularly the labour wage, as a key indicator of employee’s productivity (Johnson, 1981). During the early stage of globalisation in the 1950s, companies tended to adopt a more sophisticated approach that considered the quality of product, delivery time and stakeholder satisfaction to measure the overall business performance (Kaplan, 1983; Neely et al., 1995). Later, as the economic engine shifted from the supply to the demand side, the performance measurement has been developed into a multi-dimensional view, which considers the financial performance, marketing effectiveness and operational efficiency to form a rounded overview of firm performance.

To bring together different views, Neely (2007a) wrote a book on the business performance measurement with a collection of views from different scholars. He claims that the business performance should be mainly measured from financial (Otley, 2001), operational (Neely, 2007b) and marketing (Clark, 2007) perspectives. The financial measurement quantifies the business performance based on the common financial indicators, such as net profits and working capitals, which offers an easy way to monitor the business by comparing the figures year by year (Otley, 2001). Besides, the marketing and operational measures, as non-financial indicators, are used to evaluate the business activities. The research shows that 5-20% of business revenues are spent on the marketing activities that capture the attention of senior management who are keen to know the return on investment (Eechambadi, 2005). This is usually assessed through customer engagement and feedback gathering via established marketing research portals. The operational perspective focuses on the productivity within the organisation, in which the performance is assessed from five aspects: quality, dependability, speed, flexibility and cost (Neely, 2007b). In the light of these, the business performance should be measured from a rounded perspective in order to

achieve the optimal result. This is especially true in the servitized business as it is more complex in nature than the product-centric business.

The servitization literature indicates that moving towards servitization improves the performance of the product-centric companies via three benefits: financial, marketing and strategic. The contributions of financial and marketing benefits are straightforward, as they are aligned with the indicators of financial performance and customer satisfaction respectively (Clark, 2007; Otley, 2001; Zhang & Banerji, 2017). Although the operational indicators are not directly aligned with the strategic benefits, the business strategy provides guidance regarding the daily operation. This implies that companies retaining a high level of operational efficiency are able to secure its strategic benefits. Considering that the operational indicators are used to measure the overall performance, it is argued that the strategic benefits have a direct impact on the business performance. These arguments suggest that the servitization benefits are positively related to the business performance as they are closely linked to the main indicators, leading to the formulation of hypotheses 9a, 9b and 9c:

H9a: Strategic benefits (SB) positively influence the business performance.

H9b: Financial benefits (FB) positively influence the business performance.

H9c: Marketing benefits (MB) positively influence the business performance.

2.6.3 Theoretical model

Based on the hypothetical relationship discussed above, Figure 2-6 illustrates a theoretical model that comprises the proposed linkages among the servitization challenges, benefits and business performance.

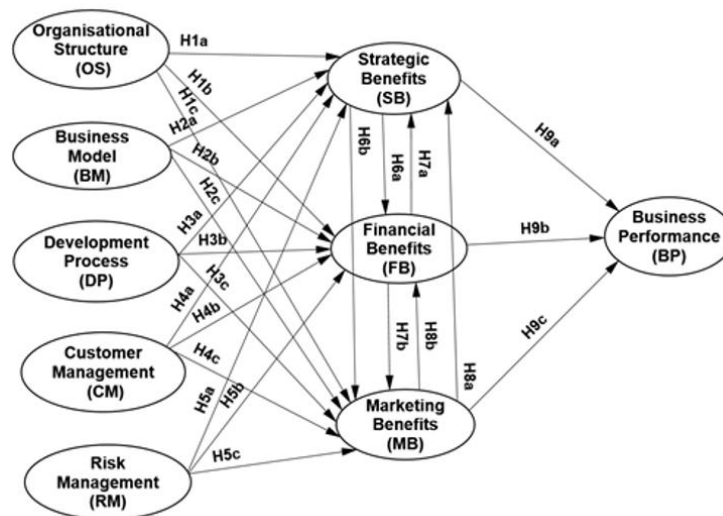


Figure 2-6 Theoretical model

2.7 Classification of different servitized businesses (Towards RQ2)

Although the above section discussed the performance implications of servitization challenges, the distinction between different types of servitization was not considered, which has formed another research gap (Kreye, 2018a; Ziaee Bigdeli et al., 2018). To understand how the identified challenges are manifested in the different types of servitized organisations (addresses RQ2), this section reviews the existing typology and proposes a new typology to classify the servitized businesses within the empirical study.

2.7.1 Existing typologies

A large number of researches have distinguished different types of servitization from different aspects. For instance, Mathieu (2001a) proposed a typology based on companies' intensity and service specificity, in which the author categorized the service offerings into two types: 1) services supporting the product function and 2) services supporting customers' activities. This typology is in line with Frambach et al.'s (1997) concept of the transactional-based and relationship-based service model, in which the support services are purchased on a transactional basis while the solution-oriented offering is delivered on a long-term relational basis. Apart from the generic service typology, scholars have proposed some typologies specifically for the PSS (Product Service System). The prime instance would be Tukker's (2004) PSS typology, in which he classifies PSS as product-oriented, use-oriented and result-oriented (Barquet et al., 2013; Tomohiko et al., 2009). Build on Tukker's (2004) work, Neely (2008) extended the typology by including the integrated-oriented and service-oriented types. More recently, Baines and Lightfoot (2013) proposed a typology that considers the aspect of the value proposition for business customers, in which they differentiate the base services (customers who want to do it themselves), intermediate services (customers who want us to do it with them) and advanced services (customers who want us to do it for them).

In addition, there are a few typologies developed to classify companies according to the service strategy, but only two studies are supported by empirical evidence. Gebauer (2008) identified four strategies: after-sales service providers (ASPs), customer support providers (CSPs), outsourcing partners (OPs) and development partners (DPs). However, each of these strategies contains only one service offering that is unable to indicate the service strategy of the company. In contrast, Raddats and Kowalkowski (2014) introduced a more comprehensive service category, which comprises three service strategies (service doubters, service pragmatists and service enthusiasts) and each strategy caters for multiple service offerings. In the light of this, a list of measuring

items for different servitized offerings (product-attached services, operations services on products and vendor independent services) was developed and empirically tested through a quantitative study. Although the strategy typology seems to be indicative of the different servitizations, it is established only from the service perspective and does not consider the BM, organisational intensity, and customer relationship (Mathieu, 2001b). To address this limitation, the other studies sought to differentiate the servitized businesses from different aspects; for instance, considering the resource availability and supply chain perspective (Löfberg et al., 2010), customer-supplier relationship and business logic (Windahl & Lakemond, 2010), value proposition for customers and revenue generation logic for suppliers (Kujala et al., 2010) and BM (Reim et al., 2015). As no consensus has been reached on the key dimensions of distinguishing the servitization business, this implies that the BM and customer relationship appear to be important indicators as they are covered in different studies.

2.7.2 The proposed typology

Building on the current typology, a new typology, as shown in Table 2-10, is proposed based on the dimensions of the BM and CM to differentiate those servitized businesses with different strategic focuses. From an internal aspect, the BM shows the strategic focus of the company, and therefore it is considered to be a powerful tool to analyse the characteristics of the business (Hedman & Kalling, 2003). With respect to the external CM, the companies moving towards servitization have to change the way of interacting with their customers (Baines, Lightfoot, Peppard, et al., 2009; Sousa & da Silveira, 2017) as the customer relationship has changed from the transactional basis to relational basis (Kohtamäki et al., 2013a; Kreye, 2017b; Tuli et al., 2007). In the light of this typology, the servitized businesses are classified into two types in this study – integrated solution providers (IS providers) and product suppliers providing generic services (PS suppliers). The IS provider in this study refers to companies that provide a high level integration of products services, in which a typical offering covers integrated solutions, support services and products. The PS supplier refers to companies that provide support services and products on a separate basis. Table 2-10 details the characteristics of each kind.

In the BM dimension, several sub-dimensions were applied to assist with the categorization. In terms of the strategic focus, the current literature makes a distinction between the servitized offerings supporting the product functionality vs. the servitized offerings supporting the customer process, which match the business objectives of PS suppliers and IS providers respectively (Oliva & Kallenberg, 2003; Ulaga & Reinartz, 2011). To be in line with the strategic focus, the value proposition of the IS providers is the predefined performance or guaranteed result, while PS suppliers provide a wide

range of services including spare parts, repairs, and maintenance services to retain the product life cycle (Kindström & Kowalkowski, 2014; Kujala et al., 2010; Reinartz & Ulaga, 2008). In so doing, the IS provider can secure its competitive advantage through the differentiated offerings and the high level of customer engagement (Cusumano et al., 2015; Martinez et al., 2010). On the other hand, the PS suppliers focus on minimizing the operational costs through the standardization of products and services, where the customization is minimal (Azarenko et al., 2009). To support the company strategy, the OS needs to be aligned with the strategic focus. The IS business requires a high-level of integration across the business functions, whereas the PS business embraces that the separate management of the product and service team can be more effective (Wiesner et al., 2015). Thus the level of formalisation is low and high in IS and PS companies respectively, as the boundary between the service and product is blurred in the IS business, whereas a clear boundary is retained in the PS business (Azarenko et al., 2009). This has significant impacts on the organisational complexity, in which the IS business certainly increases the organisational complexity and the latter retains a relatively low level of complexity (Meier et al., 2010). The level of risks is highly associated with the complexity, and the current literature indicates that risk levels exhibit differently in the servitized businesses (Nordin et al., 2011). Specifically, the IS provider retains more risks, as many internal changes are triggered when moving towards servitization, and they are contracted to share risks with customers to realise the value proposition (Hou & Neely, 2017; Nordin et al., 2011). In contrast, the risk level facing the PS supplier is relatively low, as they experience fewer changes in different parts of the business (Nordin et al., 2011).

From the CM perspective, the value of integrated solutions is determined by the customer and provider as the value proposition is an agreed output or a predefined performance (Windahl & Lakemond, 2010). In contrast, the value of PS is mainly determined by the supplier, as the product plays a dominant role in the PS while services are supplementary for extending the product life cycle (Windahl & Lakemond, 2010). In the light of this, the value creation in the solution business requires a close collaboration between the customer and provider, where the customer is engaged as a value co-creator (Rönnerberg Sjödin et al., 2016; Vargo et al., 2008). On the other hand, in the delivery of PS offerings, the customer acts as a value receiver and the provider is solely responsible for the value delivery, which limits the interaction between the two parties (Rajala et al., 2013). Accordingly, the nature of customer relationships is different in servitized businesses, in which delivering integrated solutions engages customers on a long-term basis while providing support services retains a transactional relationship (Baines, Lightfoot, Peppard, et al., 2009; Reim et al., 2015; Sousa & da

Silveira, 2017). It is therefore established that trust among the IS providers and customers is key to minimize the relational uncertainties, where the key account management and effective interactions play a significant role (Kreye, 2017b). In contrast, the relationship in the PS business can be managed through standard marketing activities.

In short, the proposed typology classifies the servitized businesses from a high level strategic perspective rather than differentiates them based on the service offering, as most companies in practice offer a broad range of offerings that covers integrated solutions and support services to address the diversity of customer needs.

Table 2-10 Proposed service typology

| | Dimensions | IS provider | PS supplier | References |
|---------------------------------------|---|---|--|--|
| Business model (internal) | The strategic focus of the business model | Integral to customer's operational process through the delivery of predefined performance/result | Fulfilling customer needs by supporting the functional use of products | Oliva & Kallenberg (2003), Sousa & da Silveira (2017), Ulaga & Reinartz (2011) |
| | Core value proposition | Providing a broad range of servitized offerings, including the use/performance based contracts (e.g. power by the hour) and support services | Providing support services to support functional use/life cycle of products (e.g. spare parts, maintenance, service contract) | Baines & Lightfoot (2013), Baines et al. (2009), Gebauer (2008), Kujala et al. (2010), Raddats & Kowalkowski (2014), Ulaga & Reinartz (2011) |
| | Competitive advantage/ customization of offerings | <ul style="list-style-type: none"> • Differentiation • High level of customization | <ul style="list-style-type: none"> • Cost leadership • Customization is mainly available for large customers | Gebauer (2008), Kujala et al. (2010), Reim et al. (2015), Sousa & da Silveira (2017), Tukker (2004), Ulaga & Reinartz (2011) |
| | Organisational structure | <ul style="list-style-type: none"> • The roles and responsibilities become blurred among the business functional teams • High level of interactions among the teams • Low formalization, high complexity | <ul style="list-style-type: none"> • The role and responsibilities are clearly divided among the teams • Low level of interactions ('silo management') • High formalization, low complexity | Azarenko et al. (2009), Meier et al. (2010), Reim et al. (2015), Wiesner et al. (2015) |
| | Risk | The level of risks is high as the business complexity is increased | The risk level is low, as expanding service business does not trigger significant changes in different parts of the business | Nordin et al. (2011), Reim et al. (2015), Hou & Neely (2017), Johnstone et al. (2009) |
| Customer management (external) | Value determination and perception | Value is mutually determined by the customer and provider | Value is determined by the supplier | Windahl & Lakemond (2010) |
| | Value creation | <ul style="list-style-type: none"> • The customer is involved as a value co-creator • Much 'personal' communication | <ul style="list-style-type: none"> • The customer is acting as a value receiver and rarely contributes to the value creation • Formal and standardized communication | Baines, Lightfoot, Peppard et al. (2009), Baines et al. (2007), Rajala et al. (2013), Rönnberg Sjödin et al. (2016) |
| | Customer relationship | <ul style="list-style-type: none"> • Long-term relationship building through key account management • Trust is necessary | <ul style="list-style-type: none"> • Relatively short-term relational and transactional relationship • Limited interactions | Baines, Lightfoot, Peppard et al. (2009), Reim et al. (2015), Sousa & da Silveira (2017) |

2.8 Chapter summary

This chapter reviewed the current literature that underpins this research project. It started with the definition of the key concept – servitization and relevant research streams (support services, PSS, integrated solution and servitized offerings). Following this, the next two sections explored the benefits and challenges of servitization, in which an SLR was conducted on the challenges, in order to explore the formal constructs and relevant indicators. After this, the two research gaps were emphasised and led to the formulation of one RA and two supplementary RQs. To address the questions, the last two sections presented the theoretical framework towards each RQ respectively, which provided a knowledge basis for the empirical study. Table 2-11 summarises the key findings of this chapter.

Table 2-11 Summary of the literature review chapter

| |
|--|
| <p>Servitization literature</p> <p>-Definition: <i>Servitization is an overarching strategy that is adopted by the product-centric company to align its business objective to the customer needs, through which the company delivers value-in-use for business customers through an integration of products, services, technologies and customer interactions.</i></p> <p>-Relevant concepts in the servitization research:</p> <ul style="list-style-type: none"> • Support services • Product Service System (PSS) • Integrated solutions (IS) • Servitized offerings <p>-Servitization benefits:</p> <ul style="list-style-type: none"> • Strategic benefits • Financial benefits • Marketing benefits <p>-Servitization challenges:</p> <ul style="list-style-type: none"> • Organisational structure • Business model • Development process • Customer management • Risk management |
| <p>Research gaps</p> <p><i>Gap1: The performance implications of servitization challenges remain under-explored</i></p> <p><i>Gap2: There is a lack of understanding on how the challenges are varied in different servitized businesses</i></p> |
| <p>Research aim</p> <p><i>To explore the impacts of servitization challenges on business performance and how they are different in the servitized businesses with different strategic focuses.</i></p> |
| <p>Research questions</p> <p><i>RQ1: How do servitization challenges affect the realisation of servitization benefits (strategic, financial, and marketing) leading to superior business performance?</i></p> <p><i>RQ2: How are the challenges different in businesses with different strategic focuses (IS providers vs. PS suppliers)?</i></p> |
| <p>Theoretical framework</p> <ul style="list-style-type: none"> • <i>To address RQ1, a set of hypotheses was developed to form a theoretical model (Figure 2-6).</i> • <i>To address RQ2, a new typology (Table 2-10) was developed to classify the servitized businesses, which helps in understanding how the identified challenges exhibit in different business settings.</i> |

3 METHODOLOGY

3.1 Chapter overview

This chapter outlines the methodological design of this study. It begins with the justification of the author’s philosophical stance – pragmatism, and the chosen research approach – abductive, and then moves on to the detailed research design. Given that a sequential explanatory mixed research design is applied in this study, the quantitative phase (survey) and qualitative phase (case study) are detailed in a sequential order, and the design specifics comprise the sampling strategy, data collection, data analysis and methodological rigour of each phase. Figure 3-1 illustrates the structure of this chapter.

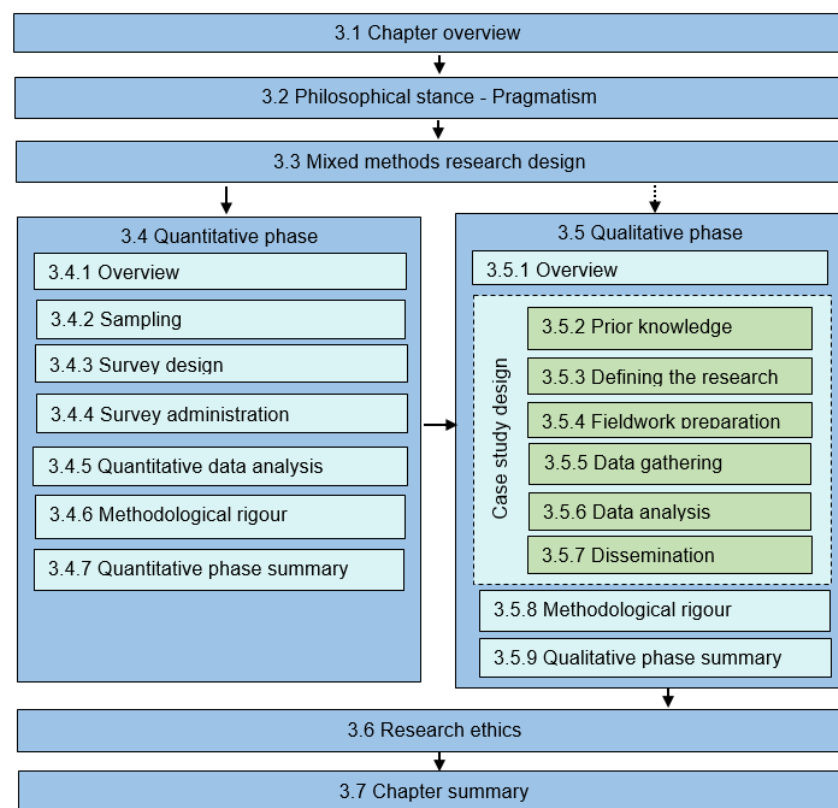


Figure 3-1 The structure of the methodology chapter

3.2 Philosophical stance

Research philosophy refers to a series of beliefs and assumptions of how researchers develop knowledge in a particular research area (Saunders et al., 2016). There has been a wide consensus that each research project, particularly the doctoral study, is underpinned by one or more research philosophies. The philosophical choice provides a guidance on the research design, specifically the data collection, analysis and result interpretation, which can be determined based on the researcher’s opinion of the nature of reality (ontology), the possible ways of knowing reality (epistemology) and the role of

value in the research (axiology) (Saunders et al., 2016). The determination of one particular research philosophy usually means that the researcher will adopt a certain research method that is in line with the chosen philosophy (Van de Ven, 2007), and therefore it is important that the researcher should be clear about the research philosophy from the beginning of the project. In the following section, the author will first introduce the common philosophies – positivism and interpretivism – and then justify her philosophical stance as a pragmatist.

3.2.1 Positivism and interpretivism

In operations research, two research philosophies – positivism and interpretivism – are mostly applied, which represent the two extremes of the philosophical stances. Positivism is derived from the scientific research that encourages researchers to be independent of the data and retain an objective stance (Hair et al., 2015). Following this philosophy, a highly structured quantitative research method, such as the survey and an experiment with a large sample size would be appropriate to test the hypothesis that is developed from the literature (Collis & Hussey, 2013). Interpretivism embraces an opposite stance where the researcher is part of the research project, and thus the subjective view is unavoidable (Hair et al., 2015). The interpretivists believe that reality is constructed by human insights, which are considered as valuable sources to address RQs in the operations domain (Collis & Hussey, 2013). Therefore a qualitative method, such as the in-depth interview, is appropriate to capture insights from human participants (Hair et al., 2015). Although the two philosophies can be alternatives for the researcher working on different types of research projects, their contradictory nature makes them less able to answer some RQs that require a combination of the two. Thus, an additional philosophy – pragmatism – was recently introduced that establishes a strong philosophical ground for a mixed method (qualitative and quantitative) (Creswell & Plano-Clark, 2011). It emphasises that the testing of ideas in human experiences in order to address the practical issues stems from everyday practice, which is in line with the author's viewpoint on the operations research. The following section elaborates on how the adoption of pragmatism suits this project.

3.2.2 Pragmatism

Pragmatism originated because scholars suggested that an effective researcher should be flexible by using mixed methods to produce acceptable knowledge for practical, applied research, instead of being constrained by a single paradigm (Morgan, 2007). This approach aims to solve problems that have emerged from real practice and contribute to the solutions that have implications for the future practice (Saunders et al., 2016). Thus scholars claim that pragmatism is naturally different from other philosophies, and should

be considered as “*a set of philosophical tools that can be used to address problems... the central idea is that the engagement in philosophical activity should be done in order to address problems, not to build systems*” (Biesta, 2010, p. 97). Moreover, the pragmatist advocates that the research problem is the key to determine the research design, rather than the philosophical paradigm that considers the interconnection of ontology, epistemology and axiology (Morgan, 1998; Tashakkori & Teddlie, 1998). Its advocates embrace a practical orientation that “*emphasises individual components of philosophy and theory as guiding research activities*” (Teddlie & Tashakkori, 2010, p. 13). These imply that pragmatism places emphasis on the practical research problem, anticipated result and individual philosophical assumption, rather than philosophical paradigms.

Prior to the detailed design, the key principles of pragmatism are summarised according to the well-known pragmatists: Charles Sanders Peirce, William James and John Dewey (the famous American philosophers), and modern pragmatist philosophers (Tashakkori & Teddlie, 2010). They assert that pragmatism:

- breaks the qualitative/quantitative divide, as some proponents claim that the use of these terms can be misleading (Biesta, 2010).
- believes that the knowledge comes from human interactions with the environment (Morgan, 2007).
- emphasises the balance between empiricism and constructivism in the research, as the knowledge is constituted by both constructive and empirical explorations (Cherryholmes, 1992).
- values the importance of ontological pluralism – the reality is complex (Cherryholmes, 1992).
- views the usefulness of theory in explanation or prediction, instead of judging it to be either ‘True’ or ‘False’ (Johnson & Onwuegbuzie, 2004).

These principles further differentiate the pragmatic approach from the dualism of qualitative and quantitative approaches. Table 3-1 contrasts pragmatism with the two common research philosophies, and demonstrates that the pragmatic approach combines the elements of interpretivism and positivism, which is appropriate in this study for the following reasons. First, the pragmatic approach is applied following an abductive reasoning that advocates moving back and forth between the qualitative (inductive) and quantitative (deductive) data, which primarily establishes the theory based on observations and then tests it through action (Morgan, 2007). This abductive approach is suitable for the researcher who intends to adopt a mixed research method, in which the inductive purpose of a qualitative approach is driven by the deductive results of a quantitative approach, or vice versa (Morgan, 2007).

Second, subjectivity and objectivity are referred to as the viewpoints of researchers in the research process (Morgan, 2007). The majority of researchers advocate to be ‘completely objective’ and avoid being ‘completely subjective’, or vice versa. However, in operations research, complete subjectivity/objectivity is found nowhere. It is therefore the dualism of subjectivity and objectivity that has been retained to suit different research needs, and is termed intersubjectivity in the classic pragmatism (Biesta, 2010). Intersubjectivity allows the researcher to decide when and where to become involved in the project, which requires the researcher to possess a clear understanding of the research context and recognise the potential concerns of the reviewer of the research. This indicates that a mutual understanding needs to be accomplished not only with people who participate in the research, but also with people who review the research output (Morgan, 2007).

Third, given that the qualitative study is context-focused, while the quantitative study focuses on a large population to achieve generalizability, adopting a single method makes the result either context-bound or generalized. However, the pragmatic approach focuses on shared meanings and joint actions, in which the pragmatist believes that the theory ‘can be both contextual and generalizable by analysing their transferability to another situation’ (Creswell, 2009, p. 4). This means adopting the pragmatic approach strengthens the depth and breadth of the research by connecting the qualitative and quantitative approaches, which is regarded as a key benefit of this approach.

Table 3-1 Summary of main research philosophies (Morgan, 2007, p. 71)

| Research Philosophies | Interpretivism | Positivism | Pragmatism |
|----------------------------------|-----------------------|-------------------|-------------------|
| Approaches | Qualitative | Quantitative | Combined |
| Connection of theory and data | Induction | Deduction | Abduction |
| Relationship to research process | Subjectivity | Objectivity | Intersubjectivity |
| Inference from data | Context | Generality | Transferability |

In the light of these, the pragmatic approach is considered to be appropriate in this study. Given that this study is practice-oriented, as it seeks to understand the performance implications of servitization challenges and the manifestation of the challenges in different businesses, a sequential explanatory research design is employed to address the aim through the combination of the quantitative and qualitative approaches, the detailed design of which is presented in the next section.

3.3 Research design – A sequential explanatory mixed method

A mixed methods research design has evolved into a common research approach in operations research, which combines the quantitative and qualitative approach in a single study to address the RQ through the mitigation of weaknesses of the two (Johnson & Onwuegbuzie, 2004; Johnson et al., 2007).

Although the philosophical and methodological foundations of the mixed method approach are well-established by the academic community (e.g. Creswell, 2013; Johnson & Onwuegbuzie, 2004; Morgan, 2007; Tashakkori & Teddlie, 2010), there are some challenges yet to be addressed in order to achieve an appropriate result. Table 3-2 summarises the strengths and weaknesses of the mixed method design, which should be considered by the scholar when designing the study. The challenges of adopting a mixed method research design are mainly concerned with the time issue, researcher’s capability of mastering multiple research methods, and addressing methodological issues. To address the challenges, the researcher should possess strong independent research skills and have a detailed research plan to make sure every task can be completed on time. From a practical perspective, the researcher faces challenges in validating the research results and making a connection between the qualitative and quantitative phases (Creswell & Plano-Clark, 2011). These challenges are considered and addressed through a detailed research design, and the next few sections demonstrate the author’s solution to the issue.

Table 3-2 Summary of pros and cons of mixed methods (Adapted from Creswell & Plano-Clark, 2011; Johnson & Onwuegbuzie, 2004; Tashakkori & Teddlie, 1998)

| Pros | Cons |
|--|--|
| <ul style="list-style-type: none"> Words, pictures and narratives help to explain the numbers - quantitative results cannot help researchers understand the context | <ul style="list-style-type: none"> Time-consuming |
| <ul style="list-style-type: none"> Numbers increase the levels of precision of word, picture and narratives – qualitative results cannot be generalized | <ul style="list-style-type: none"> Difficult for one researcher to complete |
| <ul style="list-style-type: none"> Taking advantage of both quantitative and qualitative methods | <ul style="list-style-type: none"> Having weaknesses of both quantitative and qualitative approaches |
| <ul style="list-style-type: none"> Generating and testing the theory in a single study | <ul style="list-style-type: none"> Requiring multiple background knowledge and skills in data analysis and interpretation |
| <ul style="list-style-type: none"> The weakness of one method can be offset by another’s strength | <ul style="list-style-type: none"> Hard to prove the validity |
| <ul style="list-style-type: none"> Providing complete knowledge and stronger conclusion resulting from ‘methodological triangulation’ | <ul style="list-style-type: none"> Problems of mixing methods (when and where to combine the methods) |

In the light of the benefits and drawbacks, the author decided to adopt the mixed research method due to two reasons. First, with the pragmatic philosophical stance, a mixed method approach is appropriate to support the application of the abductive approach in this study, which adopts both quantitative and qualitative methods in a sequential fashion to achieve methodological triangulation (Saunders et al., 2016). Second, the two RQs require a combined method to provide a rounded view on the topic. Regarding RQ1, the extant research investigates the servitization challenges mainly through qualitative studies, which form a theoretical basis for a quantitative study to validate the emerging relationship between the servitization challenges and business performance. To address this RQ, the author first adopts a quantitative survey to test the hypothetical relationship proposed in section 2.6 in the literature review chapter. RQ2 aims to explore how the challenges exhibit in different servitized businesses, where the empirical evidence is insufficient in the current body of knowledge. To answer this RQ, a qualitative case study is conducted to explore the challenge manifestations in two types of servitized businesses – IS provider and PS supplier. The qualitative study is supplementary to the quantitative survey, as the former further explores and explains the survey results by investigating unsupported relationships and group differences. Therefore this combination is highly synergistic, where the qualitative data, as a follow-up phase to the quantitative survey, reinforce the quantitative findings to provide more primary insights (Edmondson & McManus, 2007).

This design is entitled 'the sequential explanatory design', which is one of six design protocols for applying mixed research methods to addressing different research needs (Creswell & Plano-Clark, 2011). Figure 3-2 illustrates the general design adopted in this study that begins with the quantitative data collection and analysis, followed by the qualitative data collection and analysis, and the findings of each phase are then integrated into the discussion chapter to form a rounded view on the project. The main purpose of this design is to use the qualitative results to further explain and explore the quantitative results. In terms of explanation, the author uses qualitative findings to explain the significant/non-significant results of the quantitative survey (Bradley et al., 2009). In terms of exploration, the author uses the qualitative findings to investigate the different groups (servitized companies with different strategic focuses) in the quantitative study and further explore the similarities and differences among the group with regard to the challenges facing them (Creswell et al., 2003; Morgan, 1998; Tashakkori & Teddlie, 1998).

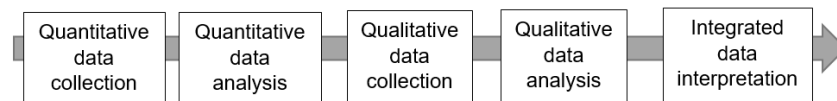


Figure 3-2 Snapshot of sequential explanatory research design (Adapted from Creswell & Plano-Clark, 2011)

Before moving onto the detailed design, Table 3-3 details the four fundamental decisions that the author made to support the implementation of the mixed method research design (Creswell & Plano-Clark, 2011; Creswell et al., 2003; Ivankova et al., 2006; Tashakkori & Teddlie, 1998; Teddlie & Tashakkori, 2009).

Table 3-3 Key decisions of mixed method research design in this study

| | |
|---------------------|--|
| Timing | Sequential or concurrent data collection |
| Weighting | Qualitative priority, quantitative priority or equal priority |
| Mixing stage | Data collection, analysis or interpretation |
| Mixing type | Merging, connecting or embedding |

Timing refers to the chronological order between the quantitative and qualitative phases in the mixed research design, where they are conducted either sequentially or concurrently (Ivankova et al., 2006). The sequential design is suitable when quantitative and qualitative data collection and analysis are carried out in two separate phases, whereas the concurrent design allows two phases to be conducted at the same time (Creswell & Plano-Clark, 2011). This study adopts the sequential design as the study is explanatory in nature, where the qualitative phase is designed according to the quantitative results.

Weighting refers to the priority of the quantitative and qualitative method in the study, in which either one phase is dominant or they are equally weighted (Tashakkori & Teddlie, 1998). In this study, the quantitative method plays a dominant role as the primary goal is to investigate the performance implications of servitization challenges, and the qualitative study is regarded as supplementary in order to further explain and explore the survey results.

Mixing stage/type indicates when and how the two research methods are mixed (Creswell, 2014). In this study, the qualitative and quantitative data are mixed only during the interpretation stage, which means the data collection and analysis phases are conducted separately. The mixing type considers how the data are combined, where three mixing strategies are recommended: 1) simply merging two strands; 2) connecting the analysis of the first strand to the second strand; 3) embedding one strand within another (Creswell &

Plano-Clark, 2011). This study applies the second strategy, in which the two phases are connected in the interpretation stage (referred to in the discussion chapter) to achieve triangulation. Table 3-4 presents the detailed implementation plan that demonstrates how the two strands are combined in this study.

Table 3-4 Implementation plan of the sequential explanatory approach in this study (According to Creswell & Plano-Clark, 2011)

| | Key Activities |
|-------------|---|
| Step 1 | Quantitative phase: <ul style="list-style-type: none"> • Develop the quantitative study according to the research question • Identify the quantitative sampling • Obtain ethical permission • Collect quantitative data via web-based survey • Analyse quantitative data using a statistical method (PLS-SEM) |
| Preparation | Connecting strategy: <ul style="list-style-type: none"> • Determine which results will be explained, such as: <ul style="list-style-type: none"> ○ Significant results ○ Non-significant results ○ Group differences • Use quantitative results to <ul style="list-style-type: none"> ○ Develop the qualitative study ○ Design the qualitative data collection protocol ○ Select research participants for the qualitative study |
| Step 2 | Qualitative phase: <ul style="list-style-type: none"> • Develop qualitative research questions that follow from the quantitative results and design the qualitative approach • Collect qualitative data • Analyse the qualitative data through coding and text analysis |
| Step 3 | Interpreting the results: <ul style="list-style-type: none"> • Discuss the quantitative and qualitative results together with reference to the current literature to form the triangulation (This demonstrates to what extent and in what ways the qualitative results help to explain the quantitative results). |

The following sections (3.4 and 3.5) present the detailed design of the quantitative and qualitative phases separately.

3.4 Quantitative phase

3.4.1 Overview

This section presents the detailed design of the quantitative phase, which includes the sampling strategy, survey development, administration process and data analysis. There are four common errors in the quantitative study, which should be thoroughly addressed in the design (Dillman et al., 2014). Table 3-5 shows the explanation of each type of error and in which section it is addressed.

Table 3-5 Survey errors (According to Dillman et al., 2014)

| Error type | Explanation | Addressed in |
|---------------------------|--|---------------|
| Sampling error | It occurs when surveying part of the sample rather than the whole population | Section 3.4.2 |
| Coverage error | It occurs when the list from which the sample is drawn does not contain all elements of the population | Section 3.4.3 |
| Measurement error | It occurs from poor instrument design, such as poor wording and ambiguous questions in the questionnaire | Section 3.4.4 |
| Non-response error | It occurs when a large number of targeted audiences do not respond to the survey | Section 3.4.5 |

3.4.2 Sampling

The sampling process in this study is designed based on a six-stage process (Figure 3-3) introduced by Churchill & Iacobucci (2010). Each stage is discussed in turn in the following section.

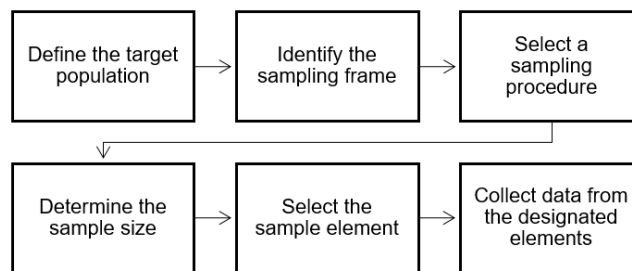


Figure 3-3 Sampling process in this study (Churchill & Iacobucci, 2010)

3.4.2.1 Define the target population

Given that this study focuses on the servitization challenges faced by the product-centric companies in the B2B context, a UK-based company that has adopted a servitization strategy would be the potential participant in this study. The author also extends the coverage to include some IT companies, as many of them have established strong service capabilities to deliver servitized offerings – particularly business solutions to customers.

3.4.2.2 Identify the sampling frame

To evaluate the relevance of the sampling frame, Chisnall (2005) suggested that the sampling frame should cover the population (adequacy); include all units in the population (completeness); exclude overlapping elements of the population (duplication); contain detailed information of the sample (accuracy); and be easily accessed (convenience).

To meet the criteria, a reliable database – FAME (Financial Analysis Made Easy) – was used to identify the sampling frame in this study, as this database has been used by peers in the same research area (Baines et al., 2010; Myrthianos et al., 2014). In addition, a set of predefined selection criteria was applied, in which the ideal company should 1) fall into UK SIC (2007) codes 17-32, excluding 31; 2) be currently active; 3) have more than 250 employees; 4) have a turnover of more than £5 million per annum. These criteria were primarily adopted by the peer scholars in prior studies, such as Baines et al. (2010) and Raddats and Kowalkowski (2014). Using these criteria, more than 2,000 companies were located on the FAME database. Given that this research is context-specific (servitized companies), the author screened the companies based on secondary data (e.g. company website, annual reports) to ensure that the target companies had developed servitized offerings and have sufficient knowledge of the servitization challenges. This screening reduced the number of companies to around 1,200.

This sampling frame reduces the sampling error as the whole population was targeted. Although the FAME database provides easy access to company information, the documented data are mainly secondary financial data and it is not possible to generate a contact list based on the results. The database provides the contact details (e.g. email and phone number) of key decision makers in some companies, but these are not sufficient to be used for this study. To extend the contact list, the author tried to generate a contact list through a ‘cold call’ to the companies located in the database; however, most of them refused to share details of internal contacts due to company policy. An alternative solution to this would be to purchase a contact list from a reliable data marketing specialist, the details of which are mentioned in section 3.4.2.5.

3.4.2.3 Select a sampling procedure

The probability and non-probability samples are two common methods that are used in operations research (Churchill & Iacobucci, 2010). A probability sample refers to the condition that all targeted populations have an equal chance of being included in the sample. In contrast, a non-probability sample indicates that the chances of a population being included in the sample are unequal, and this implies that the sample might not be able to represent the population. This study uses the simple random sample, the most common

method of probability sampling, meaning each element of the population has an equal chance to be included in the sample (Bryman, 2016).

3.4.2.4 Determine the sample size

The determination of a sample size should consider the specific requirements of the survey, instead of choosing the sample based on a certain percentage of the population, such as some studies that require a certain level of accuracy in the results (Chisnall, 2005). Similarly, De Vaus (2014, p. 77) also emphasised that the sample size depends on “the degree of accuracy required in the sample”, and “the variation in the population regarding the key characteristics of the study” should be considered. More importantly, the technical requirements of the statistical analysis should be considered, which is addressed throughout in this section.

This study aims to achieve a random sample of around an appropriate number of responses that are sufficient considering the number of constructs in the theoretical model in section 2.6 and data analysis method – partial least squares (PLS) (see section 4.3 for a detailed explanation). This estimated sample size is comparable with the prior operations research that uses the same data analysis method, such as Ng et al. (2013), Skipworth et al. (2015), Rollins et al. (2012) who used 96, 86, and 114 sample sizes respectively.

3.4.2.5 Select the sample element

Given that the researcher was unable to generate a proper contact list from the FAME database, a mailing list including 489 contacts was purchased from DataHQ, a local specialised B2B marketing data provider. The list was generated based on several predefined criteria: UK companies, currently active, more than 250 employees, falls into UK SIC (2007) codes 17-32 excluding 31. For each company, individual contacts for the selected job roles (e.g. key decision makers and marketing communication) were provided, mainly including Managing Director, General Manager and Marketing Manager. However, the service-related roles, such as Service Manager were not covered in the list, as they are not the main target audience in a B2B marketing campaign. To address this issue, the author decided to contact people who are on the list and kindly ask them to direct her to the right person if they did not have sufficient knowledge to answer the survey. Moreover, some relevant people were located through the author’s own desk-top research (e.g. LinkedIn, industry reports and company websites), from which the mailing list was extended to 542 contacts.

Since the company list was randomly generated from the data provider’s database, the researcher did not know which companies would be included in the list. This reduces the coverage error that only occurs when some elements of the sample have zero chance of

being selected (Churchill & Iacobucci, 2010). In addition, using a reputable data provider helps to minimize the coverage error as they guarantee an annual update on the contact information to retain data accuracy.

3.4.2.6 Collect data from the designated elements

This stage is about the design of a survey instrument, survey administration and response collection, which are presented in the following section.

3.4.3 Survey design

This section explains the key steps of the survey design in this study, which aims to minimize the measurement error throughout the whole process.

3.4.3.1 Clarifying the concepts

According to De Vaus (2014), survey design begins with the operationalisation of key concepts with a set of indicators, which can be transformed into survey items. The concept refers to the construct that was developed in the literature review. Given that the quantitative survey aims to explore the underlying relationship among the servitization challenges, benefits and business performance, nine constructs are developed and covered in the theoretical model in section 2.6.3.

3.4.3.2 Developing indicators

The relevant indicators of constructs were developed in the literature review chapter, where the constructs and indicators of servitization benefits (strategic, financial and marketing) are detailed in Table 2-5 (section 2.3), and the constructs and indicators of the challenges are summarised in Table 2-9 (section 2.4.3).

De Vaus (2014) highlights three issues that should be considered when developing the indicators. First, how many indicators are sufficient? There is no exact number, and it depends on several factors: the length of the questionnaire, the total number of indicators for each concept and, more importantly, the relevance of the indicators to the study (De Vaus, 2014). To capture a full scope of the concept, at least three indicators are developed for each construct in case some of them may be dropped in the data analysis. Second, how are the indicators developed? De Vaus (2014) suggests that the pre-developed indicator in the published work should be adapted to avoid 'reinventing the wheel'. However, this study is the first work to investigate the performance implications of the servitization challenges and benefits, and there is no extant indicator in the current body of literature. Therefore, a list of formal constructs and indicators are generated from the SLR, where a list of qualitative studies was reviewed and analysed to generate relevant indicators. Given that

the business performance has been developed into a mature concept (construct), the indicators proposed by Ahmed et al. (1996) are adopted to measure the performance from a common economic perspective (e.g. revenues, net profits and market share). Considering that the potential participants are mainly industrial practitioners, measuring the business performance from an economic perspective forms a common view among them (Skipworth et al., 2015). Table 3-6 summarises the constructs and indicators of servitization challenges, benefits and business performance. The questionnaire used for this study is shown in Appendix 1.

Table 3-6 Defining and measuring the construct

| Constructs | | Definition (D) and Indicators (I) |
|--------------------------|-------------------------------|---|
| Servitization benefits | Strategic benefits (SB) | D: Retaining a competitive position in the market I: Product differentiation; setting barriers against competitors; reducing price-based competition; gathering feedback for technical improvement; retain competitive advantages |
| | Financial benefits (FB) | D: Improving financial performance I: Increase revenues; balance declining product sales; new channels of revenue growth |
| | Marketing benefits (MB) | D: Maintaining long-term collaboration with customers I: Respond to customer needs; increase customer satisfaction; establish corporate brand image; retain long-term customer relationship |
| Servitization challenges | Organisational structure (OS) | D: Challenges of restructuring the internal OS for supporting the adoption of servitization I: Culture change; communication; service expertise; inter-department collaboration |
| | Business model (BM) | D: Challenges of modifying the BM for supporting the adoption of servitization I: BM modification; value proposition; resource alignment; costing mechanism; pricing mechanism; supplier collaboration |
| | Development process (DP) | D: Challenges of developing an integrated DP for supporting the adoption of servitization I: Integrated DP; tools, methods and techniques; performance measurement; customer engagement |
| | Customer management (CM) | D: Challenges of establishing and maintaining a relationship with customers in designing and delivering servitized offerings I: Matching customer needs; ownership transfer; long-term relationship building; value co-creation; information sharing |
| | Risk management (RM) | D: Internal and external risks companies face during the servitization process I: Financial risks; operational risks; external risks |
| Business performance | Business performance (BP) | D: Financial performance of a firm over the past five years I: Net profits; revenue; market share; return on investment |

3.4.3.3 Constructing the questionnaire

To design an effective questionnaire, six elements should be considered: **reliability** (a respondent should answer the question in the same way at different times assuming their opinion has remained the same); **validity** (the question measures what is supposed to be); **discrimination** (provide adequate choices to identify any variation in the sample); **response rate** (high response rate to each question in the survey); **same meaning for all respondents** (all respondents perceive the question in the same way); and **relevance** (all questions are highly relevant to the RAVRQs) (De Vaus, 2014).

Many scholars claim that the wording of questions is crucial in designing an appropriate questionnaire. For instance, Bryman (2016) highlights that the researcher should use simple and short sentences, and avoid using 'double-barrelled' (asking two questions in one sentence), technical terms and guiding questions. Churchill and Iacobucci (2010) emphasise that open-ended questions should be minimized in the survey, as they may lead to no conclusion. In addition, they also recommend including categorical questions which are necessary to identify the characteristics of respondents, and using some general questions at the beginning of the survey to lead the respondent to the research-related questions smoothly (Churchill & Iacobucci, 2010). Building on this, Dillman et al. (2014) highlight the importance of logical flow, in which the questions should be designed following a logical order to reduce the cognitive burden of finishing the survey.

In the questionnaire, two types of questions were used: multiple-choice and rating scale. The multiple-choice categorical questions were used to capture the background information about respondents, from which the author could assess their relevance to the project and identify different groups (Jensen & Laurie, 2016). Following this, the rating scale questions were constituted as a main part of the research-related questions, whereby the respondents were asked to rate the given statement (each statement represents an indicator) based on their perceptions. A seven-point Likert scale was used in the questionnaire, and the range varies from 1 (strongly disagree) to 7 (strongly agree), where 4 indicates 'neither agree nor disagree'. This is a common survey technique for understanding the respondent's perception towards the statement, as it allows the respondent to express to what extent they agree or disagree with the statement (De Vaus, 2014). Although the Likert scale is reliable and easy to adapt, its ease of use may result in misuse if the researcher writes a statement without due care (Chisnall, 2005). However, from a practical perspective, the application of the Likert scale has been demonstrated in similar studies in the operations research field (e.g. Ng et al., 2009; Raddats et al., 2015; Skipworth et al., 2015). Therefore applying the Likert scale is considered to be appropriate for this survey.

Apart from the question formulation, there are other factors to be considered in the survey design. De Vaus (2014) highlights the importance of giving a clear instruction at the beginning of the survey, and the length of the questionnaire should be succinct. Churchill and Iacobucci (2010) also emphasise that the questionnaire should be as short as possible, as respondents may be put off by a questionnaire that never comes to an end. In terms of layout, the format usually depends on the type of survey. For a postal survey, the questionnaire should be formatted into a well-designed booklet (Dillman et al., 2014). For a web survey, the layout of the questionnaire should be tidy and easy to follow (Saunders et al., 2016). Given that a postal survey is costly and time-consuming, this project used a web-based survey that was established on a reputable platform called Qualtrics via the free access provided by the University of Warwick.

Before administering the survey, many scholars recommend undertaking a pilot test as this can be 'the most affordable insurance for the researcher to achieve success on the survey as well as the research project' (Churchill & Iacobucci, 2010, p. 255). The pilot test helps to check for potential errors in the format, language, logic and, more importantly, it confirms that the intended meaning of the questions is clear to the respondent (Jensen & Laurie, 2016). The survey used in this project was reviewed by the author's main supervisor, two colleagues who completed their PhD on servitization, and one external professor in the same research area, for academic comments. Apart from this, four industrial practitioners working in the servitized business were engaged to review the questionnaire to make sure the survey was understandable and would make sense to the potential respondent. All the comments were taken into consideration and necessary amendments were made to improve the overall quality.

3.4.4 Survey administration

This section describes how the survey was administered with the aim of reducing the non-response error, whereby several approaches are adopted to maximize the response rate.

3.4.4.1 Contact methods

The survey was distributed through a mass mailing to the targeted audience by using the survey distribution function of Qualtrics, in which the targeted audience received an email including the covering letter (shown in Appendix 2) giving the project aim, guidance for participation and survey link. The participants could simply click on the link to start the survey on their own devices, including PCs and cell phones. Moreover, Qualtrics helps to monitor the response of each recipient and can generate an instant report on the completion and dropout rate. For someone who is not willing to participate in the survey, they can unsubscribe from future communication by clicking on a link included in the email. These functions helped the researcher to categorize the audience according to their reactions,

and plan for the follow-up communication. Three weeks after the initial email was sent out, two reminders were sent out with the survey link to boost the response rate, in case the previous email was not 'received' by recipients (e.g. overlooked, marked as spam, away on holiday, etc.). After the final deadline passed, the follow-up phone calls were made by the researcher to gather more responses and explore the reasons for not participating in the survey (see section 3.4.4.3 for details).

3.4.4.2 Maximizing the response

A low response rate is a common issue in collecting data through a survey, no matter what format is used. To maximize the response, the researcher adopted several approaches. First, including a covering letter to address the key information. Churchill and Iacobucci (2010) stated that inclusion of a covering letter is important in survey administration as it persuades people to participate by stressing the importance of the study, the potential benefits they may obtain from the survey and the ethical concerns. Second, making it personal. The email was individually addressed with the correct title and full name (Chisnall, 2005). Third, giving incentives. A charity donation (£2 donation to UK Cancer Research for every completed response) was provided as an incentive instead of a cash reward in this study, as this costs a small amount of money for each returned survey and makes the participants feel that they did something meaningful (Chisnall, 2005). In addition, a free survey report was available upon request for each completed survey, as the potential participants are mainly from senior management, who would be interested in the survey results. Fourth, selecting an appropriate mail-out time (De Vaus, 2014). The email was sent out on the Thursday around lunch time, when the participants are more flexible after intensive work loads in the earlier weekdays. Also, people normally receive fewer disruptions during their lunch time. In addition, ethical issues, such as personal and commercial confidentialities, are reasons why potential participants may be reluctant to complete the survey. To address the ethical issues, the researcher followed the university guidelines on dealing with research ethics, and the detailed actions are summarised in section 3.6.

3.4.4.3 Follow-up to non-respondents

This section summarises the record of survey responses after each communication (including emails and phone calls). It is difficult to retain a completely precise record of who replied to which correspondence, thus an estimated result is shown in Table 3-7. In total, 96 responses were retained after eliminating the incomplete and suspicious responses; the details of the data examination are presented in section 3.4.5.2.3.

Table 3-7 Survey response record

| Correspondence | Targeted respondents | Number of responses | Percentage |
|-----------------------|----------------------|---------------------|------------|
| First email | 542 | 34 | 6.2% |
| Second email | 508 (542 - 34) | 15 | 3.0% |
| Third email | 493 (508 - 15) | 8 | 1.6% |
| Follow-up phone calls | 485 (493 - 8) | 39 | 8.0% |

Through three email communications, 57 valid responses were retained. Although the follow-up phone call was time-consuming, the researcher decided to do it in order to increase the response rate and collect the reason for non-response. The various issues were identified when contacting the recipient who had previously been contacted by emails. First, the recipient did not receive the survey, which could have been caused by the email being marked as spam or blocked by the company's IT system. Second, the recipient felt that the survey was not relevant to their job role. Considering this project is about servitized challenges and business performance, the ideal person for completing the survey would be someone who is involved in the service business or senior managers who possess an overview of the business. In this case, it was fortunate that some recipients forwarded the email to someone who they felt was in a better position to answer the survey. Third, there was no response to the voice message. The researcher often left a short voice message to unanswered calls stating the purpose of the phone call and sent a follow-up email to the person. It was quite often that the recipient never replied to the call and email, and the author generally abandoned trying to make contact after three attempts. Fourth, in a few cases the recipient that the author sought to reach was no longer working in the company, which meant she had to find new contact in the company herself. Finally, it is a common that recipients refuse to participate due to the company's policy on confidentiality. Despite these issues, 39 industrial representatives completed the survey after the follow-up phone calls.

In total, 96 valid responses were collected over a five-month period from November 2016 to March 2017. The response rate of 17.7% is comparable to similar studies in the operations management, such as De Giovanni (2012): 17.1% and McCormack et al. (2008): 21.4%. As a pre-agreed incentive, a charity donation of £192 (96 × £2) was made to the UK Cancer Research. The donation confirmation letter is shown in Appendix 3.

Although a series of actions was taken to increase the response rate, there is a certain percentage of targeted respondents who did not respond to the survey. In this case, the non-response bias is assessed by examining the size and industry type of companies that did not respond to the survey. According to Table 3-8, this study is not affected by the non-response bias as the figure demonstrates the non-responses spread over a variety of companies across different industries and company sizes.

Table 3-8 Company Profile of Non-responses (N = 446)

| Characteristic | | Frequency (%) |
|----------------------|--------------------------------|---------------|
| Industry type | Electronic equipment | 19.2 |
| | Aerospace & defence | 15.5 |
| | Metal products (not machinery) | 14.3 |
| | Transport equipment | 10.2 |
| | Medical systems | 8.5 |
| | Publishing & printing | 7.9 |
| | Information technology | 8.5 |
| | Chemicals | 6.4 |
| | Rubber & plastic products | 5.8 |
| | Wood (and paper products) | 1 |
| | Mining and quarrying | 1 |
| | Other | 1.7 |
| Firm size | 5000+ | 24 |
| | 1000-4999 | 22.4 |
| | 500-999 | 20.1 |
| | 250-499 | 25.1 |
| | 0-249 | 8.4 |

Notes: The companies were categorised according to the company profile in the FAME database.

3.4.5 Quantitative data analysis

To validate the hypotheses developed from the SLR, the structural equation modelling (SEM) method is used in this study. This section explains the rationale of using SEM and the process of analysing the data.

3.4.5.1 The basics of SEM

SEM is a common statistical method for testing theoretical hypotheses in operations research, whereby a path analysis is conducted for analysing the hypothetical relationship between latent variables (constructs) (Bagozzi & Yi, 2012; Shah & Goldstein, 2006). Through the application of SEM, the hypothesis (a causal relationship among constructs) is statistically tested, and the path coefficient is calculated to demonstrate the strength of the causal effect. In this study, the theoretical model in section 2.6.3 is validated with 96 responses by using the SEM method.

An SEM model consists of a measurement model and a structural model. The structural model, also named an inner model, demonstrates the relationships between endogenous and exogenous constructs. The measurement model, also named an outer model,

illustrates the related indicators of each construct (Henseler et al., 2016). Figure 3-4 illustrates a basic SEM model with one exogenous and one endogenous construct, whereby the relationship between them is shown as γ . The measurement model on the left side measures the exogenous construct (ξ) based on the indicator (X) considering the measurement error (δ). On the right side, the endogenous construct (η) in the measurement model is measured based on the indicator (Y) with the consideration of the measurement error (ε). To summarise, the SEM method tests each hypothesis as the causal relationship between two constructs through the relevant indicators, which are presented as statements in the questionnaire to capture the respondents' perceptions.

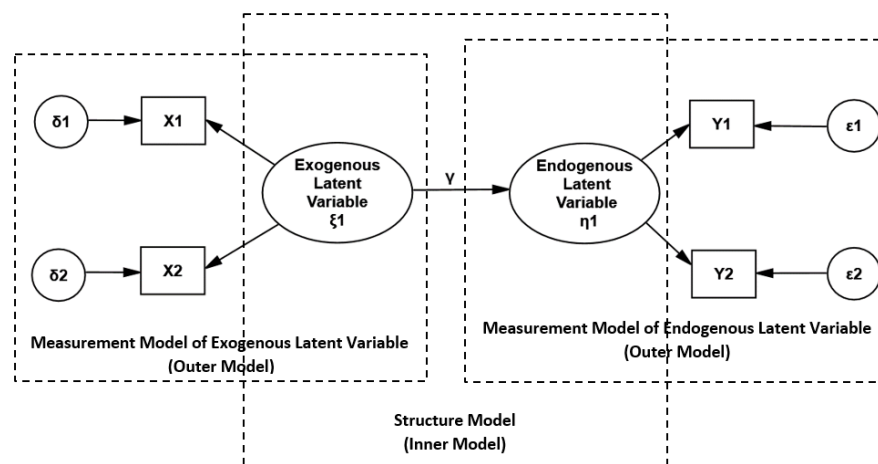


Figure 3-4 A basic SEM model (Adapted from Henseler et al. (2016))

Although SEM is widely applied in operations research, scholars have suggested there are two common issues that need attention. First, determining the sample size is important in the application of SEM and this usually depends on multiple factors (e.g. the model complexity and statistical power) (Hair, Black et al., 2014). In principle, the sample size in an SEM application is classified into three levels: small (<100), medium (100-200) and large (>200) (Kline, 2015), and it is common that a large sample is necessary to test a complex model (Fabrigar et al., 2010; Pairach, 2012). Second, the researcher should decide how the model fits with the data, and there are two choices – either the one-step or two-step approach. The former is suitable for a well-established model with hypotheses and constructs that are theoretically grounded (Anderson & Gerbing, 1988). The latter is suitable for an exploratory model that seeks to test new theories, where the measurement model should be tested first to test the check the construct validity, and then the structural model is tested if the construct is proved to be valid (Anderson & Gerbing, 1988). Considering that

the quantitative survey of this study seeks to validate a newly established model, the two-way approach is adopted in the data analysis (for details see the Chapter 4 survey findings).

There are two statistical approaches for assessing the SEM model, which includes covariance-based SEM (CB-SEM) and partial least squares SEM (PLS-SEM) to serve different research projects (Hair et al., 2012). To determine an appropriate approach for the study, the researcher should understand the fundamental difference between the two approaches. In terms of theory development, the CB-SEM is applicable when the theory has been fully developed in the extant study, for example, the constructs and relevant indicators have been developed and empirically tested in previous studies (Hair et al., 2016). In contrast, PLS-SEM is suitable for the project that explores a new theory, where the main purpose of the SEM model is to validate newly developed constructs or explore the theory that underpins the model and hypothesis (Astrachan et al., 2014; Hair, Sarstedt, et al., 2014).

Given that the CB-SEM has been widely applied in operations research, instead of reviewing the reason for not applying CB-SEM in this study, I justify the application of PLS-SEM. This approach is considered to be appropriate when 1) the primary objective of the research is to predict the targeted constructs or explore a structural theoretical model; 2) the model is complex and contains many constructs and indicators; 3) the sample size is relatively small (<100) and not normally distributed (Hair et al., 2012; Henseler et al., 2016; Marcoulides & Saunders, 2006).

In addition to the CB-SEM, the regression is another alternative approach for analysing the hypothetical relationships between a set of latent variables, and thus it is important to understand why the PLS-SEM is applied in this study rather than the regression. Likewise, we compare the PLS-SEM and regression and provide reasons for applying the former in this study. First, the constructs in our research model have multiple indicators to measure the different dimensions of each construct. Given that the regression deals with the model where the construct only has one indicator, the PLS-SEM is more appropriate for this study (Ramli et al., 2018). Second, the regression deals with the relationship between dependent latent variables and observed variables (indicators), which is not effective for investigating the relationship among the latent variables (Aibinu & Al-Lawati, 2010). Third, considering that constructs and measuring items in this study were newly developed based on the literature review, the measurement model needs to be assessed to identify the validity and reliability of indicators and latent variables. Due to the fact that the regression does not require any test on the validation of indicators for measuring the constructs (Aibinu & Al-Lawati, 2010), PLS-SEM is more suitable as it tests the validity and reliability at both the indicator and construct level. More importantly, our research model contains mediators,

where the mediation effects should be examined following a formal step. Based on the comparison (see Table 3-9) of the two methods above, the PLS-SEM is more suitable than the regression for testing the mediation in this study. This is as the regression is unable to deal with the constructs with multiple indicators and simultaneously examine more than one relationship within a single model (Aibinu & Al-Lawati, 2010). Moreover, unlike PLS-SEM, the regression does not address the difference between indirect ($\rho_1 \cdot \rho_2$) and direct relationship (ρ_3) in the mediation model (see Figure 3-6) (Ramli et al., 2018).

Table 3-9 Decision rules for choosing analytical method (According to Ramli et al., 2018)

| | PLS-SEM | Regression |
|--|----------------|-------------------|
| Support the examination of multiple indicators for each construct | Yes | No |
| Support the hypothesis testing with latent variables | Yes | No |
| Support the simultaneous analysis of multiple path ways in a single research model | Yes | No |
| Support the analysis of measurement and structural model in one analysis | Yes | No |

3.4.5.2 The application of PLS-SEM in this study

This section explains the process of applying PLS-SEM, which comprises six stages (Hair et al., 2016).

3.4.5.2.1 Stage 1: Specifying the structural model

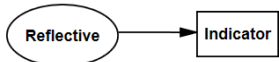
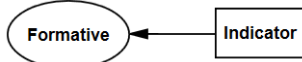
In an early stage of the research, a structural model that illustrates the constructs and their hypothetical relationships should be developed, which refers to the theoretical model that was developed in the literature review chapter (section 2.6.3).

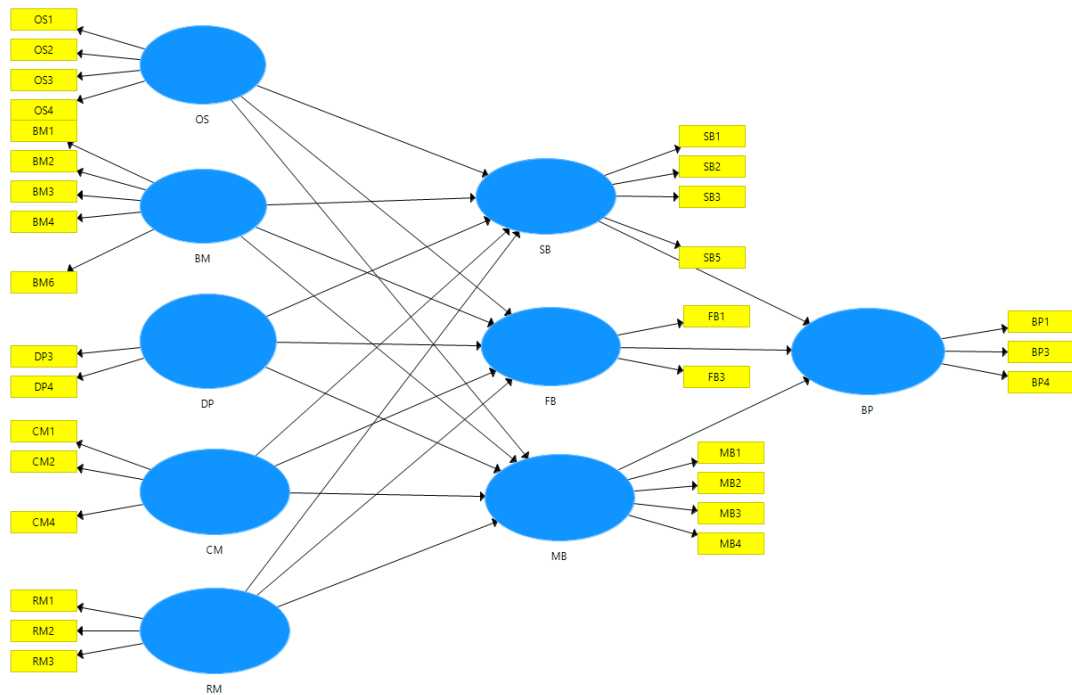
3.4.5.2.2 Stage 2: Specifying the measurement model

The measurement model illustrates the relationship between the constructs and their measuring indicators (Hair et al., 2016). Specifying the measurement model is a straightforward process, but there are two issues to be addressed. First, how many indicators are sufficient to measure a single construct? The rule of thumb is three valid indicators, in case some of the indicators are removed as they may score low in validity tests in the data analysis (Hair et al., 2016). Second, what is the type of measurement model? There are two common types: reflective model (direction of causality is from construct to indicator) and formative model (direction of causality is from indicator to construct) (Jarvis et al., 2003). Table 3-10 demonstrates the key decision rules for determining the model type, which have been taken into consideration in this study. The reflective measurement model is adopted in this study for several reasons. Given that the identified indicators are manifestations of the construct (servitization challenges, benefits and business performance), dropping any indicators in the later stage cannot affect the

constructs, instead, changing the construct could affect the relevant indicators. Besides, the indicators of a particular construct are relevant to each other, which means there is co-variation among them (Becker et al., 2012; Jarvis et al., 2003). This study uses *SmartPLS 3*, a reputable software recommended by Hair et al. (2016) which has been used by peer scholars such as Ng et al. (2009) and Skipworth et al. (2015). Figure 3-5 shows a snapshot of *SmartPLS*'s workplace, which gives the reader an idea of what the model looks like in the software.

Table 3-10 Decision rules for choosing model type (Adapted from Becker et al., 2012)

| |  |  |
|--|--|---|
| Direction of causality | from construct to indicator | from indicator to construct |
| Indicators defining | manifestations of the construct | characteristics of the construct |
| Would changes in the indicators cause changes in the construct? | No | Yes |
| Would changes in the construct cause changes in the indicators? | Yes | No |
| Interchangeability of the indicators | Yes | Not necessarily |
| Should indicators have the same or similar content? | Yes | Not necessarily |
| Would dropping one of the indicators alter the conceptual domain of the construct? | No | Yes |
| Are there co-variations among indicators? | Yes | Not necessarily |
| Should a change in one of the indicators be associated with changes in other indicators? | Yes | Not necessarily |
| Are indicators are expected to have the same antecedents and consequences? | Yes | Not necessarily |



Note: Constructs – Blue ellipses; Indicators – Yellow rectangles

Figure 3-5 A snapshot of *SmartPLS 3* workspace

3.4.5.2.3 Stage 3: Examination of the collected data

The data collection and examination are crucial for the application of SEM in the research project. Before the final analysis, the researcher should address the potential issues, such as missing data and suspicious response patterns (Hair et al., 2016).

Missing data is a common issue in operations research, especially when the data are collected through a survey method. A particular issue is that one or more participants failed to answer all the questions, which results in the questionnaire being left as incomplete. Hair et al. (2016) suggest that incomplete responses should be excluded from the data analysis if unfinished questions account for more than 15% of the overall length. However, the incomplete response with less than 15% unfinished questions may also be removed if there is a high percentage of responses missing for a particular question, which is common issue in measuring sensitive topics such as racism, political issues or business performance. In general, this research project only experienced missing data where some questionnaires were left incomplete. To achieve a high completion rate, the author always checked through the questionnaire on the day it was returned. For the incomplete surveys, respondents were contacted to remind them to finish the survey by email and follow-up phone calls. It was usual that they had been interrupted when filling in the survey, and believed they would

need to do it all over again, but actually the author explained that they could carry on and finish the survey if they accessed the survey via the original web link.

The 'suspicious' response should be checked before data analysis is performed. The typical issue is called 'straight lining', which refers to a participant ticking the same answer for all questions throughout (Hair et al., 2016). This is common when using a Likert scale in the survey, where the participant ticks one particular number for all questions. This implies that the participant may not have read the question, thus the response should be removed from the final analysis to avoid its potential impact on the findings. Similarly, another situation is that the participant selects an extreme answer such as 1s (strongly disagree) or 7s (strongly agree) only throughout; these responses should be disregarded as well. To address these issues, the author manually checked every questionnaire when it was returned, and two suspicious responses were abandoned.

3.4.5.2.4 Stage 4: Evaluation of measurement model

The assessment of PLS-SEM results follows a systematic approach. Considering that the measurement model in this project is reflective, a set of evaluation criteria for a reflective model has been applied, comprising the construct convergent validity, internal consistency and discriminant validity. This section only provides an explanation of how to interpret the data analysis results and the pass threshold for each test. The quantitative results are presented in Chapter 4 Survey Findings.

The *construct convergent validity* indicates the extent to which the indicator correlates with other indicators of the same construct. This is assessed using confirmatory factor analysis (CFA) at an indicator level, where the factor loading of each indicator on its construct is examined. The loading should pass a minimum threshold of 0.7 in order to be included in the final analysis, otherwise, it should be removed to improve the model fitness (Hair et al., 2016). It is common that factor loadings are low (less than 0.7) in a study where the constructs and indicators are newly developed (Garson, 2016). However, eliminating the low score indicator may not be wise, as the researcher should carefully assess the impact of item removal on the model, and it should only be necessary if deleting an indicator can improve the model, particularly for the results of composite reliability and content validity (Hair et al., 2016). Besides, the average variance extracted (AVE) is applied to measure the convergent reliability from a construct level. This value indicates the mean of indicators associated with the same construct, and is equal to the sum of the indicators divided by the number of indicators (Hair et al., 2016). The AVE value should be more than 0.5 for the construct to be retained (Garson, 2016; Hair et al., 2016).

The *internal consistency reliability* is measured using Cronbach's alpha (CA) and composite reliability (CR). The former assesses the reliability based on the inter-correlation of

observed indicators to a particular construct, while the latter takes into account that indicators retain different outer loadings to facilitate the result of CA in PLS-SEM. The CR is a value between 0 and 1, and a higher value indicates a higher level of reliability. The recommended passing threshold for CA and CR is the same, in which a value between 0.6 and 0.7 is satisfactory for an exploratory research, and a value between 0.7 and 0.9 is appropriate for an advanced research (Hair et al., 2016).

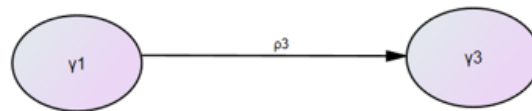
The *discriminant validity* identifies the distinction among constructs by assessing the correlations between indicators and non-associated constructs. Cross-loading is a common method to assess the discriminant validity of indicators, in which an indicator's outer loading on the associated construct should be higher than its cross-loading on a non-associated construct (Garson, 2016). If an indicator is highly correlated with a non-construct, a discriminant validity issue is signified and the indicator may be removed to address the issue. In addition to cross-loading, the Fornell-Larcker criterion is another approach to assess the validity, where the square root of AVE on a construct should be higher than its correlation with any other construct. This confirms that the associated indicator should share a greater variance with the associated construct rather than others.

3.4.5.2.5 Stage 5: Assessing PLS-SEM structural model results

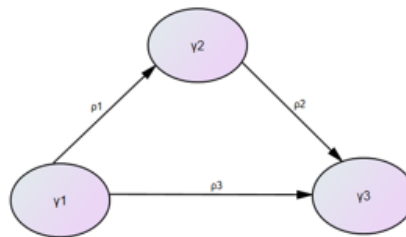
The structural model analysis shows the results of hypothesis testing by revealing the path coefficient and statistical significance of each hypothetical relationship. This stage is carried out after the measurement model has been assessed and its reliability and validity have been demonstrated. In PLS-SEM, the structural model is assessed according to the coefficient of determination (R^2) and path coefficients. First, the R^2 of each endogenous construct is assessed, which indicates the variance explained by a particular endogenous construct to the total variance of the model (Hair et al., 2016). There is not yet a rule of thumb on the value of R^2 , and an acceptable value depends on the model complexity and research domain. For example, the value of 0.20 is considered to be high in consumer behaviour research, whereas the value of 0.75, 0.50 and 0.25 are considered to be substantial, moderate and weak respectively in marketing research (Hair et al., 2016). The value of R^2 in this study is further explained in Chapter 4 Survey Findings, where the value of the endogenous construct is revealed. Furthermore, the Stone-Geisser Q^2 value for the endogenous construct should be examined to assess the predictive relevance of the model, and a value that is greater than 0 indicates an adequate prediction validity (Hair et al., 2016; Henseler et al., 2009). After the structural model has been assessed and accepted, a bootstrapping function is applied to examine the path coefficients among constructs, in which a larger number of samples are drawn from the original sample to enlarge the sample size (Hair et al., 2016). The absolute value of path coefficient that is above 0.100 at a

significance level of 0.1 is considered to be an acceptable hypothesis. The data analysis results from the structural model are presented in Chapter 4 Survey Findings.

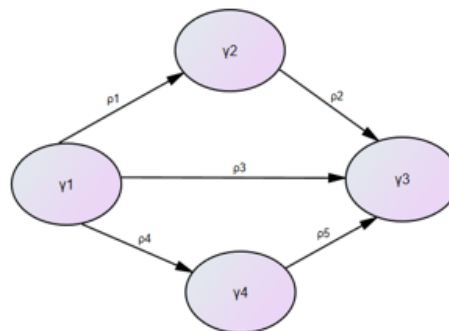
Given that the proposed model contains mediating effects, a proper mediation analysis should be carried out as a mediating variable can intervene in the relationship between two constructs (Hair et al., 2016). Figure 3-6 distinguishes the mediation model from the basic cause effect relationship. Figure 3-6 (a) illustrates the relationship (ρ_3) between γ_1 and γ_3 , whereas Figure 3-6 (b) illustrates a general mediation model that includes γ_2 as a mediator to the relationship, where ρ_3 represents a direct path and $\rho_1 \cdot \rho_2$ represent two indirect paths. In addition, Figure 3-6 (c) presents a multiple mediation model that comprises more than one mediator.



(a) Simple cause effect relationship



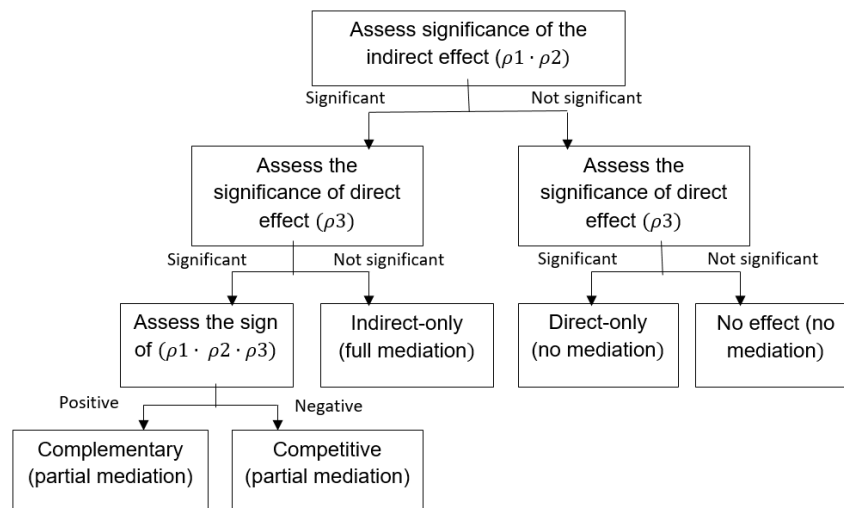
(b) General mediation model



(c) Multiple mediation model

Figure 3-6 Illustration of the mediation model

In this study, the proposed model contains three mediator variables – strategic benefits, financial benefits and marketing benefits. Hypotheses 6 to 8 suggest that the benefits (SB, FB and MB) are positively interrelated with each other, and each of them has a positive impact on the business performance, as suggested by hypothesis 9. These hypotheses confirm multiple mediation models within the model, and therefore, a further mediation analysis is necessary. A formal step of mediation analysis in Figure 3-7 is followed (Hair et al., 2016; Nitzl et al., 2016), which starts by assessing the significance of the indirect and direct effect, and then compares the results. The results of the mediation analysis are presented in Chapter 4 Survey Findings.



Note: Please refer back to Figure 3-5 (b) to understand this procedure.

Figure 3-7 Mediation analysis procedure (Hair et al., 2016; Nitzl et al., 2016)

3.4.6 Methodological rigour

The reliability and validity of the quantitative phase are examined by conducting a set of tests for evaluating the measurement model and structural model; the detailed results of data analysis and interpretation are presented in Chapter 4 Survey Findings.

3.4.7 Quantitative phase summary

This section presents the design of the quantitative phase of the empirical study. Given that a mixed method is applied in this project, the qualitative phase is presented in the following section.

3.5 Qualitative phase

3.5.1 Overview

Following the quantitative study, the qualitative phase is carried out to further explain the survey results and explore the answer to RQ2 'How are the challenges different in businesses with different strategic focuses (IS providers vs. PS suppliers)?' To answer this RQ, a case study methodology is adopted for three reasons: 1) it is an appropriate method for answering 'how' and 'why' RQs; 2) the researcher does not gain control over behavioural events; 3) this research project investigates a contemporary event within a real world context (Yin, 2014). Apart from fulfilling these basic conditions of applying a case study method, other methodological considerations led the author to make this decision. Considering that the prior empirical findings on this topic are few, adopting a case-based research could offer more insights to improve our understanding and develop theory (Siggelkow, 2007). More importantly, case-based research allows the researcher to be immersed within the empirical context of the case, which offers the opportunity to deeply investigate the phenomenon to understand the topic (Yin, 2014). This is particularly important in investigating the servitized offerings as there are many factors, such as the industrial setting and OS, that could affect the empirical observation, thus this requires the researcher to be highly engaged to understand the topic (Kastalli & Van Looy, 2013). To understand how the challenges exhibit in different servitized businesses, a multiple case study approach is suitable for this study, where two groups of servitized companies, one each of integrated solution providers (IS providers) and product suppliers providing generic services (PS suppliers) are investigated. The typology (Table 2-10 in section 2.7.2) developed in the literature review chapter distinguishes the two businesses in terms of BM and CM, which provide guidance for categorizing the participating companies. Figure 3-8 illustrates the research process for conducting the case study, and each stage is then explained in turn.

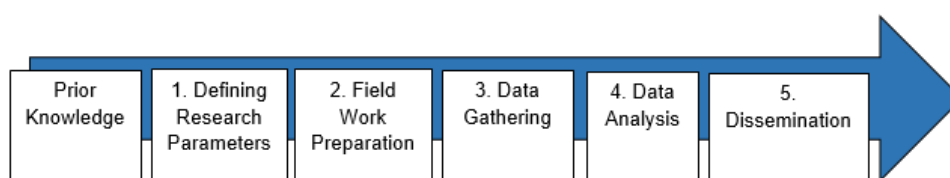


Figure 3-8 The case study research process (Yin, 2014)

3.5.2 Prior knowledge

Prior knowledge refers to the results of the literature review and quantitative phase that the qualitative phase can be built upon.

3.5.3 Stage 1: Defining the research parameters

The aim of this stage is to define the research parameters, where the research focus should be explicitly stated to guide the design of the case study. Yin (2014) highlights that three research components should be determined at this stage, and they are RQs, hypothesis/propositions and units of analysis.

To recap, the aim of this project is to *explore the impacts of servitization challenges on business performance and how they are different in the servitized businesses with different strategic focuses*. The two supplementary RQs are shown below to support the RA.

RQ1: How do servitization challenges affect the realisation of servitization benefits (strategic, financial, and marketing) leading to superior business performance?

RQ2: How are the challenges different in businesses with different strategic focuses (IS providers vs. PS suppliers)?

The second component concerns the development of theoretical hypotheses or propositions. However, it is acknowledged that while the hypothesis is suitable for deductive research, it is not necessary for the exploratory study, considering the nature of the second RQ (Yin, 2014). However, the theoretical model and typology developed in the literature review serve as an overall framework that underpins the design of the case study.

The unit of analysis refers to the definition of a 'case' in this project. Given that this research aims to understand how the servitization challenges are manifested in different servitized businesses, a company or an individual is not regarded as a case in this study; instead, a number of servitized companies that seek the same strategic focus are considered to be a single case. In this study, two types of servitized companies (IS providers and PS suppliers) are focused on and participating companies are clustered according to the developed typology. Therefore the unit of analysis is servitized businesses with different strategic focuses.

3.5.4 Stage 2: Fieldwork preparation

The main purpose of this stage is to prepare for the fieldwork through some detailed plans. Yin (2014) suggests that there are three components that should be addressed in the instrument development stage: case selection, instrument selection and case study protocol. They are discussed in turn below.

The case selection is straightforward as the potential participants were recruited during the collection of survey responses, and part of this qualitative stage is to investigate the

group difference that was not observed in the survey. This is because the nature of the qualitative phase is complementary to the quantitative study, and the design of this phase is according to the survey results. Overall, 21 (14 IS providers and 7 PS suppliers) out of 96 survey respondents signed up for the interviews after completing the survey, and 13 respondents made a real contribution to this project eventually, while the rest dropped out due to a busy agenda. Given that survey respondents were purposively selected based on the predefined screening criteria, they fit into the context of the qualitative study. Based on the service typology developed in section 2.7, the 13 respondents are classified into 9 IS providers and 4 PS suppliers; a detailed summary is provided in Chapter 5 Case Study Findings.

Regarding the instrument selection, Yin (2014) highlights six forms of evidence that can be used to form a part of case study research, and their strengths and weaknesses are summarised in Table 3-11 for the research consideration.

Table 3-11 The six common forms of evidence for case studies (Yin, 2014, p. 106)

| Source of Evidence | Strengths | Weaknesses |
|-------------------------|---|---|
| Documentation | <ul style="list-style-type: none"> - Stable: can be reviewed repeatedly - Unobtrusive: not created as a result of the case study - Exact: contains exact names, references, and details of an event - Broad coverage: long span of time, many events, and many settings | <ul style="list-style-type: none"> - Retrievability: can be low - Biased selectivity, if collection is incomplete - Reporting bias: reflects (unknown) bias of author - Access: may be deliberately blocked |
| Archival Records | <ul style="list-style-type: none"> - [Same as above for documentation] - Precise and quantitative | <ul style="list-style-type: none"> - [Same as above for documentation] - Accessibility due to privacy issues |
| Interviews | <ul style="list-style-type: none"> - Targeted: focuses directly on case study topic - Insightful: provides perceived causal inferences | <ul style="list-style-type: none"> - Bias due to poorly constructed questions - Response bias - Inaccuracies due to poor recall - Reflexivity: interviewee gives what interviewer wants to hear |
| Direct Observations | <ul style="list-style-type: none"> - Reality: covers events in real time - Contextual: covers context of event | <ul style="list-style-type: none"> - Time-consuming - Selectivity: unless broad coverage - Reflexivity: event may proceed differently because it is being observed - Cost: hours needed by human observers |
| Participant Observation | <ul style="list-style-type: none"> - [Same as above for direct observation] - Insightful into interpersonal behaviour and motives | <ul style="list-style-type: none"> - [Same as above for direct observations] - Bias due to investigator's manipulation of events |
| Physical Artefacts | <ul style="list-style-type: none"> - Insightful into cultural features - Insightful into technical operations | <ul style="list-style-type: none"> - Selectivity - Availability |

For the purpose of this research, the interview is considered to be an appropriate data collection method, as it allows the researcher to further explore the topic with rich information. More importantly, it provides the researcher with a better understanding of the adoption of a servitization strategy at both cooperative and offering levels in the companies and an additional opportunity to gather more information by expanding the

conversation. Following this, the next decision is to determine the type of interview, of which three types are available: structured, semi-structured and unstructured (Bryman, 2016; Silverman, 2013; Yin, 2014). Table 3-12 provides a fundamental definition of the different types of interviews. Given that the qualitative phase is exploratory oriented, the semi-structured interview was adopted in order to follow an interview outline with some flexibility to ask additional questions.

Table 3-12 Three types of interview (Robson & McCartan, 2016, pp. 290-294)

| Type of interview | Definition |
|----------------------------|--|
| Fully structured interview | This type of interview uses fixed questions in a pre-set order and the level of flexibility is low. |
| Semi-structured interview | The interviewer has an interview outline as general guidance, and leaves some space for open questions to gather additional information. |
| Unstructured interview | The interviewer has a general topic and lets the conversation develop as it goes on. |

The development of a case study protocol provides a guidance to carry out the fieldwork, for which a proper protocol should contain four elements: 1) overview of the research; 2) field procedure, 3) interview protocol, and 4) reporting protocol. A case study protocol was developed to address these elements.

First, the overview of the research should clearly indicate the aim and RQs of the project, which have been presented in the literature review chapter and are recapped in this chapter. Second, the field procedure is a set of activities during the data collection, which should be developed in advance to be used as guidance for the researcher to carry out the work properly. In this study, the interviews were conducted either by conference calls or via face-to-face meetings, depending on the participant's preference, and both types of interviews followed a similar procedure (see Table 3-13) with some slight differences.

Table 3-13 An outline of the field procedure

| Timing | | Key tasks |
|-----------------------------------|----------------------|--|
| Preparation for the interview day | | <ul style="list-style-type: none"> • Generate a contact list • *Send an email invitation to potential participants about the purpose of the interview, interview questions, benefits of participation and participant information leaflet (PIL), and ask them to confirm the time availability. • (This is followed by phone calls if the recipient did not respond to the email). • Once the time and date are confirmed, a meeting invitation is sent to the participant to confirm the attendance. • Book a meeting room in the department. • Arrange a departmental trip (<i>this is only for face-to-face interviews</i>). |
| On the day | Before the interview | <ul style="list-style-type: none"> • Print the interview questions and consent form (two copies of each). • 'Interview pack' includes pens, spare paper, recorder, extra batteries and business cards. • If the participant requests to cancel the interview on the agreed day, rearrange the meeting time and update the meeting invitation. |
| | During the interview | <ul style="list-style-type: none"> • State the purpose of the interview. • Ask for the participant's consent to use the recorder. If they decline, proceed with the interview without recording. • Clarify the timing and ask if he/she has any time limitation on the day. • Check if they have any questions before starting the interview. • Upon completion, ask the participants whether any issues were overlooked and if they have any additional information to provide. • Ask the participant if he/she would like to receive a copy of the interview report. • Ask the participant if he/she would like to be contacted for any follow-up questions in case the researcher needs additional information. • The interviewer and interviewee both sign the consent form (<i>this is only for face-to-face interviews</i>). • The interviewee signs the consent form and sends a copy to the interviewer (<i>this is only for telephone interviews</i>). |
| | After the interview | <ul style="list-style-type: none"> • Provide a departmental tour for the interviewees (<i>this is only for face-to-face interviews</i>). • Send a 'Thank you' email to the interviewee. |

Note: *The email invitation letter is shown in Appendix 4.

Third, the interview protocol is the most important part of the case study protocol, which outlines the logic behind the interview questions. For the purpose of this research, the theoretical model developed in section 2.6 and the typology in section 2.7 are used as a guiding framework for the question design. The main areas of inquiry were driven by the key research themes: servitization benefits and challenges. To better understand the business and offerings of each organisation, some general questions about the company and individual were asked at the beginning of the interview. In the light of these, the interview protocol comprises three sections: 1) background information of the company and individual participant, 2) servitized offerings and related benefits, and 3) servitization challenges. Table 3-14 shows an overview of the interview protocol; the protocol used in this study is shown in Appendix 5.

Table 3-14 An overview of the interview protocol

| Sections | Description | Additional details |
|--------------------------------|--|--|
| Section A: Interview checklist | A checklist of all the essential items that are needed for the interview | The items include spare copies of interview questions, consent forms, pens, paper, and recorder. |
| Section B: Introduction | This is an introductory section to the interview, which clearly states the aim of the research and informs the participants about the interview procedure (e.g. timing and request for recording the interview). | The researcher must obtain permission from the participants before recording the interview. |
| Section C: Interview questions | Part 1: The interview questions are mainly related to the general background of companies and individuals to understand the case context. | Part 1: -About the company <ul style="list-style-type: none"> • Industry overview • General background • Size and business scope • Business performance -About the individual <ul style="list-style-type: none"> • Role and responsibility |
| | Part 2: The interview questions explore the servitized offerings and the related benefits perceived by the company | Part 2: -Servitized offerings -Servitization benefits <ul style="list-style-type: none"> • Financial • Marketing • Strategic • Additional benefits? |
| | Part 3: The interview questions explore the servitization challenges perceived by the companies and the manifestations. | Part 3: -Servitization challenges <ul style="list-style-type: none"> • Organisational structure • Business model • Development process • Customer management • Risk management • Additional challenges? |
| Section D: End of interview | This section wraps up the interview. It is important to confirm with the participant whether he/she is willing to be contacted for further inquiries. | Thank the participants for their contribution and obtained their signature on the consent form. |

Last, the reporting protocol is presented later, in the dissemination section (the 5th stage of the case study design process).

3.5.5 Stage 3: Data gathering

Given that interview participants were recruited during the survey administration, the qualitative data collection process was relatively short as the researcher did not have to spend much time on locating potential contacts. Overall, 13 semi-structured interviews were conducted over a two-month period from August to October 2017, including five face-to-face meetings and eight telephone interviews. All interviews were recorded with the participants' permission, and this is addressed as part of the ethical consideration (see section 3.6). In addition, extra notes were taken to capture the insights, which total 9.5 hours of recording and 9 pages of notes. Table 3-15 provides a general summary of the interviews that were conducted for this project.

Table 3-15 A brief interview record

| Interviewee | Role | Interview type | Interview duration |
|-------------|---|----------------|--------------------|
| Serv001 | Data Scientist | Face-to-Face | 54 mins |
| Serv002 | Chief Executive Officer | Telephone | 73 mins |
| Serv003 | Head of Research and Development | Telephone | 25 mins |
| Serv004 | General Manager of Customer Services | Face-to-Face | 44 mins |
| Serv005 | Managing Director | Telephone | 56 mins |
| Serv006 | Managing Director | Face-to-Face | 42 mins |
| Serv007 | Head of Delivery Strategy and Service Improvement | Telephone | 35 mins |
| Serv008 | Service and Maintenance Manager | Face-to-Face | 27 mins |
| Serv009 | Head of Technology | Telephone | 29 mins |
| Serv010 | Director of Customer Support | Telephone | 53 mins |
| Serv011 | Chief Executive Director | Face-to-Face | 61 mins |
| Serv012 | Head of Business Intelligence | Telephone | 38 mins |
| Serv013 | Director of External Affairs (Government Relations) | Telephone | 38 mins |

3.5.6 Stage 4: Data analysis

To prepare for the data analysis, the recording was transcribed verbatim by the researcher and the professional qualitative data analysis software – *NVivo 11* was used. The data analysis method adopted in this project follows a template analysis strategy (King, 2012), which offers a structured data analysis process with a high level of flexibility to fit with different types of studies. This strategy has been used by peer scholars in servitization research, and has proved to be effective in the qualitative study (Bastl et al., 2012; Raddats et al., 2016).

Following this strategy, a list of prior codes (referred to as the ‘code book’) was generated according to the theoretical underpinning of this study and an initial review of interview transcripts. The codes refer to a short phrase that summarises the meaning of a proportion of text (Miles et al., 2013). Given that the template analysis is hierarchical in nature, the servitization benefits and challenges were clustered as tier-one codes, and manifestations of each were categorized as sub-codes. This template was applied for analysing each interview transcript individually. To capture the most insights, all transcripts were coded through three rounds of reviews. As the themes emerged and were extended during the repetitive review, the code book was constantly updated to reflect the changes. With the coded transcript, the emerging patterns were identified by categorizing the codes into themes, and a singular tabular display was developed to facilitate the case analysis.

The coding manual developed by Saldaña (2015) was used as a predominant source to facilitate the coding process, and mixed coding techniques were applied. Given that the core themes (servitization benefits and challenges) were used to frame the semi-structured interviews, they were used to code the text (this is referred to as *structural*

coding) (Saldaña, 2015). Moreover, ‘*sub-coding*’ was used, where the relevant indicators of core themes were used to enrich the insights; for example, culture change and inter-departmental collaboration are regarded as the sub-codes of OS challenges (Miles et al., 2013). As mentioned, the core themes and their items (indicators) were extended as new themes emerged, and the code book was revised to reflect these changes. This is entitled ‘*provisional coding*’, which is when the researcher starts with pre-listed codes based on the pre-investigation/knowledge and revises the list during the coding process (Miles et al., 2013). The final version of the code book is shown in Appendix 6.

3.5.7 Stage 5: Dissemination

The final stage of the case study design concerns the dissemination of the results. Given that this project has been conducted for obtaining a doctoral degree, the main output is a doctoral thesis. In addition, the case study results are disseminated by means of academic publications and practical reports to serve different types of audience, and Table 3-16 details the relevant research output of the qualitative phase.

Table 3-16 Research output of the qualitative study

| Academic Output | Description |
|--|--|
| Zhang, W., Banerji, S., Lu, D. & Day, S. “Challenges of servitization: a comparison study of manufacturers with different strategic focuses” | This is a conference paper, which was accepted for and presented at EurOMA 2018 in Budapest, Hungary |
| Practitioner Oriented Output | Description |
| The impacts of servitization challenges on business performance | This is a managerial report prepared for the case participants in order to share the research results. |

3.5.8 Methodological rigour

In contrast to the quantitative study, the qualitative study needs a stricter assessment of the methodological rigour as there is no statistical test that can be used for examining the research quality. Scholars have proposed several assessment criteria. For example, Hirschman (1986) claims that the qualitative study should be measured in terms of credibility, transferability, dependability, confirmability, and integrity, in order to assess the methodological rigour. Corbin et al. (2014) suggest another set of criteria that comprises validity and reliability, credibility and truthfulness, rigour, credibility and applicability. These criteria are suitable for different types of qualitative research, including but not limited to the case study. To address the methodological rigour in case study design, Yin (2014) introduced four quality criteria specifically for case-based research, and this study is

evaluated from those four aspects: construct validity, internal validity, external validity and reliability.

Construct validity refers to an appropriate operationalisation of the key themes being studied (Yin, 2014). The SLR and quantitative phase help to achieve this purpose through the development of formal constructs and relevant indicators of servitization challenges and benefits. Given that the SLR results have been peer-reviewed and published in an international standard journal, the construct validity has been confirmed in the initial step. Moreover, a set of statistical tests were carried out to measure the validity of constructs and their indicators, which have contributed to the improvement of construct validity in this phase.

Internal validity refers to the plausibility of the causal relationship established in the study that properly reflects the phenomenon of interest, which is mainly applicable to the study that is explanatory in nature (Yin, 2014). Given that the purpose of the qualitative phase is partially to explain the unsupported relationship in the quantitative survey phase, the internal validity should be assessed. The theoretical model developed in the literature review chapter illustrates the logic behind the hypothetical relationship that indeed improves the internal validity. Moreover, given that the quantitative phase has validated the relationship using the empirical data, designing the case study according to the survey findings has also improved the internal validity.

External validity concerns the generalizability of the case study findings, particularly in which domain the findings can be generalized (Yin, 2014). Given that this research project focuses on servitization and only UK-based businesses were engaged, this research is limited in terms of context and geographical scope. However, engaging different types of servitized businesses retains the variation in terms of strategic focus, which increases the external validity as the servitization challenges facing different businesses can be identified.

Reliability concerns the replication of this study, such as whether the study can be repeated with the same design to obtain the same result (Yin, 2014). The case study design procedure by Yin (2014) was followed in this study, and a detailed case study protocol was presented in section 3.5.4. In addition, the data were analysed following a systematic approach, as described in section 3.5.6, and the establishment of a document database in NVivo has also enhanced the reliability of the research.

3.5.9 Qualitative phase summary

This section provided details of the case study design and implementation as the second phase of the empirical study in this project. The next section highlights the ethical concerns in this study.

3.6 Research ethics

Given that the primary research of this project engaged industrial practitioners who work in servitized businesses as key informants, ethical concerns such as personal and organisational confidentiality need to be thoroughly addressed. As mentioned in the survey administration section, the ethical issue could be one of the reasons why the potential participant refused to complete the survey as well as the follow-up interview. To address this, the ethical issue in this project is handled following university guidance and regulations. First, in the preparation stage of the field work (both survey and interview), the researcher submitted applications for ethical approval by the Biomedical & Scientific Research Ethics Committee (BSREC) of the University of Warwick, and ethical approval was granted for both studies. The reference number is REGO-2016-1801 for the survey and REGO-2017-2048 for the case study. Second, to comply with the university regulations, the participant information leaflet (PIL) was sent to the respondent before conducting the survey and interview to ensure that they were aware of how the data were to be used in this study. The author emphasised that the data collected from them would only be used for the purpose of her research project, and would be retained only for two years, from the day it was collected, on a password accessed laptop. Moreover, all responses have been kept anonymous in the research outputs (e.g. PhD thesis, conference paper and journal paper), and respondents' identities are not identifiable nor are those of the company. Third, participants consented by first signing the consent form, which the researcher always informed them about before the survey/interview was conducted. During the interview, the participant's consent to record the conversation was also sought, and all of them agreed to this.

3.7 Chapter summary

This chapter presents the methodological research design in this study and the rationale behind the choices made. Table 3-17 summarises the key elements of this chapter. The survey and case study results are presented in Chapters 4 and 5 respectively, and the discussion part in Chapter 6 brings the results of the two phases together to achieve triangulation in an attempt to increase the validity and reliability of the study as a whole.

Table 3-17 Summary of the methodological chapter

| |
|---|
| Philosophical stance |
| Pragmatism research philosophy (Morgan, 2007; Saunders et al., 2016; Tashakkori & Teddlie, 2010) |
| Research approach |
| An abductive research approach (Morgan, 2007) |
| Research method |
| A mixed research method was adopted - sequential explanatory research design (Creswell & Plano-Clark, 2011) |
| <i>Phase 1: Quantitative study (Survey)</i> |
| Data collection method: Web-based survey Total response: 96 Data analysis: partial least squares structural equation modelling (PLS-SEM) (Hair et al., 2016) Methodological rigour: A set of tests for evaluating both measurement and structural models (Hair et al., 2016) |
| <i>Phase 2: Qualitative study (Case study)</i> |
| Data collection method: Semi-structured interviews Total response: 13 (9.5 hours of recording and 9 pages of notes) Data analysis: Template analysis strategy (King, 2012) Methodological rigour: Construct validity, internal validity, external validity and reliability (Yin, 2014) |

4 SURVEY FINDINGS

4.1 Chapter overview

This chapter presents the quantitative survey findings. Figure 4-1 illustrates the structure of this chapter. First, following this introduction, section 4.2 revisits the theoretical model established in the literature review chapter to recap the hypothetical relationship, and then assess the adequacy of the sample size (section 4.3). After that, the data are analysed descriptively and statistically. The descriptive analysis in section 4.4 indicates that the survey responses include a group of heterogeneous organisations and individuals that are suitable for the purpose of the survey. Furthermore, the statistical analysis in section 4.5 evaluates both the measurement and structural model following a standard procedure, and the hypothesis testing results are presented. An additional mediation analysis is also performed as part of the statistical analysis to examine the mediation path in the model. Finally, a basic conceptual model is developed in section 4.6 based on the quantitative findings.

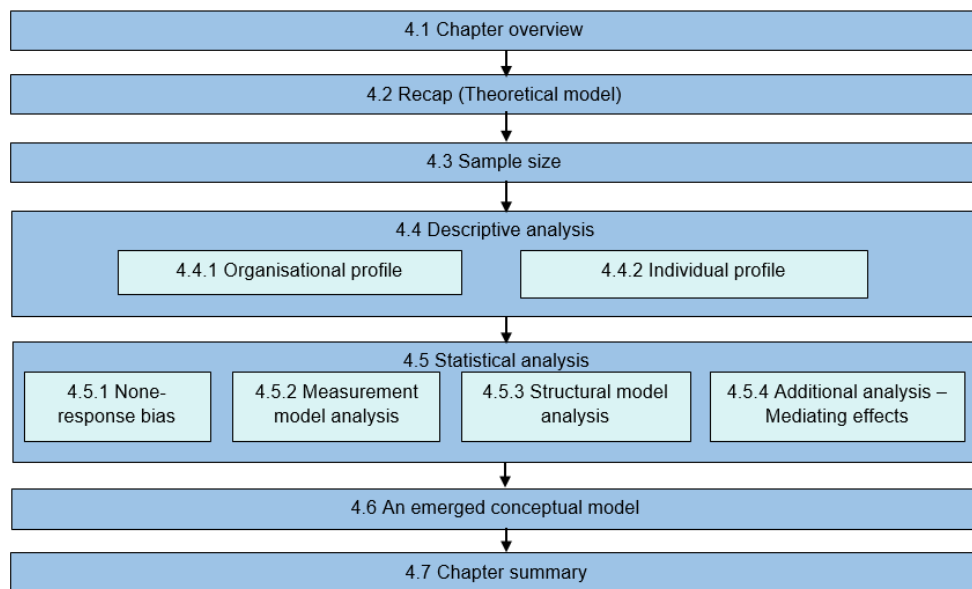


Figure 4-1 The structure of the survey findings chapter

4.2 Recap

The quantitative survey was carried out to validate the theoretical model (Figure 4-2) developed in the literature review chapter. Considering that the extant literature demonstrates that there is no direction on the interrelationship among the servitization benefits (strategic, financial and marketing), the original model was separated into three models that are identical excluding the relationship.

- **Model 1** includes strategic benefits (SB) positively affecting financial benefits (FB) and marketing benefits (MB).
- **Model 2** includes financial benefits (FB) positively affecting strategic benefits (SB) and marketing benefits (MB).
- **Model 3** includes marketing benefits (MB) positively affecting strategic benefits (SB) and financial benefits (FB).

A diagram of each business model can be found in Figure 4-3 in section 4.5.3.

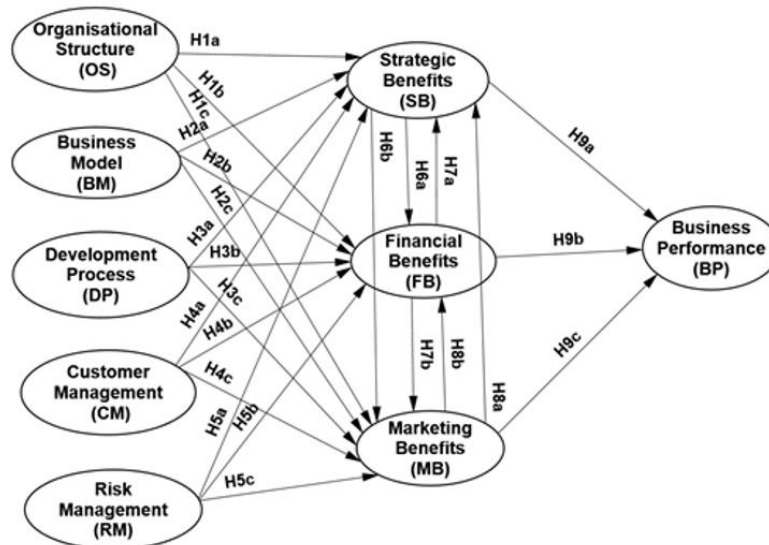


Figure 4-2 Combined theoretical model (Model 1: with SB → FB & MB; Model 2 with FB → SB & MB; Model 3: with MB → SB & FB)

This study adopted the PLS-SEM method for the data analysis as it is suitable for the early stage of theory testing, especially when the constructs and indicators were not fully established in the prior studies (Fornell, 1992; Yin, 2014). More importantly, the method has gained popularity in operations research as it addresses the issues of non-normality and small sample size (Chin et al., 2003; Marcoulides & Saunders, 2006). To support the analysis, a reputable software – *SmartPLS 3* – is used. The following sections present the data analysis results.

4.3 Sample size

The general rule of thumb for determining the sample size for PLS-SEM is 10 times the largest number of structural paths directed at a particular construct in the structural model (Hair et al., 2016). Based on the theoretical model in Figure 4-2, the constructs 'strategic benefits', 'financial benefits' and 'marketing benefits' have the most paths, where seven paths for each of them indicates that the minimum sample size for testing the whole model is 70.

However, some scholars claim that the '10 times' rule is only a rough guide for indicating the small effects, or for estimating robust parameters to draw generalizable conclusions; instead, they recommend that a power analysis should be conducted (Hair et al., 2012; Marcoulides & Saunders, 2006). Hair et al. (2016, p. 26) provided a table (see Appendix 7) that shows the recommended sample size (assuming the statistical power is 80%) to detect the R^2 values of 0.10, 0.25, 0.50 and 0.75 in any endogenous constructs in the model for significance levels of 1%, 5% and 10%. In this study, there are four endogenous constructs in the theoretical model, and each of them has three R^2 values as the model was separated into three models.

Table 4-1 details the number of independent variables and R^2 values of each endogenous construct in the three models, and the recommended sample size. According to the table, the sample size used in this study is more than the majority of required sample sizes. Although the recommended sample size for the construct with five independent variables (***highlighted*** in Table 4-1) is 99 when the minimum R^2 value is 0.10, the actual R^2 value of the construct is greater than 0.10 and 96 responses are closer to 99. It is therefore concluded that 96 responses form an appropriate sample size for this study.

Table 4-1 Recommended sample size for a statistical power of 80% (According to Hair et al., 2016)

| Model | Construct | Number of independent variables* | R ² Value (10%) | Recommended sample size |
|---------------------------|----------------------------------|----------------------------------|----------------------------|--|
| Model 1 (SB → FB & MB) | <u>Strategic benefits</u> | <u>5</u> | <u>0.156</u> | <u>99 (R²>0.10)</u> |
| | Financial benefits | 6 | 0.420 | 40 (R ² >0.25) |
| | Marketing benefits | 6 | 0.657 | 18 (R ² >0.50) |
| | Business performance | 3 | 0.167 | 83 (R ² >0.10) |
| Model 2 (FB → SB & MB) | Strategic benefits | 6 | 0.397 | 40 (R ² >0.25) |
| | <u>Financial benefits</u> | <u>5</u> | <u>0.198</u> | <u>99 (R²>0.10)</u> |
| | Marketing benefits | 6 | 0.415 | 40 (R ² >0.25) |
| | Business performance | 3 | 0.164 | 83 (R ² >0.10) |
| Model 3 (MB → SB & FB) | Strategic benefits | 6 | 0.602 | 18 (R ² >0.50) |
| | Financial benefits | 6 | 0.370 | 40 (R ² >0.25) |
| | Marketing benefits | 5 | 0.251 | 37 (R ² >0.25) |
| | Business performance | 3 | 0.181 | 83 (R ² >0.10) |

Note*: This is equivalent to the number of arrows pointing at the construct.

4.4 Descriptive analysis

Before proceeding to the statistical analysis, the 96 responses were descriptively analysed to develop a profile of participating companies and survey respondents which will help to validate the suitability of the respondents and the company that they were representing.

4.4.1 Organisation profile

Overall, the survey response indicates a good portfolio of companies, which covers a broad range of the industrial sector and company size. Table 4-2 shows the cluster of participated companies based on the industry type, company size, annual turnover and service revenue. More than 50% of companies operate in the area of electronic equipment, aerospace & defence, metal products (excluding machinery) and transport equipment, which are common areas in which companies are adopting a servitization strategy to grow their businesses. Other sectors include energy, contract manufacturing, packaging machines, power generation, automotive, medical and semiconductor systems, showing the diversity of the surveyed organisations. In terms of firm size, each category has a comparable number of companies, except for the firm with fewer than 249 employees. The annual turnover figure matches the firm size figure, which indicates a considerable number of large companies were engaged in the survey. This is particularly important in

this project as large companies are more likely to adopt the servitization strategy to fulfil the market needs and secure a leading position in the sector. Moreover, this type of company is financially capable of updating its BM and developing new offerings.

In addition, the service revenue figure is used to assess the company's service capability as an organisation with a certain service capability is considered to be relevant to this study. The majority of companies retain service revenues that account for less than 30% of annual revenues, which is reasonable for product-centric companies that use servitized offerings as a support factor to their core product business. More than 10% of companies claim that their service revenues are above 70%, which may be because some companies include total revenues of servitized offerings, such as integrated solutions. The solution revenues often comprise the product and operation revenues, which could substantially increase the total service revenue.

Table 4-2 Profile of participating companies (N=96)

| Characteristic | | Frequency (%) |
|-------------------------------|--------------------------------|---------------|
| Industry type | Electronic equipment | 19.7 |
| | Aerospace & defence | 17.5 |
| | Metal products (not machinery) | 13.5 |
| | Transport equipment | 11.5 |
| | Medical systems | 9.4 |
| | Publishing & printing | 6.3 |
| | Information technology | 5.2 |
| | Chemicals | 4.2 |
| | Rubber & plastic products | 3.1 |
| | Wood (and paper products) | 2.1 |
| | Mining and quarrying | 1 |
| | Other | 6.5 |
| Firm size | 5000+ | 26 |
| | 1000-4999 | 20.8 |
| | 500-999 | 18.8 |
| | 250-499 | 27.1 |
| | 0-249 | 7.3 |
| Annual turnover | > £1,000M | 28 |
| | £750-1,000M | 18.3 |
| | £500-749M | 14.3 |
| | £250-499M | 6.3 |
| | £100-249M | 17.8 |
| | < £100M | 15.3 |
| Annual service revenue | 71%+ | 10.4 |
| | 50-70% | 17.7 |
| | 31-50% | 15.6 |
| | 11-30% | 25 |
| | 0-10% | 31.3 |

4.4.2 Individual profile

Given that a servitization strategy is a top level strategy, the senior management representatives are targeted as they should possess a solid understanding of the overall business. Table 4-3 illustrates the job profile of individual participants, where most respondents are senior management who should be in a good position to answer this survey. The 'other' category includes some special job titles, such as integrated solution manager, head of marketing and product management, and information manager, which

are also considered to be relevant to this study. This table is indicative that survey respondents have high relevancy to the research context.

Table 4-3 Profile of survey respondents (N=96)

| Job role | Frequency (%) |
|---------------------------------------|----------------------|
| Managing director/CEO | 22.9 |
| Operations director/manager | 12.5 |
| Technical director/manager | 9.4 |
| Business development director/manager | 8.3 |
| Service director/manager | 6.3 |
| General manager | 5.2 |
| Customer support director/manager | 4.2 |
| Financial director/manager | 4.2 |
| Marketing manager | 4.2 |
| Analyst | 3.1 |
| Design director/manager | 3.1 |
| HR manager | 3.1 |
| Engineering director | 2.1 |
| Production director/manager | 2.1 |
| Purchasing director/manager | 2.1 |
| Other | 7.2 |

Overall, the sample profile (organisational and individual) shows that a group of heterogeneous organisations and individuals that are relevant to this study were engaged, which has enhanced the reliability of the survey findings.

4.5 Statistical analysis

This section presents the statistical analysis results. Before we look at the main results, a series of descriptive analyses was conducted, and the relevant figures such as mean, standard deviation and correlation matrix are shown in Appendix 12. We also clustered the survey respondents according to the servitization type of organisations they represent, and the result of each group (IS providers vs. PS suppliers) is also attached in the appendix.

4.5.1 Comparison of groups

Given that some survey responses were collected after the follow-up phone call, it is necessary to conduct a non-response bias test to ensure that the group that responded before the phone call (57 responses) is statistically similar to that which responded after the phone call (39 responses). This is important as the subsequent statistical tests treat

the responses as a whole by assuming there is no statistical difference between the two groups.

The independent sample T-test is applied to assess the difference, and the detailed results are shown in Appendix 8. Particularly Levene's test was used to confirm that the variance in the two groups is the same. If the Levene's test result is significant ($p \leq 0.05$), then there is a significant difference between the groups. Otherwise, if the result is non-significant ($p > 0.05$), this indicates that the variance is equal in both groups. The T-test was carried out on each Likert scale question to examine whether there were any significant differences in the mean score between the two groups. The results indicate that there is no significant difference between the groups, as the sig (2-tailed) value was greater than 0.05 for every Likert scale question. Therefore the data can be treated as a single set in the final data analysis.

4.5.2 Measurement model analysis

According to the procedure of evaluating the measurement model, as explained in section 3.4.5.2.4, this section presents the results (Table 4-4) of assessing the validity and reliability of the model.

The *construct convergent validity* was primarily examined using the CFA (confirmatory factor analysis) at an indicator level, where the factor loading of indicators is more than 0.7 except for six indicators (shown in *italics* in Appendix 9). After six indicators were dropped, the factor loading of the other indicators mostly remained at the same level, implying that the deletion of indicators does not have a significant impact on the model. In addition, the average variance extracted (AVE) of the construct was assessed to confirm the convergent validity at the construct level, in which the AVE value of constructs varied from 0.591 to 0.825, indicating that all constructs retain a satisfactory level of convergent validity.

The *internal consistency reliability* was assessed using Cronbach's Alpha (CA), and the recommended threshold is 0.6. The results show that all constructs are more than 0.8, a more rigorous threshold suggested by Straub (1989). Moreover, the composite reliability (CR) was measured to facilitate the test, and the values of the constructs are mainly above 0.8, indicating a high level of reliability.

The final criterion that needs to be examined is *discriminant validity*. To do so, the correlation matrix of the constructs is applied, in which the square root of the AVE value (**bold figures** in Table 4-4) is placed on the diagonal line, and the correlation between the constructs is placed in the column. According to Table 4-4, the results exhibit a satisfactory level of discriminant validity, as the square root of AVE for the construct is considerably

higher than its correlation with other constructs in the same column. In addition, the item loadings of indicators for each construct were compared with cross loadings to further confirm the discriminant validity (see Appendix 10). The results show that all indicators are loaded correctly and strongly to their corresponding construct, indicating that the scale used in this study is valid.

Table 4-4 Construct validity and reliability for the three models

| Construct | CA (>0.6) | CR (>0.7) | AVE (>0.5) | BM | BP | CM | DP | FB | MB | OS | RM | SB |
|-----------------------------------|--------------|--------------|---------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| Model 1 (SB → FB & MB) | | | | | | | | | | | | |
| BM | 0.858 | 0.897 | 0.637 | 0.798 | | | | | | | | |
| BP | 0.805 | 0.877 | 0.707 | 0.297 | 0.841 | | | | | | | |
| CM | 0.809 | 0.881 | 0.714 | 0.597 | 0.275 | 0.845 | | | | | | |
| DP | 0.931 | 0.950 | 0.826 | 0.576 | 0.420 | 0.657 | 0.909 | | | | | |
| FB | 0.883 | 0.945 | 0.895 | 0.275 | 0.190 | 0.145 | -0.095 | 0.946 | | | | |
| MB | 0.877 | 0.915 | 0.730 | 0.457 | 0.340 | 0.336 | 0.214 | 0.513 | 0.854 | | | |
| OS | 0.867 | 0.905 | 0.704 | 0.541 | 0.307 | 0.532 | 0.648 | 0.205 | 0.413 | 0.839 | | |
| RM | 0.838 | 0.900 | 0.749 | 0.589 | 0.303 | 0.664 | 0.411 | 0.278 | 0.286 | 0.588 | 0.866 | |
| SB | 0.889 | 0.923 | 0.751 | 0.352 | 0.404 | 0.266 | 0.110 | 0.566 | 0.576 | 0.271 | 0.212 | 0.866 |
| Model 2 (FB → SB & MB) | | | | | | | | | | | | |
| BM | 0.858 | 0.897 | 0.637 | 0.798 | | | | | | | | |
| BP | 0.805 | 0.877 | 0.707 | 0.298 | 0.841 | | | | | | | |
| CM | 0.809 | 0.881 | 0.714 | 0.597 | 0.276 | 0.845 | | | | | | |
| DP | 0.931 | 0.950 | 0.826 | 0.577 | 0.420 | 0.657 | 0.909 | | | | | |
| FB | 0.883 | 0.944 | 0.895 | 0.274 | 0.188 | 0.145 | -0.095 | 0.946 | | | | |
| MB | 0.877 | 0.916 | 0.730 | 0.464 | 0.341 | 0.344 | 0.225 | 0.513 | 0.855 | | | |
| OS | 0.867 | 0.905 | 0.704 | 0.541 | 0.308 | 0.532 | 0.648 | 0.206 | 0.420 | 0.839 | | |
| RM | 0.838 | 0.900 | 0.750 | 0.589 | 0.304 | 0.665 | 0.411 | 0.278 | 0.295 | 0.589 | 0.866 | |
| SB | 0.889 | 0.923 | 0.751 | 0.352 | 0.397 | 0.265 | 0.104 | 0.573 | 0.560 | 0.269 | 0.214 | 0.866 |
| Model 3 (MB → SB & FB) | | | | | | | | | | | | |
| BM | 0.858 | 0.897 | 0.637 | 0.798 | | | | | | | | |
| BP | 0.805 | 0.877 | 0.708 | 0.297 | 0.841 | | | | | | | |
| CM | 0.809 | 0.882 | 0.714 | 0.597 | 0.275 | 0.845 | | | | | | |
| DP | 0.931 | 0.950 | 0.826 | 0.576 | 0.420 | 0.657 | 0.909 | | | | | |
| FB | 0.883 | 0.945 | 0.895 | 0.274 | 0.191 | 0.144 | -0.096 | 0.946 | | | | |
| MB | 0.877 | 0.915 | 0.730 | 0.454 | 0.337 | 0.333 | 0.210 | 0.518 | 0.854 | | | |
| OS | 0.867 | 0.905 | 0.704 | 0.541 | 0.307 | 0.532 | 0.648 | 0.203 | 0.410 | 0.839 | | |
| RM | 0.838 | 0.899 | 0.749 | 0.589 | 0.303 | 0.664 | 0.410 | 0.278 | 0.286 | 0.587 | 0.866 | |
| SB | 0.889 | 0.922 | 0.748 | 0.347 | 0.422 | 0.268 | 0.125 | 0.540 | 0.586 | 0.272 | 0.203 | 0.865 |

Notes: 1. CA= Cronbach's Alpha; CR= Composite Reliability; AVE=Average Variance Extracted
 2. The figure in the brackets is the recommended threshold for each test
 3. Figures in bold indicate the square root of the AVE.

In short, the evaluation of the measurement model indicates that all constructs are valid and reliable. The next section presents the results of the structural model analysis.

4.5.3 Structural model analysis

This section evaluates the structural model following the procedure described in section 3.4.5.2.5. The R^2 value (determinant coefficient) of each endogenous construct shows the quality of the structural model in explaining and predicting the construct. For instance, the R^2 values for strategic benefits (SB) are 0.156, 0.397 and 0.602 in models 1, 2 and 3 respectively, implying that 15.6%, 39.7% and 60.2% of the construct is explained in each of the models. In this study, the R^2 value range is between 0.156 and 0.657 in the three models (see Table 4-1). The R^2 values of servitization benefits (strategic, financial and marketing) are substantially different in the three models, and this is because the models investigate different relationships among the benefits. For instance, model 1 focuses on the impacts of strategic benefits on the financial and marketing benefits, which increases the R^2 value of the latter. Unlike other criteria, there is no passing threshold for assessing the R^2 value. For instance, Merschmann and Thonemann (2011) consider a value of 0.39 to be good, Ringle et al. (2010) consider 0.239 as a moderate level, and Stan and Saporta (2010) consider 0.27 to be a satisfactory result. However, Garson (2016) emphasise that the researcher should refer to the R^2 value in a prior study to assess the result. More importantly, it is important to be aware that a complex model with several endogenous constructs in operations research is unable to achieve such high values (Brenner, 2015). Considering that there is no similar study found in the current body of knowledge and this study is the first to investigate this topic, the result is considered to be satisfactory according to the suggested value.

Furthermore, the Stone-Geisser Q^2 values (see Table 4-5) for endogenous constructs in the three models are assessed and they are more than 0, indicating that the model exhibits an appropriate prediction validity (Hair et al., 2016; Henseler et al., 2009).

Table 4-5 The Stone-Geisser Q^2 values for endogenous constructs

| | Model 1 | Model 2 | Model 3 |
|----------------------|---------|---------|---------|
| Strategic benefits | 0.079 | 0.222 | 0.401 |
| Financial benefits | 0.294 | 0.100 | 0.222 |
| Marketing benefits | 0.406 | 0.242 | 0.142 |
| Business performance | 0.072 | 0.070 | 0.082 |

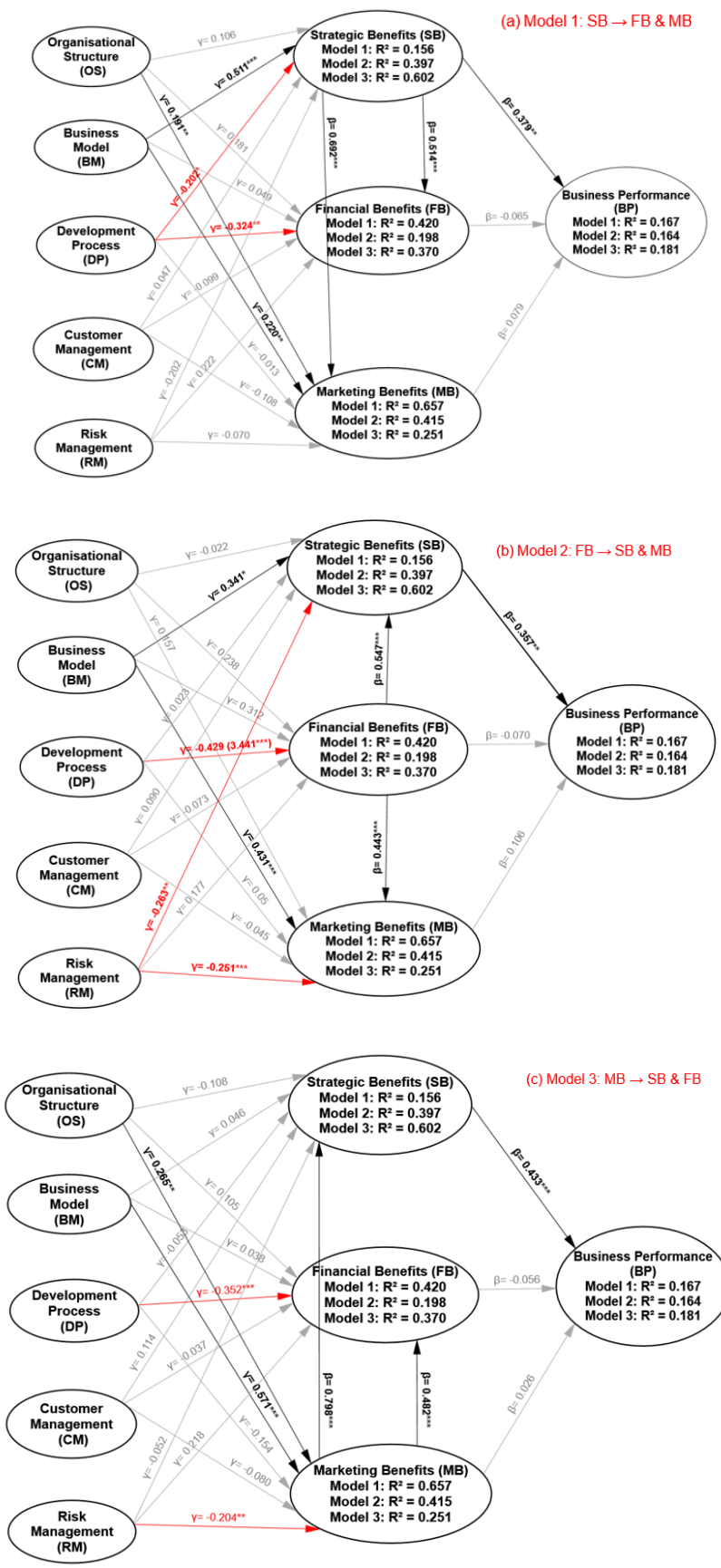
Before moving on to the hypothesis testing results, the model fit should be assessed. However, there is no clear rule for assessing the model fit in PLS-SEM; Hair et al. (2016) suggest that the standardized root mean square residual (SRMR) value should be less than 0.08 to be considered as a good fit, and Wilden and Gudergan (2017) claim that the value of 0.097 flags up a good fit. The SRMR value for this model is 0.105, which is slightly higher than the suggested value. However, considering the model contains nine constructs and such a high complexity can affect the model fit, the value is considered to be acceptable.

As indicated in the methodology chapter, the bootstrapping method is commonly used in PLS-SEM to examine the significance of path coefficients (Hair et al., 2016). In bootstrapping, the original dataset presents a basic population, in which the sub-samples are randomly drawn in an iterative process with k repetitions, and the result is calculated and recorded (Hayes, 2009). Cheung and Lau (2008) suggest 1000 bootstrapping (k=1000) would be appropriate, whereas Hayes (2009) recommends to take at least 5000 (k=5000). This is because larger samples can produce more accurate results (Brenner, 2015; Szász & Seer, 2018; Wilden & Gudergan, 2017), thus a 5000 re-sample bootstrapping with the significance level at 0.05 (two-tailed) was used in this study, and the results are shown in Table 4-6 and Figure 4-3. According to Hair et al. (2016), when the t-value is greater than 1.96, it indicates that the path coefficient is significant at a level of 5%, and passing thresholds for 1% and 10% are 2.58 and 1.65 respectively. Given that the survey is exploratory in nature, the passing threshold of 1.65 (10%) is acceptable in this study (Lee et al., 2018; Skipworth et al., 2015). According to Table 4-6, the data analysis results show three different findings: 1) the hypothesis is significantly supported by the empirical data (bold figures), 2) the hypothesis is unsupported by the empirical data, and 3) the hypothesis is rejected by the empirical data (red figures). In this chapter, the unsupported and rejected hypotheses are distinguished to show the statistical results; however, they are all treated as unsupported hypotheses in the discussion chapter as the nature of the quantitative phase is exploratory with the intention of validating newly developed constructs and their hypothetical relationships.

Table 4-6 Statistical results for the hypotheses

| Hypothesis | | Model 1 | Model 2 | Model 3 |
|--|--|--------------------------|--------------------------|--------------------------|
| <i>Servitization challenges -> benefits</i> | | | | |
| H1 | Organisational structure (OS) -> Strategic benefits (SB) | 0.106 (0.687) | -0.022 (0.166) | -0.108 (1.224) |
| | Organisational structure (OS) -> Financial benefits (FB) | 0.181 (1.460) | 0.238 (1.621) | 0.105 (0.881) |
| | Organisational structure (OS) -> Marketing benefits (MB) | 0.191*** (2.695) | 0.157 (1.577) | 0.265** (2.022) |
| H2 | Business model (BM) -> Strategic benefits (SB) | 0.511*** (2.850) | 0.341* (1.851) | 0.046 (0.374) |
| | Business model (BM) -> Financial benefits (FB) | 0.049 (0.202) | 0.312 (1.268) | 0.038 (0.147) |
| | Business model (BM) -> Marketing benefits (MB) | 0.220** (1.986) | 0.431*** (2.581) | 0.571*** (3.405) |
| H3 | Development process (DP) -> Strategic benefits (SB) | -0.202* (1.710) | 0.023 (0.203) | -0.053 (0.703) |
| | Development process (DP) -> Financial benefits (FB) | -0.324** (2.553) | -0.429*** (3.468) | -0.352*** (2.729) |
| | Development process (DP) -> Marketing benefits (MB) | -0.013 (0.151) | 0.050 (0.384) | -0.154 (1.281) |
| H4 | Customer management (CM) -> Strategic benefits (SB) | 0.047 (0.270) | 0.090 (0.613) | 0.114 (0.959) |
| | Customer management (CM) -> Financial benefits (FB) | -0.099 (0.619) | -0.073 (0.385) | -0.037 (0.251) |
| | Customer management (CM) -> Marketing benefits (MB) | -0.108 (0.931) | -0.045 (0.362) | -0.080 (0.474) |
| H5 | Risk management (RM) -> Strategic benefits (SB) | -0.202 (1.586) | -0.263** (2.203) | -0.052 (0.513) |
| | Risk management (RM) -> Financial benefits (FB) | 0.222 (1.617) | 0.177 (0.764) | 0.218 (1.538) |
| | Risk management (RM) -> Marketing benefits (MB) | -0.070 (0.887) | -0.251*** (2.612) | -0.204** (2.071) |
| <i>Interrelationship among the benefits</i> | | | | |
| H6 | Strategic benefits (SB) -> Financial benefits (FB) | 0.514*** (4.915) | | |
| | Strategic benefits (SB) -> Marketing benefits (MB) | 0.692*** (12.242) | | |
| H7 | Financial benefits (FB) -> Strategic benefits (SB) | | 0.547*** (6.929) | |
| | Financial benefits (FB) -> Marketing benefits (MB) | | 0.443*** (4.798) | |
| H8 | Marketing benefits (MB) -> Strategic benefits (SB) | | | 0.798*** (14.533) |
| | Marketing benefits (MB) -> Financial benefits (FB) | | | 0.482*** (3.932) |
| <i>Servitization benefits -> business performance</i> | | | | |
| H9 | Strategic benefits (SB) -> Business performance (BP) | 0.379** (2.209) | 0.357** (1.987) | 0.433*** (2.726) |
| | Financial benefits (FB) -> Business performance (BP) | -0.065 (0.398) | -0.070 (0.434) | -0.056 (0.703) |
| | Marketing benefits (MB) -> Business performance (BP) | 0.079 (0.644) | 0.106 (0.804) | 0.026 (0.206) |

Notes: 1. t-values in parentheses. *p<0.10, **p<0.05, ***p<0.01
2. **Bold figures** represent the hypothesis that is supported by the survey data.
3. **Red figures** represent the hypothesis that is unsupported and rejected by the survey data.



Note: The figures are detailed in Table 4-6.

Figure 4-3 Structural model analysis results

H1 to H5 proposed that the servitized companies overcoming the relevant challenges (OS, BM, DP, CM and RM) contributes to the realisation of relevant benefits. H1 hypothesised that addressing OS challenges enables the realisation of SB, FB and MB; however, only the relationship between OS and MB (H1c) was supported while its relationship with SB (H1a) and FB (H1b) was unsupported by the data. Similarly, H2a and H2c were supported, implying that addressing BM challenges have positive impacts on the achievement of SB and MB, and its relationship with FB (H2b) was not supported. In contrast, the relationship between DP and SB (H3a) /FB (H3b) was rejected, and its relationship with MB (H3c) was unsupported. With respect to H4, it indicated that the relationship between CM and the benefits, but all of them (H4a, b, & c) were not supported in this study. Lastly, H5 suggested that addressing RM would have positive impacts on the servitization benefits. According to the results, its relationship with SB (H5a) and MB (H5c) was rejected by the empirical data, whereas H5b, regarding its correlation with FB, was unsupported.

H6 to H8 shed light on the interrelationship among the servitization benefits. The data suggest that SB, FB and MB complement and reinforce each other as our data strongly support the hypotheses. H9 proposed a positive correlation among the servitization benefits and the BP, in which the relationship between SB and BP (H9a) was supported by the data while H9b (FB-BP) and H9c (MB-BP) were unsupported. Given that the interrelationship among the servitization benefits could have certain impacts on the hypothesis testing result, the mediating effects are examined in the next section.

4.5.4 Additional analysis – Mediating effects

A formal procedure of mediation analysis (Figure 3-7 in the methodology chapter) in the PLS-SEM introduced by Hair et al. (2016) was followed, in which the direct and indirect effects in the model were analysed and the results compared. In total, three mediation paths are identified and shown below, where each path contains multiple mediators. Some researchers may try to split the model and test each mediator individually; however, this is problematic as multiple mediators in the same model are correlated with each other, and omitting any of them could lead to incorrect results (Hair et al., 2016). Therefore the multiple mediators are retained in the model for the final analysis.

- Model 1: The indirect effect from SB to BP via FB/MB is the product of path coefficients from SB to FB/MB and from FB/MB to BP (Mediation path 1).
- Model 2: The indirect effect from FB to BP via SB/MB is the product of the path coefficients from FB to SB/MB and from SB/MB to BP (Mediation path 2).
- Model 3: The indirect effect from MB to BP via SB/FB is the product of the path coefficients from MB to SB/FB and from MB/FB to BP (Mediation path 3).

To test the mediation effects, the PLS bootstrapping (with 5000 re-samples) was applied (Hair et al., 2016). Table 4-7 summarises the results, and each mediating effect is reviewed in turn. First, the direct effect from SB to BP is strong (0.379) and statistically significant ($t = 2.209$), whereas the indirect effect from SB to BP via FB/MB is weak (0.021) and statistically non-significant ($t = 0.080$). Therefore we conclude that FB/MB does not mediate the SB to BP relationship. Second, the direct effect from FB to BP is weak (-0.070) and statistically non-significant ($t = 0.434$) while the indirect effect is strong (0.242) and significant ($t = 2.280$). This indicates that the SB/MB fully mediates the FB to BP relationship. Considering that two mediators are involved, further analysis on the specific indirect effect is necessary. The results show that FB to BP via SB is strong (0.207) and significant ($t = 1.937$), and FB to BP via MB is not significant (0.052, $t = 0.720$). Thus it is concluded that SB plays a mediating role in the relationship. Third, the direct effect from MB to BP is statistically weak (0.026, $t = 0.206$), but the indirect effect via SB/FB is strong (0.318, $t = 3.354$). Following the same procedure as the multiple mediation analysis, the result shows that MB to BP via SB is strong (0.352, $t = 2.932$), and MB to BP via FB is weak (-0.031, $t = 0.353$). Thus it is concluded that SB mediates the MB to BP relationship while FB does not. In short, the mediating role of SB in the FB to BP and MB to BP relationship is confirmed.

Table 4-7 Significance analysis of direct and indirect effects

| | Direct effect | t value | Significant? | Indirect effect | t value | Significant? |
|----------------------------------|---------------|---------|--------------|-----------------|---------|--------------|
| SB -> BP (Model 1) | 0.379** | 2.209 | Yes | 0.021 | 0.080 | No |
| FB -> BP (Model 2) | -0.070 | 0.434 | No | 0.242** | 2.280 | Yes |
| MB -> BP (Model 3) | 0.026 | 0.206 | No | 0.318*** | 3.354 | Yes |

Notes: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

4.6 An emerged conceptual model

To summarise the insight of quantitative survey, a basic conceptual model (Figure 4-4) is developed. According to the model, among the five challenges, the organisational structure (OS) and business model (BM) challenges were confirmed to have direct impacts on strategic benefits (SB) and marketing benefits (MB) respectively. This implies that overcoming these challenges could contribute to the realisation of benefits. Regarding the relationship between the benefits and BP, only SB is confirmed to be positively correlated to the business performance (BP), whereas FB and MB seem not

have a direct contribution to the BP. However, the indirect impact of FB and MB on BP has been confirmed as the mediation analysis demonstrated the mediating role of SB. Moreover, the impact of challenges on the benefits can be explained in the same way, as the challenge that inhibits one benefit could be an indirect inhibitor of others. For instance, the results confirmed that BM challenges are correlated to SB and MB, which potentially indicates that overcoming BM could also enable FB considering the interrelationship among the benefits. To further interpret the results, a comprehensive discussion can be found in Chapter 6, where the empirical results are discussed in relation to the existing literature and the qualitative findings.

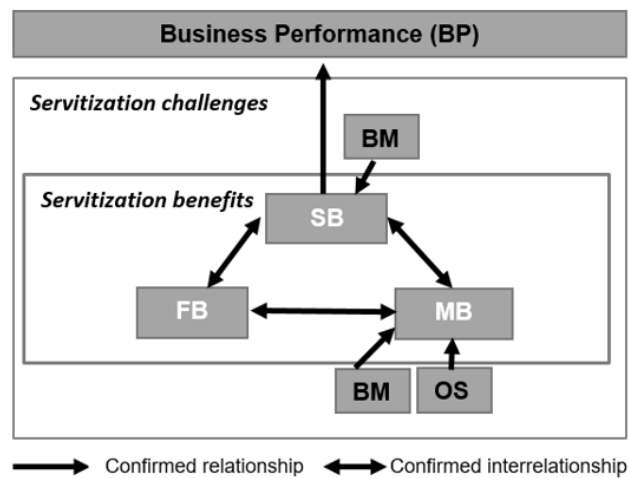


Figure 4-4 A basic conceptual model

4.7 Chapter summary

This chapter presented the results of the quantitative survey, which validated the proposed hypotheses with the empirical data. To begin with, the sample size was analysed and discussed, and then followed by the descriptive analysis, in which the organisational and individual profile of survey responses was established to provide a background overview. After this, a series of statistical analyses was carried out to examine the measurement and structural model as well as test the hypothesis. Table 4-8 summarises the key findings of this chapter.

Table 4-8 A summary of the survey findings chapter

| |
|---|
| Sample size |
| 96 survey responses are valid for testing the theoretical model in this study. |
| Measurement model analysis |
| <ul style="list-style-type: none"> • <i>Construct convergent validity</i>: the item loadings and AVE values indicate that all constructs retain a satisfactory level of convergent validity. • <i>Internal consistency reliability</i>: the Cronbach's Alpha and composite reliability show a high level of reliability. • <i>Discriminant validity</i>: the correlation matrix of the constructs and cross loadings indicate a satisfactory level of discriminant validity. • The evaluation of the measurement model confirms that all constructs are valid and reliable. |
| Structural model analysis |
| <ul style="list-style-type: none"> • The R^2 value (<i>determinant coefficients</i>) indicates an appropriate level of predictive power. • The <i>Stone-Geisser Q^2 value</i> for endogenous constructs indicates an appropriate prediction validity. • The <i>SRMR value</i> of the model is slightly higher than the recommended threshold; however, the model has a good fit considering the complexity of the model. • Hypothesis testing results (only supported hypotheses are listed): <ul style="list-style-type: none"> ○ The results confirmed that overcoming organisational structure (OS) challenges contributes to the realisation of marketing benefits (MB). ○ The results confirmed that overcoming business model (BM) challenges contributes to the realisation of strategic benefits (SB) and marketing benefits (MB). ○ The results confirmed that strategic benefits (SB) positively influence the financial benefits (FB) and marketing benefits (MB). ○ The results confirmed that financial benefits (FB) positively influence the strategic benefits (SB) and marketing benefits (MB). ○ The results confirmed that marketing benefits (MB) positively influence the strategic benefits (SB) and financial benefits (FB). ○ The results confirmed that strategic benefits (SB) positively influence the business performance (BP). |
| Mediation effect analysis |
| <p>Three mediation paths were examined, and the results are as follows:</p> <ul style="list-style-type: none"> ○ Mediation path 1 (SB-FB/MB-BP): FB/MB does not mediate the SB to BM relationship. ○ Mediation path 2 (FB-SB/MB-BP): SB fully mediates the FB to BP relationship, and MB does not. ○ Mediation path 3 (MB-SB/FB-BP): SB fully mediates the MB to BP relationship, and FB does not. |
| Conceptual model |
| A basic model was conceptualised according to the survey findings to illustrate the empirical insights. |

5 CASE STUDY FINDINGS

5.1 Chapter overview

This chapter presents the detailed findings of a case study that explores how servitization challenges exhibit differently in servitized businesses with distinctive strategic focuses. Prior to the findings, the case profile is presented with reference to the proposed typology in the literature to inform the reader about how the participant companies are classified based on their BM and CM (section 5.2). Then the key findings are presented starting from the within-case analysis (section 5.3) to understand each case in the research content, and then the cross-case analysis (section 5.4) is carried out to explain the survey results as well as answer the 2nd RQ ‘*How are the challenges different in businesses with different strategic focuses (IS providers vs. PS suppliers)?*’ The findings of the within-case and cross-case analyses are structured around the core constructs of servitization benefits (strategic, financial and marketing) and challenges (OS, BM, DP, CM and RM). Figure 5-1 shows the detailed structure of this chapter.

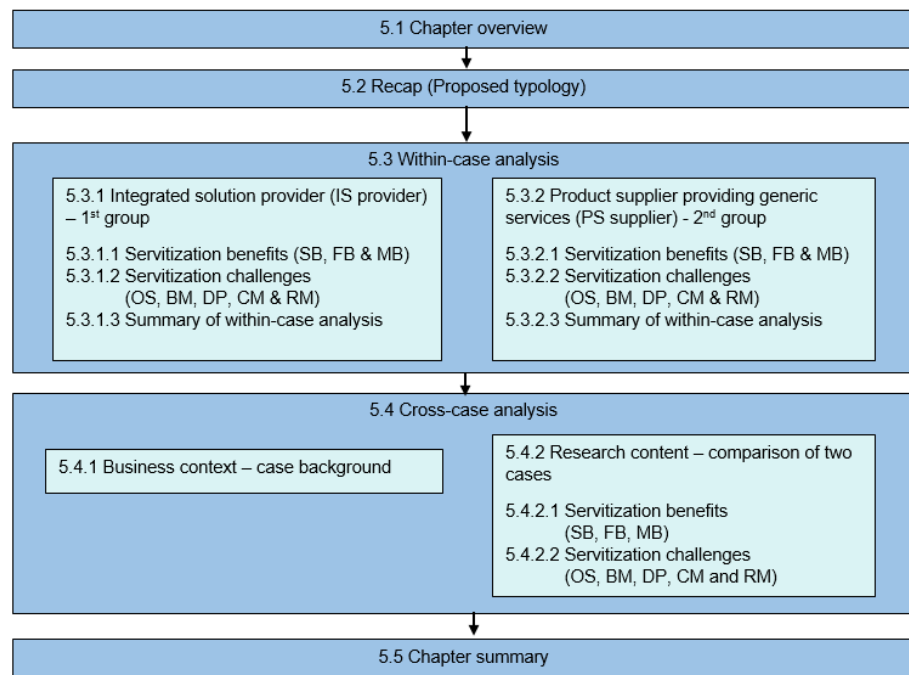


Figure 5-1 The structure of the case study findings chapter

5.2 Recap

Following the quantitative study on the performance implications of servitization challenges, the purpose of the qualitative phase is to seek some explanations for the unsupported relationship in the survey findings and investigate how the challenges exhibit in different types of servitized businesses through further interviews with 13 survey respondents from different companies. As mentioned in the methodology chapter, the unit of analysis in this study is servitized businesses that seek different strategic focuses. Therefore a 'case' refers to a group of organisations that seek the same strategic focus (this is grounded in the developed typology) rather than a single organisation. To understand the distinction of different types of servitization, the pre-established typology in section 2.7.2 is used for clustering the 13 companies, and the results are presented in Table 5-1.

Overall, the sample includes nine IS providers and four PS suppliers. According to the table, most IS providers engaged in this study are large multinational companies that have large numbers of employees worldwide. However, two companies (Serv005 and Serv006) are relatively small in size, thus the author will provide some background information. Serv005 is a joint venture created by two large global companies headquartered in Europe, and a key part of this company's strategic objectives is to provide commercial and technical solutions to industrial customers. The company is in an initial stage of providing integrated solutions to a small amount of business customers, which places them in a good position to talk about the servitization challenges they face during the business journey. Serv006 is a UK subsidiary of a global manufacturer located in another European country. The main production duty is retained by the headquarters, and this subsidiary mainly focuses on the sales, including products, support services and integrated solutions. Although the two companies are relatively small in terms of company size, their BM and level of servitization have proved their relevance to this study. Among the four PS suppliers, two companies (Serv004 and Serv008) operate in the UK only, while the other two (Serv009 and Serv011) are UK subsidiaries of global companies. Although Serv011 has a large number of employees worldwide, its UK business, particularly the servitized businesses, is not as advanced as other large companies in the IS provider category. The next section presents the results of the within-case analysis, and the research relevance of these companies is reflected in the findings.

Table 5-1 Case profile of organisations and individuals

| Code | Interviewee's job title | Core products | Typical solutions/services | Size |
|--|---|--|--|--|
| Integrated solution provider (IS Provider) | | | | |
| Serv001 | Data Scientist | Lifting equipment for industrial customers | Turnkey solution, inspection and preventive maintenance, remote monitoring, consultation services, breakdown services, spare parts, repairs | 17,000 employees (Global) |
| Serv002 | Chief Executive Officer | Elevators for business and residential constructions | Turnkey solution, contractual maintenance, service contract, modernization, base inspection, breakdown services, spare parts, repairs | 68,000 employees (Global) |
| Serv003 | Head of Research and Development | Engineering solutions for corporate customers across various sectors | Turnkey solution, service contract, maintenance | 15,000 employees (UK) |
| Serv005 | Managing Director | Rail products and installation materials | Turnkey solution (initial stage), maintenance, repair, product provision | 300 employees (Single business division) |
| Serv006 | Managing Director | Machines for wood and material processing | Turnkey solution, lifetime service, installation, commissioning, training, breakdown support | 4,290 employees (UK) |
| Serv007 | Head of Delivery Strategy and Service Improvement | Information technology products and solutions | Turnkey service, infrastructure management services, operating system, outsourcing, application support cloud service, warranty-based services | 25,000 employees (Global) |
| Serv010 | Director of Customer Support | Provides flight control systems to major aircraft manufacturers | Turnkey solution, aircraft on ground (AOG) service, maintenance, warranty, overhaul, repair, spare parts | 40,900 employees (Global) |
| Serv012 | Head of Business Intelligence | Defence electronics products, encompassing electronic warfare, radar, displays, defence radio and command information systems. | Turnkey solution, maintenance contract, managed service, training | 64,000 employees (Global) |
| Serv013 | Director of External Affairs (Government Relations) | Supplying power and automated solution/system across various sectors | Turnkey solution, operational excellence service, performance improvement service, LCM services, installed base management, maintenance, reactive service (customer helpline, breakdown, repair) | 134,800 employees (Global) |
| Product supplier providing generic services (PS Supplier) | | | | |
| Serv004 | General Manager of Customer Service | Machine for food packaging, weighing and inspection | Service contract, training, service installation, field service, repairs, spare parts | 564 employees (UK) |
| Serv008 | Service and Maintenance Manager | Laser, electrochemical and electro-discharge systems | Maintenance contract, technical support, technical upgrades, decommissioning, commissioning, training, spare parts | 200 employees (UK) |
| Serv009 | Head of Technology | High-performance machines (precision motion control equipment, simulators) | Onsite maintenance, warranty, repair, onsite installation, spare parts | 10,976 employees (Global) |
| Serv011 | Chief Executive Director | Water treatment technologies and systems | Service contract, maintenance, instrument test, warranty, spare parts | 168,600 employees (Global) |

5.3 Within-case analysis

This section presents the findings from IS providers and PS suppliers as two individual cases, in which the content is structured around the core construct of three servitization benefits and five challenges. In the sub-section, the findings are presented with some quotations from the interviews to combine different views. At the end of each case, a chain of evidence is established by presenting the evidence from each interviewer in a cross-tabulated table that shows how the findings are concluded. In addition, a summative table is presented to detail the key findings of each case.

5.3.1 Integrated solution provider (IS provider) – 1st group

5.3.1.1 Servitization benefits

5.3.1.1.1 Strategic benefits

In terms of strategic benefits, IS providers emphasise that adopting a servitization strategy and providing solution-oriented offerings help them to retain a competitive position in the market by increasing market shares of the company. This is because providing integrated solution creates a new market in addition to the installed equipment base (Serv001, Data Scientist), where the provider can escalate the value chain to become a strategic partner in business customers' operations. In addition, Serv002 (Chief Executive Officer) indicated that being an integrated solution provider is a key strategic part of their business in order to survive in the global competition. He believes that adopting a servitization strategy helps the company to secure a leading position in the market, where he described *"started off the year with the revenue stream that everybody else would die for, and it is there forever unless we mess it up."* More importantly, as the digital age and technical innovation have been generalized in the manufacturing sector, being a solution provider rather than a product supplier can maintain a competitive advantage by providing better customizable and technical solutions to customers (Serv005, Managing Director).

The strategic benefits are further reflected through the improvement of operational efficiency, which is achieved through frequent interactions with direct customers and end users in the form of problem reporting and feedback of user experiences. Serv002 (Chief Executive Officer) stressed that they have been working with some business customers to allow end users to communicate with the IS provider directly, thus the provider can receive an instant notification on real time incidents and manage to solve them in a short time. This improves the overall operational efficiency from the provider's side and enhances the user experience, which has simplified the business process and created benefits to three parties (the IS provider, business customer and end user). Moreover, the provider's knowledge and speciality on their own equipment gives the company a better

understanding of how to integrate the products and services to form an appealing solution for business customers. Both Serv005 (Managing Director) and Serv010 (Director of Customer Support) emphasise that their technical teams are familiar with the equipment and understand how reliable they are, which makes them capable of being an efficient solution provider. Particularly, some IS providers highlight the importance of adopting the Internet of Things (IoT) for achieving better operational efficiency, in which they remotely monitor the equipment embedded with electronics, software and sensors. This allows the provider to capture the data, predict and prevent the equipment failure by analysing the live time data (Serv013 Director of External Affairs). Serv006 (Managing Director) and Serv007 (Head of Delivery Strategy and Service Improvement) stress that integrating IoT as part of the servitized offering allows them to do a better job in providing the solution, as they can proactively monitor the performance of equipment rather than wait until something goes wrong. This potentially reduces the machine/equipment downtime on the customer's side and maximizes their operational efficiency to avoid the waste of time and operation costs.

In short, IS providers have acknowledged that providing IS is advantageous for retaining a prominent position in the market competition as it helps to increase the current market shares and more importantly, improves the overall operational efficiency by proactively monitoring the product performance.

5.3.1.1.2 Financial benefits

The financial benefits of servitization refer to the creation of an additional channel of revenue generation in addition to the product sales and enhanced financial stability.

Since the global production chain has become mature over the past decade, manufacturers in developed countries have found themselves in a weak position in contrast with competitors from developing countries, where production costs are cheaper due to low-cost materials and labour. To overcome the competition from developing regions, the IS providers operating in the developed countries opt for a different sales strategy, in which they sell the equipment at a marginal price to enter the market and generate additional revenues through solution contracts that usually last for a long time period (Serv002, Chief Executive Officer; Serv010, Director of Customer Support).

Given that the solution contracts are offered on a fixed time; the provider could retain a stable financial performance as they expect regular revenues over the contracted period. A typical example is Serv006 (Managing Director) whose core product is a machine for processing glass, wood, stone and advanced materials. In the UK subsidiary, the company provides an integrated solution to customers, where the machine is contracted for operating 5 years or 1000 hours whichever finishes first. The interviewee highlights

that this BM provides the company with long-term stable revenues through solution contracts, which potentially balance out the declining product sales in the old model. He explains that the company has been facing a strong competitor in the same market that is unable to be beaten with a lower price. Instead, providing the solution distinguishes the company from its competitor as business customers are looking for long-term solutions. In addition, the provider could generate more revenues by extending the product life cycle of equipment through specialized maintenance and a total care offering:

“We’ve got ways and means of extending the operation of the unit which obviously if we extend the life of the lift for another five years then we should be able to get our revenue for another five years.” (Serv002, Chief Executive Officer)

Overall, the financial benefits are evident in this case, as IS providers create an additional channel of revenue generation and retain a steady financial performance by supplying solution contracts to the business customers.

5.3.1.1.3 Marketing benefits

The marketing benefits are reflected through responding to customer needs, building long-term cooperative relationships, gaining better customer understanding and engaging with end users. It is evident that providing solutions could better fulfil customers’ needs. Serv005 (Managing Director) stresses that industrial customers are looking for solution providers to support their operations as a key partner in the supply chain, which leaves the customer free of trouble and allows them to focus on their core business. Specifically, providing integrated solutions means the provider needs to take more responsibility for proactively monitoring and maintaining the equipment that they supply, which potentially reduces the downtime for the customer (Serv005, Managing Director, 006, Managing Director).

Given that the solution delivery requires the provider and customer to work together, this gives the provider an opportunity to ‘lock in’ customers by *‘building more stickiness of the contract’* (Serv002, Chief Executive Officer) through interactions at both organisational and individual levels. Through this, the provider *‘works closely with the customer to find the best solution, and gain a better understanding of the customer’s future needs and where their business is going to be in the future’* (Serv003, Head of Research and Development). This allows the provider to be positioned in a competitive place for any future business opportunities. In addition, providing IS enables the provider to be connected with end users, and gather direct feedback from end users to improve the operational efficiency and generate feedback for improve the offering.

“It's really this change that we're seeing between the traditional B2B types of offering where we were providing integrated solution to a customer to now looking at how we improve the experience of end users.” (Serv002, Chief Executive Officer)

Moreover, Serv001 (Data Scientist) emphasises that delivering solutions allows them to build relationships with everyone who is involved in the business, which potentially gives them an access to more business opportunities.

The findings suggest that the marketing benefits are strongly perceived by the IS provider, in terms of building and retaining close relationships with customers, gaining better understanding of customers' needs, and having a direct connection with end users.

5.3.1.2 Servitization challenges

This section gives the findings on the servitization challenges, where each challenge is discussed in turn.

5.3.1.2.1 Organisational structure (OS) challenges

The extant literature indicates that transforming from a product-centric company to an IS provider requires significant changes to the internal OS. Particularly, the internal collaboration among different business functional groups (mainly product and service) is ineffective for various reasons, such as the lack of communication and feasibility of establishing an integrated system within the firm. This issue has been confirmed in the interviews, and one interviewee shared that:

“There are issues with [departmental collaboration] because obviously, you have one team of people installing new [equipment]. Some of that can get difficult at times because the service guys either don't like the quality of the job that's been done by the new equipment guys, or they don't know because the new equipment guy doesn't communicate.” (Serv002, Chief Executive Officer)

Although integrating service and product teams may achieve internal synergy, the interview findings indicate that the majority of IS providers keep them separate and are still following the silo management approach of the old product-centric business. This 'heritage' has proven to be an inhibitor of inter-departmental collaboration, and a clear boundary between the role and responsibility prevents them from working as a team.

“...we try and achieve a team mentality as much as we can... I think we generally achieve that but there are tensions between departments...it takes a lot of my time in thinking of ways in which we can promote teamwork, because silo management, of course, is negative to the operation of the servitization and to the structure of the business.” (Serv005, Managing Director)

The knowledge gap between the service and product team is another inhibitor to internal synergy, especially when transferring the manufacturing knowledge (typically the technical part) to the service team, which makes it difficult for the service personnel to collect valuable feedback from the field and bring it back to the R&D department (Serv013, Director of External Affairs). On the other hand, the production team's lack of service knowledge causes similar issues in the different companies:

“Some of the production staff, they're just used to dealing with our equipment, but they have less knowledge of how equipment can actually be used in service. This becomes a real challenge in bringing product and service together.” (Serv010, Director of Customer Support)

Another OS challenge is the culture change, which refers to how the company shifts the mindset from product-oriented to solution-oriented. Considering that the servitization strategy is adopted through a top-down approach, where the senior management has a clear view of the 'whole picture' whereas employees are not clear about it, the employees' lack of understanding may mean that they are unable to convince the customer that the servitized offerings provide better value.

“It's difficult to pass the message [concept of servitization] to our staff and customers, so you have to continue the work. It's not just a list of rules that people in the company really understand and can communicate. We have to constantly remind people and refresh them of the value of [integrated solution] because the sales guys or customers try and bend rules and interpret things differently. It requires continuous education and refreshment.” (Serv006, Managing Director)

Similarly, Serv012 (Head of Business Intelligence) stresses that employees' lack of understanding of the servitized BM has been a real concern in the company. This is because the company used to operate within a project-based model where the value proposition and internal structure are different from the servitized model, which now requires senior management to have intensive discussions with and continuous education of employees in order to gain a mutual understanding.

In short, the qualitative findings show that inter-departmental collaboration and culture change are two critical OS challenges in this case. Specifically, the silo management of different departments eliminates the team's efforts to achieve internal synergy. Moreover, the lack of communication means the stakeholder is lacking in understanding on the servitization strategy and strategic decision, which could prevent the shift in mindset.

5.3.1.2.2 Business model (BM) challenges

This dimension captures the challenges of modifying the BM to support the delivery of IS, and the challenge relates to the overall BM, value proposition, supply chain network, sales channel, costing and pricing mechanisms. First, the IS provider claims that modifying the BM to support solution-oriented business is challenging, as it is an ongoing process that involves working with customers to understand their business challenge and to respond them effectively. More importantly, modifying the BM is not an internal task as the company needs to consider how the servitized BM is strategically aligned with the customer's BM to promote value co-creation (Serv005 Managing Director).

"I think [modifying the business model] is always a work in progress and we've actually changed the [name of integrated solution eliminated] seven times to give a better definition of it and to meet the customers' needs better." (Serv006, Managing Director)

Apart from the modification of the overall BM, the IS provider highlights that designing a value proposition that meets customer requirements is challenging. This is because the value of an integrated solution is measured in terms of performance, where the provider and customer may perceive the value in a different way. Moreover, a high level of integration between the product and service increases the complexity of the contract, which may lead to arguments if both parties interpret things differently. Serv002 (Chief Executive Officer) highlights that *"having a very clear understanding of what is entitled under the contract and what the customer wants on the contract and what they are paying for is often quite difficult. It's making sure that you put the value proposition together very carefully and making sure that you're showing that value proposition as you change the business model."*

In addition, the internal resource alignment is identified as the third challenge considering the complexity of IS, which refers to the planning and management of internal resources to support the delivery of solution contracts. Given that the IS delivery is highly customizable in order to meet different customer needs, the IS provider serving customers from different sectors faces a huge challenge in building a team with diverse expertise. For instance:

"Retaining skilled labourers is a very big challenge for us because the machinery is becoming more sophisticated and software is becoming a lot more sophisticated, because we supply a broad spectrum of industries and it's very difficult to get the competence in both the application and the machine and the software." (Serv006, Managing Director)

Another interviewee also shared his view on the resource alignment, but from a different angle.

“At one stage, we really need to provide integrated solutions between elevators, air conditioning, security systems and the rest of them. The concept of selling them is very straightforward. Our customers love the concept because they can put all of their problems into one pair of hands, but the delivery of that is actually very tough.” (Serv002, Chief Executive Officer)

The interviewee further explains that this issue stems from the internal integration of resources as well as the modification of the BM, where the company is still struggling to sort out a way of combining service and product teams.

Overall, it is evident that the IS provider faces severe BM challenges, including the modification of BM, and designing the value proposition and internal resource alignment.

5.3.1.2.3 Development process (DP) challenges

DP challenges refer to the issues involved in the DP of integrated solutions, including the creation of an integrated process, customer involvement in the DP, design of performance measurement and development of an applicable toolkit. According to the primary research, most IS providers engaged in this study do not have an integrated DP in place, as product and service businesses are mostly managed separately, as so-called silo management.

“...we don't have this homogeneous working together if you wish to properly get to either a large regional structure or a company level. We have a service director and a new equipment director and then the business comes together at the end level.” (Serv002, Chief Executive Officer)

This appears to be the same challenge in another company that operates across multiple sectors. The interviewee indicates that there is no such integrated process in their company to facilitate the development; however, they foresee some challenges as they impose more changes to support the business transformation.

“I would say the solution is still to follow on from product rather than being done in an integrated way. But I think about more changes as we go forward, but it's a challenge at the moment.” (Serv013, Director of External Affairs)

In addition, a few companies express their intention to integrate the service and product teams, but they are still in the planning stage. They are aware that there might be some challenges in integrating the process, but it is too early for them to comment on it.

Apart from this, IS providers also raised concern over measuring the performance of IS, which determines whether what is expected is delivered by the integrated solution. However, given the fact that IS is delivered through the integration of several business

units and that more human resources are involved, the company found it challenging to measure the overall performance.

“In fact, we found that [measuring IS performance] didn't work. Not that it didn't work from a practical point of view, but it was very tough to measure the benefit of the leverage between different businesses.” (Serv002, Chief Executive Officer)

The IS providers engaged in this study are mostly managing the product and service on a separate basis; there is very little information on the DP, typically only on the performance measurement and application of a relevant toolkit. Other than that, the author also asked about customer engagement in the DP as it emerged as a DP challenge in the literature; however, IS providers seem not to have this challenge as their customers would like to contribute to the development of IS because they see there are mutual benefits in it.

In short, there is little evidence about the DP challenges in this case as the IS providers engaged in this study are in an initial stage of integrating the DPs. However, they highlight some concerns about developing the process and measuring the overall value/performance of the IS.

5.3.1.2.4 Customer management (CM) challenges

The CM challenges refer to the issues of establishing and maintaining relationships with customers in the solution business, and they are reflected through matching customer needs, ownership transfer, long-term relationship building, value co-creation and information sharing. According to the data analysis, IS providers actually face several challenges in this area.

First, the provider found it challenging to convince some customers about the value of IS offerings, as they are not familiar with the servitization notion and therefore remain sceptical about the value of the offering.

“...some customers, providing the solution was a breath of fresh air for them, because our market is very traditional. And we used to supply products, show how to use them and then leave. Now we were very much more about trying to provide a solution. Some customers accepted, others were very sceptical about [name of integrated solution].” (Serv006, Managing Director)

This challenge is also evident in another company in the IT sector.

“...from a customer perspective, we have to spend a lot of time going to markets and explaining to sales companies. It's very easy to talk about I got X number of data centres and X number of engineers. It's very different to talk about we can deliver this integrated

solution or we can meet 95 percent of the SLA (service level agreement) which is a different context. The key is what customers want and what customers receive.” (Serv007, Head of Delivery Strategy and Service Improvement)

Apart from this, the IS providers highlight that customers sometimes can be very demanding, and they try to negotiate many free value-added offerings to maximize their benefits in the contract. This certainly increases operational costs and offsets profits on the provider’s side, which has negative impacts on the relational process. However, customers may have not realised that procuring servitized offerings is different from the procurement model used in the product-centric company, where low price products can stand out from the competition. In the servitized business, the provider and customer need to go through the process together to ensure that they reach a consensus on the price, performance, and etc.

“The big problem is that customers underestimate the cost of doing things. And if we take certain operations away from them, certain functions and management of the supply chain, then we're looking for a percentage [of profits] to do that. They're looking at something considerably less than that. And therefore to reach a common ground and to reach a common understanding is a challenge.” (Serv005, Managing Director)

Another interviewee shares his experience on the same challenge.

“...when you start looking at the contract, does it include the breakdowns? Does it include the recovery at weekends? Does it include the parts? Does it include the parts up to a certain value? Does it include misuse abuse? Does it include vandalism matters? Valuing all those things may make the situation more complex. So very often the customer is pushing to get as much included for the same price.” (Serv002, Chief Executive Officer)

In addition, there are some uncertainties that stem from the customer changing their mind, as they may add to or remove requirements from the contract. This could be caused by the IS provider’s lack of a good understanding of the customer’s needs and therefore fails to predict their intentions.

“Business needs a change within the short space of time, so they order machines and with a [solution] contract, you need different functionality or different performance. And when the machine arrives they're going to say, ‘You know, it doesn't meet our performance criteria’ etc. So this is why we have to be really clear and make sure that everyone understands what they're going to get from this machinery, from both customers and suppliers. So this is the most difficult thing to manage in customer management.” (Serv006, Managing Director)

Second, the value co-creation among providers and suppliers can be regarded as an inhibitor of CM if one of the parties is lacking in commitment to the process. A typical example is that the customer refuses to share the operational data with the IS provider. This may cause some difficulties on the provider's side as they may not be able to monitor the equipment and access the live data, and therefore the provider is unable to detect the potential machine/equipment failure. Serv001 (Data Scientist) commented on this challenge after sharing his experiences with some customers who were reluctant to share information.

"...we got a lot of automations going on behind the scene, so it's to their [customers] benefit that the [equipment] tells us things. Because if there is something that breaks down or it's broken, we say ok, we can fix it. But if we could have had the data, then we could have predicted when it's going to be broken." (Serv001, Data Scientist)

Serv005 (Managing Director) also offered his explanation on data sharing, as he believes that many industrial customers are not familiar with the servitization concept and they are sceptical about what is called value co-creation. This prevents them from building a close relationship with the provider and being open-minded about data.

"Some customers understand [Servitization], others prefer short-termism or silo management. They keep us at arm's length...The basic problem is that customers do not open their books to us and therefore we don't have perfect information to support the delivery of the solution." (Serv005, Managing Director)

Some IS providers encounter a similar challenge in a different situation. For instance, their business customers may be an indirect competitor in the near future, thus the customer is more cautious about data sharing in order to remain competitive in the business (Serv010, Director of Customer Support; Serv012, Head of Business Intelligence). Furthermore, one interviewee highlights that there are always some arguments about the ownership of data, especially when the provider, customer and end user are all involved.

"It is interesting now as I was saying with all this focus on big data. Now people are realizing that the data that is on the aircraft is a valuable commodity. We have a lot of debate about who owns the data, is it the aircraft manufacturer, is it the equipment supplier or is it the end user?" (Serv010, Director of Customer Support)

In short, the findings suggest that IS providers face two challenges in this category. In terms of customer needs and expectations, the provider found it difficult to convince the customers that the IS could match their needs and expectations. Regarding value co-creation, the customer's lack of commitment and trust in this relational process increased some uncertainties in the value delivery.

5.3.1.2.5 Risk management (RM) challenges

RM challenges refer to those challenges that arise from an increased level of internal and external risks in the solution business. The primary findings indicate that IS providers are exposed to operational and financial risks internally, and there is little evidence on the external risks. In terms of operational risks, they originate from the changes that are triggered in different parts of the business and lead to even more challenges, for instance, the OS, BM, DP and CM. The findings presented in the first four sections have proved that providing IS to business customers indeed increases the level of internal risks. In addition, the operational risks can be aggregated when the IS provider takes more operational risks from the business customers to realise the value of servitized offerings.

“We have to take the risk because that is the only way to realize the value, and that will be a challenge to the way we think; and we have a risk profile in place to make sure that we get a sensible risk and reward balance.” (Serv013, Director of External Affairs)

IS providers explain that delivering solution contracts may cause a workload peak during the contracted period as the equipment is often trouble-free in the first few years of the contract, and then starts to cause some issues after a particular time. This increases the operational risks when multiple contracts are started at the same time, as the equipment provided to different customers could cause some issues at around the same time. The provider may face the risk of labour shortage as the company’s daily operation requires fewer employees. If the provider fails to deliver to the contract, then they will face huge financial penalties, which are discussed later as a part of the financial risks.

“With servitization, we’re taking on far more than just the warranty on the product. We are here averaging out, so we’re accepting that we will have some years we’ll have more work to do than others. We choose to apply a flat fee on a monthly basis. So we’re taking the risk there that some months there will be a lot of activity which we have to pay for.” (Serv005, Managing Director)

Another interviewee is also concerned about the internal capacity of dealing with booming sales, as they have found it difficult to increase the capacity in a short time, as the company tries to achieve a lean operation in its daily business.

“...be able to manage resources and the growth of the company in balance is very difficult because you tend to find the sales increase first and you have to take on staff, train them and try and meet that demand but not over exceed it. Because our industry is very competitive, we have to keep as lean as possible to overcome the competition.” (Serv006, Managing Director)

Apart from the two operational risks, the health and safety risk was identified as an emergent theme. Given that IS delivery is highly reliant on the support of its human resources, the front tier employees, such as engineers and technicians, are required to work with large machines and heavy objects. This certainly increases the likelihood of injuries and fatalities during the work (Serv001, Data Scientist; Serv002, Chief Executive Officer). Serv002 (Chief Executive Officer) offered some details from his point of view:

"...we have more people injured on service that is perhaps because they're working late at night or early in the morning, or because they're in unfamiliar places... they seem to be in conditions where they take..., either they break their safety rules and do something stupid, or they don't see the risk and they then again do something stupid.

...we have very strong safety rules about how to isolate equipment...but very often we find that for some reason people are either too complacent or they just don't follow the rules."

In addition, IS providers claim that the financial risks have increased as they have changed the BM from product-oriented to service-oriented, where the risks originate from the upfront investment of servitization business, high operations costs and financial penalties that are attached to solution contracts. Unlike the product-centric business, the revenues from solution contracts normally take longer to be received, and this causes an ineffective cash flow in the company after they have made heavy upfront investment.

"...the biggest challenge there is affordability of integrated solutions for us as a business. It's obvious to us that it's a different cash profile. It does require us to invest more upfront because the revenue stream that we get from the customer will stretch over a long period of time, we don't get the order and payback that we got from our traditional product business." (Serv012, Head of Business Intelligence)

Furthermore, IS providers are likely to take on a huge amount of financial penalties if they fail to retain performance reliability in the long-term. Although attaching financial penalties could be persuasive for customers with regard to the value of offerings, this could cause more internal financial instabilities if the company is unable to maintain a good performance throughout the contracted period. A good example is shared by an interviewee:

"[Name of place removed] where we're doing the crosswalk escalators. The demand for the reliability is 99% throughout its working life. If it falls below 98%, we get penalties. We are actually 99.7% and we intend to remain at that level throughout the contract, but the contract is for 30 years. So this is a long-term task to make sure we maintain at that level to avoid the penalty." (Serv002, Chief Executive Officer)

Overall, the findings suggest that IS providers encounter two RM challenges as many operational and financial risks have been triggered during the servitization. The operational risks stem from the challenges that are identified in different business areas, risk sharing with business customers, and management of health and safety issues. On the other hand, the financial risks are increased as the heavy investment and contract penalties are involved in the business.

5.3.1.3 Summary of within-case analysis

To summarise the findings of the first group – IS provider, Table 5-2 presents the supporting evidence regarding the manifestations of servitization benefits and challenges from each interview, which forms a chain of evidence demonstrating how the author concludes the key findings shown in Table 5-3.

Table 5-2 A summary of evidence from the 1st group – IS provider

| Constructs and indicators | 001 | 002 | 003 | 005 | 006 | 007 | 010 | 012 | 013 |
|---|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Strategic benefits (SB) | | | | | | | | | |
| Secure leading market position | x | x | | x | x | | | x | |
| Improvement of operational efficiency | | x | x | x | x | x | | | x |
| Financial benefits (FB) | | | | | | | | | |
| Additional revenues | | x | | x | x | | x | x | |
| Financial stability | | x | | | | x | x | x | x |
| Marketing benefits (MB) | | | | | | | | | |
| Responding to customer needs | x | x | | x | x | | | x | |
| Customer engagement (Long-term) | x | x | x | x | x | x | | | x |
| Understanding customer needs | | | | x | x | | x | x | x |
| Connect to the end user | x | x | | | | | | | |
| Organisational structure (OS) challenges | | | | | | | | | |
| Inter-departmental collaboration (Internal value co-creation) | x | x | x | x | | x | | x | x |
| Culture change | x | | | | x | x | x | x | x |
| Business model (BM) challenges | | | | | | | | | |
| Modification of overall BM | | | | x | x | x | | | |
| Design of value proposition | | x | | | x | | x | | x |
| Internal resource alignment | x | x | x | x | x | | x | | x |
| Separate sales channel | | | | | | | | | |
| Development process (DP) challenges | | | | | | | | | |
| Development of an integrated process | x | x | | | | | | | x |
| Performance measurement | | x | | | | | | | x |
| Application of toolkit | | | | | | x | | | |
| Customer engagement | | | | | | | | | |
| Customer management (CM) challenges | | | | | | | | | |
| Customer needs and expectations | x | | | x | x | x | | | x |
| Value co-creation Communication | x | x | x | x | x | x | x | x | x |
| Market competition | | | | | | | | | |
| Risk management (RM) challenges | | | | | | | | | |
| Operational risks | x | x | x | x | x | x | x | x | x |
| Financial risks | x | x | x | x | x | x | x | x | x |

Note: 1. The constructs and indicators in this table are final codes (see Appendix 6) that have evolved during the qualitative data analysis. 2. The grey rows indicate that there is no evidence supporting the indicator in this case.

Table 5-3 Summative evidence for the 1st group – IS provider

| CORE THEME | SUMMATIVE EVIDENCE (IS provider) |
|--|---|
| Servitization Benefits | |
| Strategic benefits (SB) | <ul style="list-style-type: none"> • Providing servitized offerings to business customers helps the company secure a leading position in the market • Engaging business customers as value co-creators enhances the overall operational efficiency through effective communication and monitoring the equipment |
| Financial benefits (FB) | <ul style="list-style-type: none"> • Supplying servitized offerings creates an additional channel of revenue generation in addition to product sales • Delivering integrated solutions through long-term contracts enhance the financial stability of the company |
| Marketing benefits (MB) | <ul style="list-style-type: none"> • The IS provides a comprehensive solution to address customer needs by directly responding to their operational challenges • Delivering solution-oriented contracts allows the provider to engage the business customers on a long-term basis • The provider working closely with customers enables a better understanding of customer needs and to plan for future business • Providing IS enables the provider to build a connection with end-users and obtain an instant feedback on the user experience |
| Servitization Challenges | |
| Organisational structure (OS) challenges | <ul style="list-style-type: none"> • Managing the product and service team separately ('silo management') prevents inter-departmental collaboration • The stakeholder's lack of a clear understanding on the servitization concept and strategy prevents the shift of the business culture from product-centric to solution-centric |
| Business model (BM) challenges | <ul style="list-style-type: none"> • Modifying the entire BM to support the solution business is a critical challenge, as the company needs to make changes in different areas of the business and ensure the BM is aligned with the customer's business needs • Designing a value proposition to suit customer's needs is challenging as there is a mismatch between the provider and customer in terms of value perception • Planning and managing internal resources is a challenge, given that the solution delivery may experience a 'peak time' when the provider requires more human resources to support the solution delivery |
| Development process (DP) challenges | <ul style="list-style-type: none"> • Creating an integrated DP to support the development of an integrated solution is prevented by the silo management of the product and service business • The complex nature of IS makes it difficult to measure the overall performance of the offering • The applicable toolkit for supporting the solution development is lacking and underdeveloped |
| Customer management (CM) challenges | <ul style="list-style-type: none"> • There is a gap between the provider and customer in the way of perceiving the value of servitized offerings, thus the provider finds it difficult to demonstrate how the offering matches the customer's needs and expectations • The lack of commitment from the customer's side in the co-creation prevents the effective delivery of solutions, such as the customer being reluctant to share operational data with the provider |
| Risk management (RM) challenges | <ul style="list-style-type: none"> • The four servitization challenges identified above increase the level of operational risks in the business • The provider needs to share some risks with the customer to realise the value of servitized offerings and this could increase the level of operational risks • The level of financial risks is increased due to heavy upfront investments and potential financial penalties involved in the IS contract |

5.3.2 Product supplier providing generic services (PS supplier) – 2nd group

The PS suppliers refer to servitized companies that provide a broad range of support services to facilitate the functional use of products. In contrast to the IS provider, the PS supplier provides products and services on a separate basis rather than a bundled package. There are four PS suppliers engaged in the study, and the findings are structured in the same way as in the previous section. Under each sub-heading, the similarities between the two types of servitized businesses are highlighted first, followed by the differences. This serves as a basis for the cross-case analysis in the next part.

5.3.2.1 Servitization benefits

5.3.2.1.1 Strategic benefits

The strategic benefits perceived by PS suppliers are similar to those of IS providers, in which providing a broad range of support services helps the company to increase its market share, so that the company can maintain a competitive position globally. The PS supplier claims that expanding the service business could directly contribute to the business growth of the company, as customers can be 'locked into' the after-sales services (Serv008, Service and Maintenance Manager; Serv011 Chief Executive Director).

"Delivering world-class customer service is our first and foremost goal. Obviously, the commercial growth will follow as a result of that, really making it an obvious decision for the customer to come to you for aftermarket services." (Serv004, General Manager of Customer Service)

Unlike IS providers, there is no evidence to indicate that providing support services helps PS suppliers improve the overall operational efficiency. This is because support services, such as overhaul and repair, focus on maintaining basic product functions, which does not require close interactions with customers and end users to monitor the equipment efficiency and gather prompt feedback on product usage. For instance, Serv008 (Service and Maintenance Manager) stresses that the strategic focus of providing services in their company is to *"support the functional use of products. Once we've built the product, you are supported afterwards."* This shows that the strategic focus of the PS supplier is different from the IS providers, as the former only focuses on supporting the product while the latter supports the operational needs of business customers and improves the user's experience through value co-creation with every party in the supply chain network.

To summarise, providing support services helps the PS supplier to secure a leading position by increasing the market share, through which the company could engage with customers and increase their loyalty in the after-sales market.

5.3.2.1.2 Financial benefits

The primary data show that some financial benefits perceived by PS suppliers are also evident in the 1st case. First, the PS supplier recognises that providing support services alongside the product business creates an additional channel of revenue generation.

"...obviously the warranty and the SLA (Service Level Agreement) [support services] expand the service portfolio as a revenue generator as per the customer's operation."
(Serv008, Service and Maintenance Manager)

Another interviewee from a different company also shares a similar view.

"...the business performance [product business] has been very patchy because it's had years when the profitability has been very good and last year was one of those years. This year I think it will be significantly less.... this is why I've been asked to really assess how we can grow a more balanced business with services being a core part of what we do."
(Serv011, Chief Executive Director)

Although the multiple cases show that providing servitized offerings could gain additional revenues, the two businesses realise the benefit in different ways. The IS provider seeks additional revenues in exchange for delivering integrated solutions to address customer's operational needs, while the PS suppliers look for additional revenues from aftermarket services as a separate channel from the product sales.

Second, providing support services increases the financial stability of the company due to regular market demands. Similarly to the 1st case, the PS supplier claims that they could generate stable revenues through support services, such as a monthly service subscription or paid warranty programme (Serv008, Service and Maintenance Manager; Serv009, Head of Technology; Serv011 Chief Executive Director). However, the level of financial stability in the IS business is relatively higher than the PS supplier, and this is because the IS provider is mostly contracted for delivering the solution, which means the revenues are fixed for long-term projects. For the PS supplier, the stability is relatively lower in the long term as selling support services does not generate as much revenue as IS providers, considering that basic services are mainly paid as a lump sum.

To summarise, PS suppliers providing servitized offerings improve their financial performances through the creation of an additional channel for revenue generation and increase the stability of cash flows by fulfilling regular market demands.

5.3.2.1.3 Marketing benefits

Similarly, to the 1st case, PS suppliers have acknowledged three marketing benefits. First, PS suppliers highlight that providing support services could fulfil customer satisfaction by maintaining the product functions and extending the product life cycle.

“[Providing services] is an attempt to seek commercial growth, but also brings into consideration the holistic attitude as well as processes and systems to support our customers on a long-term basis. So what we are really trying to do is take on more of a proactive approach in terms of the whole lifecycle....and really try and move as far away as possible from a run to failure kind of a response situation.” (Serv004, General Manager of Customer Services)

This view is also shared by another interviewee:

“I think our main goal was to bring closure to them [customers] and to understand their businesses through their challenges and be able to share some of that risk and potentially reduce that downtime.” (Serv009, Head of Technology)

Second, the PS supplier providing services enables a long-term customer engagement through the service contract, such as maintenance programmes and extended warranty programmes. Through the service contract, the PS supplier is contracted for maintaining the product life cycle of the equipment for a certain period of time, which *“improves our customer relationship and the longevity of these relationships”* (Serv011, Chief Executive Director). Although the two servitized businesses seek to retain a close relationship with business customers, they have to handle it in different ways. The IS provider engages customers as a value co-creator, where they interact with each other at both the organisational and individual level to enable trust building within the business. In contrast, the PS supplier retains customers through service contracts, for which the communication is standard and less interactive.

Third, the PS supplier highlights that providing services allows them to gain a better understanding of customer demands. Serv011 (Chief Executive Director) highlights that *“...services is a way of getting closer to customers, getting a better trust between organizations, better understanding of what we can deliver and, importantly, what we can't deliver on both sides.”*

These points indicate that PS suppliers have perceived similar marketing benefits to IS providers, which are that providing servitized offerings helps the company in maintaining a close relationship with customers and retaining a better understanding of the market.

5.3.2.2 Servitization challenges

This section presents the findings of servitization challenges in the 2nd case.

5.3.2.2.1 Organisational structure (OS) challenges

Similarly to IS providers, the PS supplier recognised two significant OS challenges associated with the adoption of servitization: culture change and inter-departmental collaboration. However, the two challenges exhibit slightly differently in the 2nd case.

In terms of culture change, the PS supplier stressed that the employees who have been working in a product-centric business over the past decade are reluctant to accept the changes that are brought in by the adoption of servitization. This is because moving towards servitization changes the entire BM, the DP, the customer relationship and the internal structure, all of which could make the working environment dynamic and cause some insecurities to employees.

“We’ve just been through these changes. There’s a fear of changes on a personal level. A lot of people fear change. Resistance to it obviously is a common way; it may be because it’s a process they’ve been doing for 10 years and therefore there’s always resistance to change.” (Serv008, Service and Maintenance Manager)

Another interviewee from a different company shared his view that the traditional understanding of the product and service business prevents a culture change, as the company does not address the co-existence of products and services that are contradictory in nature.

“When I first joined the company three years ago, I was told there is no market for the service contract because we don’t want to tell our customers or imply that the machines may break down. So the service was regarded as a negative and not something that the salesman wanted to bring into the discussion. So it has been a big root challenge and we’ve had to go out to prove that there is a market outside...” (Serv004, General Manager of Customer Service)

In addition, Serv011 (Chief Executive Director) highlights that the product-oriented business culture in his company has inhibited the expansion of service business, because they *“never develop products with service in mind and therefore you have a community of product development people who need to be educated and supported to understand services and how to create those service offers.”* These are root causes of resistance to change as employees, especially those who have been embedded in the product business, may feel that the shift of culture requires more service professionals, and therefore could reduce the contribution of the product team to just the overall firm performance.

In addition, inter-departmental collaboration is another OS challenge that has been identified in the 2nd case. Given that the product and service are provided on a separate

basis, the silo management approach is normally adopted by the PS supplier to manage the two business units. It is evident that the silo management potentially increases the likelihood that the two business teams transfer the responsibilities to each other to minimize the workload, which causes a huge difficulty in achieving internal synergy.

"...[because] we're working very much in silos. The idea is to get stuff off your desk as soon as possible to become somebody else's problem. So there's a little bit of a paradox as to why people are so keen to absolve themselves of responsibility for things that may manifest themselves in an e-mail instead of going to one person to act on something. It will go to five or ten people in the hope that somebody will deal with it. That's a small example [of inter-departmental collaboration issues] but it is extremely frustrating." (Serv004, General Manager of Customer Service)

Apart from the example above, the PS supplier recognises that there is an internal competition arising among the two teams, which could be a consequence of the silo management. This competition causes some potential conflicts among the teams due to resource utilisation, which indeed has a negative impact on the inter-departmental collaboration.

"There is a risk of internal competition because in the business model in particular we actually solve a product but we also make. So we all cannibalize each other. One area wants to sell more product and the other area wants to sell more resource or outsource. So there's an internal competition if you changed your model to significantly benefit one of them." (Serv008, Service and Maintenance Manager)

This issue could be aggregated if the company were to assess the performance of the two teams from a financial perspective. Given that providing services can generate more stable revenues than just selling the products, the competition within the financial performance obviously makes it harder for the product and service teams to work together.

"[Creating a service sector] was very positive from the point of view of focus on improving our services to the customer, but it also provided extremely large amounts of tension within the business. There were a lot of financial tensions within the organization, because the service sector initially had a high profit part of the business. It started too quickly to show the lack of profitability of all other parts of the business." (Serv009, Head of Technology)

The Serv009 (Head of Technology) also shared that the company had decided to disperse the service sector into different parts of the business to address the conflict. Although performance measurement could promote internal productivity, it may cause some negative impacts if the senior management were unable to address the conflict.

In short, the PS supplier faces two OS challenges that relate to the business culture and inter-departmental collaboration. Given that the product-centric culture has been a 'heritage' of the company for a long time period, dealing with employees' resistance to the changes that are associated with servitization becomes a critical challenge to the shift in the business culture. Moreover, the silo management could cause many tensions among the service and product teams as they potentially compete with each other on the team performance, which has negative impacts on achieving internal synergy.

5.3.2.2.2 Business model (BM) challenges

The BM challenges that are identified in the 2nd case are significantly different from the 1st case. This is because PS suppliers are mostly dominated by a product-centric BM and services are added as supplementary offerings to the product life cycles, and therefore adopting a servitization strategy in PS supplier business does not require significant changes to the BM.

According to the data analysis, there is an emergent BM challenge identified in the PS supplier. Unlike the IS provider, PS suppliers do not have key account managers, who are responsible for closely aligning with customers during the delivery of an integrated solution. This simplifies the whole process for the customers as they only need to speak to one person regarding all their enquiries, rather than consult with different business units. However, given that PS suppliers provide products and services on a separate basis, selling products and services needs two sets of sales teams, and they normally work in a sequential order without involving each other. However, this may lead to the confusion of roles and responsibilities and result in nobody dealing with the customer's enquiry. Regarding the issue of inter-departmental collaboration, the sales people may also eliminate themselves from the responsibilities and pass them on to others to reduce the work load.

"There's been no sort of the key account management. There's been nothing in place previously that could even be from the sales process. It's very unclear who is responsible for a customer when there is a problem." (Serv004, General Manager of Customer Services)

In addition, Serv004 (General Manager of Customer Service) claims that the product sales people are generally not interested in selling services, because they think it takes more effort to convince the customer of the value of the intangible service offering than selling the product.

"There is a reluctance amongst the traditional [product] sales people. There is a lack of willingness to become involved and in many cases it boils down to laziness. It's as simple

as that. They see themselves as there to get the signature on the order [rather than make sales].” (Serv004, General Manager of Customer Service)

This is a common issue that is raised by another interviewee.

“We had the traditional sales people who were product-based. We started to develop new sales teams for the service side, mostly because we recognize that it takes a different type of sales approach to sell services, particularly more about advanced services, such as subscription-based services and warranty type services and predictive maintenance services.” (Serv009, Head of Technology)

Although building different sales channels supports the adoption of servitization internally, this sometimes causes confusion and inconvenience to external customers, especially when they need to talk to different people for various enquiries (Serv009, Head of Technology).

Apart from the sales channel, there is an additional concern on pricing services. Both Serv004 (General Manager of Customer Service) and Serv011 (Chief Executive Director) stressed that understanding the value of services to the customers and determining the price are challenging as they try to avoid over- and under-pricing in the market. However, this is not a specific issue of servitization, as selling products also faces the same challenge.

Overall, the BM challenges that are identified in the 1st case are not the same as in the 2nd case, as the PS supplier is only concerned about the sales channel, in which they claim that the product sales team is not adequate for selling services due to the lack of sufficient knowledge and relevant business mentality.

5.3.2.2.3 Development process (DP) challenges

Similarly to the 1st case, the DP in the PS business is not yet integrated as services are developed on an *ad hoc* basis. Therefore there is no evidence on the challenge of developing an integrated process, and most PS suppliers engaged in this study are in the planning stage (Serv004, General Manager of Customer Service; Serv008, Service and Maintenance Manager; Serv009; Head of Technology). Serv011 (Chief Executive Director) points out that developing a product without thinking about relevant services has been the usual practice in the product companies, which is ineffective. He stresses that it is important to educate both product and service people to achieve a synergic innovation and consider the relevant services when developing the product, and so the two offerings could be ‘connected’ together.

Unlike IS providers, the customer involvement in the DP appears to be a critical challenge to the PS supplier. The interviewees claim that generally business customers are hard to be engaged as they do not value the engagement process.

“...you never hear from customers who think the service is outstanding...where something has gone specifically very badly wrong, they want you to know about it.” (Serv004, General Manager of Customer Service)

This is common view was shared by another interviewee:

“...they don't really get engaged in or they don't engage in what is required. They either take it or don't really care.” (Serv008, Service and Maintenance Manager)

Serv009 (Head of Technology) also shared that they *“have two types of customers, and one of them is keen to get engaged and others are not interested at all”*. He explains that this may be because the servitized offering offered by the company is the most advanced in the market and they have planned to launch integrated solutions in the next few years. This strategic plan certainly attracts some customers' attention as they see there are direct benefits in the development of integrated solutions. This is in line with the finding in the 1st case, where the IS provider highlighted that they do not have any challenges in engaging customers in the IS development.

In addition, Serv011 (Chief Executive Director) shares a slightly different view on the customer engagement, as he believes that insufficient customer engagement has resulted from talking to the wrong person. He emphasises that the senior management in the client's organisation has a broad view on their business demand and they have a better understanding of the value of the servitized offerings. On the other hand, the employee at the operational level may not see the 'whole picture' or they are under pressure to cut down on operation costs and choose a cheaper deal. He believes that *'having right dialogue with the right person'* should be the right thing to do in order to get customers involved.

In summary, insufficient customer engagement in the DP is the only DP challenge in the 2nd case, which is not evident in the 1st case where the key challenges are related to the process and performance measurement.

5.3.2.2.4 Customer management (CM) challenges

There are three CM challenges identified in the 2nd case, which are also reflected in the 1st case. First, PS suppliers highlight that they often found it difficult to convince the customer of the value of servitized offerings due to the lack of effective communication.

“I have to say one of the biggest challenges was really trying to understand how to pitch this product [service offerings] to ensure that there is an obvious financial benefit to the customer.” (Serv009, Service and Maintenance Manager).

This challenge is more noticeable in the case of the service contract, such as a maintenance contract and warranty programme, as most business customers are sceptical about the value of service contracts until something goes wrong and they suffer financial loss as a consequence of machine failure. Serv011 (Chief Executive Director) demonstrated this issue by sharing his conversation with one business customer.

“...I did have a conversation many years ago with one of the procurement people [in the customer company] because that's the other thing, the procurement attitudes tend to be very similar. A very black and white. This is a contract for services. And they said you know we don't really understand the value that you'll give me through this service. And I responded to it quite defensively and he just happened to mention that since then we have been servicing their assets and they have had zero downtime in production in the last five years. And I stopped him and said okay how much does it cost you as an organization if one of these plants stops working? And he said oh we really don't know but it's probably measured in millions rather than hundred thousands. Then I said, that's the value of our service.” Serv011 (Chief Executive Director)

Through this example, he points out that sometimes the PS supplier is clear about the value of services they offer, but business customers need further education to understand the value of service contracts. This is because most business customers retain the traditional procurement model in choosing product and service suppliers, as they often prioritize the price not the real value.

“...it's difficult to demonstrate that value to a customer who's never experienced the problem because it's a typical procurement model. Your service looks like this. There's service there like that. The price difference is six thousand euros a year or pounds a year. I'll go for the cheapest. Actually in a service organization you don't really prove your value until something goes wrong.” (Serv011, Chief Executive Director)

The second challenge is possessing a clear understanding of customer needs and expectations. Considering that the customer involvement in the service DP in PS business is insufficient, PS suppliers are often lacking in good customer understanding. Serv009 (Head of Technology) emphasises that the biggest external challenge they are facing is *“understanding what is the best way to understand what the customer really wants, how do we make money and how do they see value from our offering.”*

Like IS providers, PS suppliers have experienced that business customers want to negotiate the price of service contracts to maximize their profits, or set a high expectation that is hard to exceed. They explained that selling services takes a more flexible approach and it is difficult to draw a line with customers on what exactly is included or excluded in the service contract, or the service should be delivered to which standard.

“...we really had a tough time when managing customer expectations from the outset and everybody understands what it is, so therefore having service contracts which are established as possible or modular is absolutely essential in terms of being able to manage their expectations, so that you can deliver them consistently.” (Service004, General Manager of Customer Service)

Moreover, the PS supplier that serves a broad customer portfolio could face a more complex situation, in which the customers' requirement may be varied depending on the sector. Serv009 (Head of Technology) emphasises his concerns regarding exploring the expectations of different customers, and believes that an effective customer engagement would definitely help the company to gain the right knowledge and provide better offerings. However, regarding his view on the DP challenges, he mentioned that only a small percentage of business customers would like to be engaged in the DP. This implies that the challenges facing PS suppliers could be compounded to have a greater impact on the overall business, which confirms our findings that the challenges identified in different business areas could increase the operational risks in the company (this is discussed in the next section).

The last CM challenge is the potential market competition, which refers to the situation when the PS supplier and business customer compete in the same market. This could happen when the business customers are capable of doing all services in-house at a lower cost, and thus do not need to hire a PS supplier for services.

“Our biggest competitor is often our customers and they're always charging you for cost down and margin erosion on the basis that they can do it themselves as quickly or as efficiently. So it is a big challenge that we have to face as a business.” (Serv004, General Manager of Customer Service)

Apart from this, the business customers may regard the PS supplier as a potential competitor. This is typically when the PS supplier requires access to the end user who is the direct customer of the business client, as the equipment can only be serviced by the original supplier – PS supplier. This could create some tensions in the customer relationship as both parties may be competing in the same market in their future business.

“The other tension I think we faced was that our traditional customer was the OEM and most of our product sales teams were selling components to other manufacturers, whereas the services were more focused on the end user. So certainly most of... there was a conflict between, if you like, us bypassing our customers and talking to their customers – the end users. So again we have to manage that conflict quite carefully.”
(Serv009, Head of Technology)

These points demonstrate that the CM challenges perceived by PS suppliers are similar to the challenges in the 1st case, which relate to the lack of communication with business customers, understanding of customer needs and expectations, and potential market competition from existing customers.

5.3.2.2.5 Risk management (RM) challenges

There is little evidence in the qualitative data indicating that PS suppliers face challenges of RM when shifting towards servitization. Unlike IS providers, the PS supplier is not seeking to renovate the BM and share operational risks with customers to realise value. However, they look into developing the service business in parallel with the product to support the functional use of products. Therefore the financial and operational risks exhibit differently from the 1st case.

Although managing products and services separately causes fewer risks than the solution-oriented business, the challenges that are discussed in the previous sections have a direct effect on the level of operational risks in the business. For example, Serv004 (General Manager of Customer Service) claims that the lack of collaboration among service and product teams (one of the OS challenges) causes the loss of strategic focus to respond effectively to customer demands. He explained this as being that the two teams compete with each other on the financial performance, thus eliminating the internal synergy of improving the overall performance. Besides, Serv011 (Chief Executive Director) highlights that the PS supplier pitching the servitized offering to the customer competitively could be risky, as the company may be overcommitted about what they can deliver. This allows customers to eliminate themselves from responsibilities and transfer them to the supplier’s side. He emphasises that he spent a lot effort on designing offerings and ensures that the sales people can pitch them in the right way to their customers.

Similarly to the operational risks, there is little evidence about financial risks in the 2nd case. The PS suppliers indicate that they are positive about the internal service growth and the market trend of moving towards servitization, and more importantly, they have generated stable revenues from the service business as these were expected. Therefore they do not perceive obvious financial risks during the servitization journey. In addition, the service contracts provided by PS suppliers are standardized and do not incur such

high financial penalties as the solution contract, so there is less financial uncertainty involved in the contract with business customers.

Overall, RM challenges are less evident in the 2nd case in comparison to the 1st case, as the former does not make substantial changes in core business areas and take on operational risks from customers.

5.3.2.3 Summary of within case analysis

Table 5-4 presents the response of each interviewee in regarding to the servitization benefits and challenges perceived in the business, and Table 5-5 serves as a detailed summary of key findings from PS suppliers.

Table 5-4 A summary of evidence from the 2nd group – PS supplier

| Constructs and indicators | 004 | 008 | 009 | 011 |
|---|-----|-----|-----|-----|
| Strategic benefits (SB) | | | | |
| Secure leading market position | x | x | | x |
| Improvement of operational efficiency | | | | |
| Financial benefits (FB) | | | | |
| Additional revenues | | x | | x |
| Financial stability | | x | x | x |
| Marketing benefits (MB) | | | | |
| Responding to customer needs | x | x | x | x |
| Customer engagement (Long-term) | x | x | | x |
| Understanding customer needs | | | x | x |
| Connect to the end user | | | | |
| Organisational structure (OS) challenges | | | | |
| Inter-departmental collaboration (Internal value co-creation) | x | x | x | |
| Culture change | x | x | x | x |
| Business model (BM) challenges | | | | |
| Modification of overall business model | | | | |
| Design of value proposition | | | | |
| Internal resource alignment | | | | |
| Separate sales channel | x | x | x | x |
| Development process (DP) challenges | | | | |
| Development of an integrated process | | | | |
| Performance measurement | | | | |
| Application of toolkit | | | | |
| Customer engagement | x | x | x | x |
| Customer management (CM) challenges | | | | |
| Customer needs and expectations | x | | x | |
| Value co-creation | | | | |
| Communication | | | x | x |
| Market competition | x | | x | |
| Risk management (RM) challenges | | | | |
| Operational risks | x | x | x | x |
| Financial risks | | | | |

Note: 1. The constructs and indicators in this table are final codes (see Appendix 6) that have evolved during the qualitative data analysis. 2. The grey rows indicate that there is no evidence supporting the indicator in this case.

Table 5-5 Summative evidence for the 2nd group – PS supplier

| CORE THEME | SUMMATIVE EVIDENCE (PS supplier) |
|--|---|
| Servitization Benefits | |
| Strategic benefits | <ul style="list-style-type: none"> • Providing servitized offerings to business customers helps the company secure a leading position in the market |
| Financial benefits | <ul style="list-style-type: none"> • Supplying servitized offerings creates an additional channel of revenue generation in addition to product sales • Regular service demands and long-term service contracts constantly contribute to the overall financial growth |
| Marketing benefits | <ul style="list-style-type: none"> • Supporting product life cycle and functionalities through various service offerings satisfy customer needs • Delivering service contracts (e.g. service subscription and warranty programme) allows the supplier to engage business customers on a long-term basis • The supplier working closely with customers enables a better understanding of customer needs and to plan for future business |
| Servitization Challenges | |
| Organisational structure (OS) challenges | <ul style="list-style-type: none"> • The employee's resistance to the change of BM and operation process prevents the shift in business culture • Internal competition among the service and product team inhibits the internal-departmental collaboration |
| Business model (BM) challenges | <ul style="list-style-type: none"> • The PS supplier needs to develop a separate service sales channel as selling services requires different skillsets and business mentalities |
| Development process (DP) challenges | <ul style="list-style-type: none"> • Insufficient customer engagement in the service DP causes the PS supplier to have a lack of customer understanding |
| Customer management (CM) challenges | <ul style="list-style-type: none"> • Understanding customers' needs and setting clear expectations are hard to achieve due to the lack of customer engagement in the DP • The lack of effective communication causes some misunderstandings of the value created by services on the customer's side • The supplier and business customer may compete in the same market (e.g. service capability and access to the end user), which causes some tensions in the relationship |
| Risk management (RM) challenges | <ul style="list-style-type: none"> • The four servitization challenges identified above increase the level of operational risks in the business |

5.4 Cross-case analysis

This section compares and contrasts the two types of servitized businesses based on the findings of within-case analyses. It starts with a comparison of the business context in which the multiple cases were embedded (section 5.4.1) and then focuses on exploring how servitization benefits and challenges are manifested differently in the two groups (section 5.4.2).

5.4.1 Servitization context

Understanding the business context is crucial in the case-based research design, as it shapes the way the business process is constructed within it (Pettigrew, 1992; Simons,

2014). The participating companies (13 in total) are classified into the two groups according to the strategic focus of the business, in which an established typology (section 2.7.2) is applied using two dimensions (BM and CM) to facilitate the classification.

From the BM dimension (internal perspective), a set of seven sub-dimensions are used to differentiate servitized BMs. Regarding the strategic focus, IS providers aim to be an integral part of customers' operational process and support their business through the solution delivery. On the other hand, PS suppliers provide the product and service on a separate basis to satisfy the basic needs of business customers. To be in line with the strategic focus, the value proposition of the IS provider is to provide performance-based contracts to support the customer operations, whereas PS suppliers offer generic services to support the functional use of products. These imply that the two businesses retain their competitive advantage in a different way, as IS providers adopt a differentiation strategy in which they provide unique and customizable solutions to secure a leading position in the market, while PS suppliers are seeking to offer cost competitive and standardized offerings. In so doing, the former case exhibits a higher level of customization, whereas the latter is limited in its customization. To serve different strategic focuses, the OS is varied in the cases. In the case of the IS provider, the role and responsibility between the product and service team become blurred and a high level of interactions are promoted to achieve departmental collaboration. This diminishes the level of formalization and increases the level of structural complexity. In contrast, PS suppliers retain a formalized organisation structure, where the boundaries of rules and responsibilities are clear between the teams. Regarding the level of risks, IS providers encounter a higher level of risks due to the operational challenges in different areas and risk sharing with business customers. On the other hand, PS suppliers face relatively fewer risks when expanding the service portfolio, as it involves fewer uncertainties in the BM.

From a CM dimension (external perspective), three sub-dimensions are applied to compare the cases: value determination and perception, customer relationship, and value co-creation. In the IS providers, the value of solutions is determined mutually by customers and suppliers as they need to reach a common ground on what outcome/performance is expected to be delivered. In PS suppliers, the value of products and services is mainly determined by the suppliers and is often standardized. With respect to value creation, the customer is engaged as a value co-creator in the IS business and they have more 'personal' conversations with the provider. On the other hand, PS suppliers independently create value and the customer acts as a value receiver. These potentially imply that the IS provider has a long-term stable relationship with customers as they seek to be part of the customer's operation. In so doing, the provider often builds close ties through its key account management and strengthens the mutual trust. The IS

provider also attempts to access the end user and collect instant feedback from them via effective interactions. In the case of the PS supplier, the customer relationship is often on a short-term transactional basis and the level of interactions with business customers and end users is limited in comparison with the IS provider.

In short, this section differentiates the IS provider (Group 1) and PS supplier (Group 2) from the dimensions of BM and CM. To be clear, IS providers refer to servitized companies that aim to support business customers' operations by providing a mix of integrated solutions, support services and products. PS suppliers include servitized companies that provide products and support services on a separate basis. The next section continues the comparative analysis on the 'content' of the cases in order to explore '*RQ2: How are the challenges different in businesses with different strategic focuses (IS providers vs. PS suppliers)?*'

5.4.2 Research content – comparison of two groups

This section presents the findings of the cross-case analysis that are established on the findings of the within-case analysis. The summative table in Appendix 11 presents an overview of cross-case analysis by incorporating the summative evidence (first two columns) from the within-case analysis (Tables 5-3 and 5-5) and a brief comparison of the two categories for each construct is detailed in the last column. Based on this, the section continues by looking into how the benefits and challenges exhibit differently in the different types of servitized companies.

5.4.2.1 Servitization benefits

5.4.2.1.1 Strategic benefits

The strategic benefits are reflected through obtaining a leading position in the market and improving overall operational performance. These benefits are strongly evident in the case of the IS provider as interviewees firstly claim that providing solution-oriented offerings to industrial customers indeed strengthens their overall competitiveness through distinctive offerings and the expansion of service business on top of the product business. Besides, offering IS enables regular interactions with business customers and the instant feedback from them is of mutual benefit to the overall operation. In addition, the provider proactively monitoring the equipment also enhances the overall operation by reducing downtime. On the other hand, PS suppliers also acknowledge that seeking service growth in the organisation could help in securing a leading position by providing support services to customers. However, there is no evidence to indicate that providing generic services contributes to the overall operational efficiency of both parties in the standard service delivery. Table 5-6 combines the summative evidence from each case to demonstrate how strategic benefits exhibit differently in the two categories, and the results illustrate that IS suppliers perceive more strategic benefits in their case compared with the PS supplier.

Table 5-6 Comparison of strategic benefits for the two groups

| | IS Providers | PS Suppliers |
|---------------------------|--|--|
| Summative evidence | <ul style="list-style-type: none">• Providing servitized offerings to business customers helps the company secure a leading position in the market• Engaging business customers as value co-creators enhances the overall operational efficiency through effective communication and monitoring the equipment | <ul style="list-style-type: none">• Providing servitized offerings to business customers helps the company secure a leading position in the market |

5.4.2.1.2 Financial benefits

The construct of financial benefits is reflected through creating additional channels of revenue generation and retaining a stable financial performance on a long-term basis. These are exhibited at a similar level in the two groups as both of them have perceived these benefits in the real business. However, the way that they realise the financial benefits is slightly different. IS providers are contracted for a long-term period to support the business customer's operations by supplying a 'bundled' solution, whereas PS suppliers provide regular services and service contracts in order to generate stable

incomes from regular service demands. This implies that IS providers may retain more stable revenues as the contracted period is fixed for a certain period whereas the support services are purchased depending on customers' demands. Table 5-7 details the summative evidence from the within-case analysis.

Table 5-7 Comparison of financial benefits for the two groups

| | IS Providers | PS Suppliers |
|---------------------------|---|--|
| Summative evidence | <ul style="list-style-type: none"> • Supplying servitized offerings creates an additional channel of revenue generation in addition to product sales • Delivering integrated solutions through long-term contracts enhance the financial stability of the company | <ul style="list-style-type: none"> • Supplying servitized offerings creates an additional channel of revenue generation in addition to product sales • Regular service demands and long-term service contracts constantly contribute to the overall financial growth |

5.4.2.1.3 Marketing benefits

The marketing benefits refer to the servitized companies building and retaining close relationships with business customers through the possession of solid knowledge on customers' operation needs, fulfilment of those needs and ultimately the provision of better experiences to end users through a close connection. These benefits are strongly evident in the case of the IS provider as they are keen to engage industrial customers as value co-creators, which certainly enhances the trust between the two parties. Through this, the provider could effectively communicate with customers to understand their operational challenges and address them through the delivery of value in use. In addition, the close collaboration allows the provider to build a connection to the end user, who could facilitate an instant problem reporting system and support the IS delivery. In contrast, these benefits exhibit at a lower level for the PS supplier as companies normally retain transactional relationships with customers in the after-sales service business. Although some of them provide service contracts, the level of relationship bond and interaction between supplier and customer is relatively weaker than with the IS provider. Table 5-8 shows the comparison of manifestations of marketing benefits in the two groups.

Table 5-8 Comparison of marketing benefits for the two groups

| | IS Providers | PS Suppliers |
|---------------------------|---|---|
| Summative evidence | <ul style="list-style-type: none"> • The IS provides a comprehensive solution to address customer needs by directly responding to their operational challenges • Delivering solution-oriented contracts allows the provider to engage the business customers on a long-term basis • The provider working closely with customers enables a better understanding of customer needs and to plan for future business • Providing IS enables the provider to build a connection with end-users and obtain an instant feedback on the user experience | <ul style="list-style-type: none"> • Supporting product life cycle and functionalities through various service offerings satisfy customer needs • Delivering service contracts (e.g. service subscription and warranty programme) allows the supplier to engage business customers on a long-term basis • The supplier working closely with customers enables a better understanding of customer needs and to plan for future business |

5.4.2.2 Servitization challenges

5.4.2.2.1 Organisational structure (OS) challenges

The two categories have encountered a similar level of OS challenges, which are reflected in the inter-departmental collaboration between the product and service teams and the shift of business mindset. Nevertheless, these challenges manifest differently in different servitized businesses. In the case of IS providers, the separate management of product and service prevents the achievement of internal synergy as employees in different business units tend to work within the predefined role and responsibility rather than supporting each other. In the case of PS suppliers, the product and service teams tend to work independently and compete with each other on financial performance, which causes some tensions in the organisation and substantially reduces the mutual efforts towards the same business goal. More importantly, addressing this internal conflict in the PS business could distract senior management's attention from responding to the external customer needs, which may result in losing the strategic focus of the business.

In addition, the shift of business mindset is another common OS challenge in the two groups. Given that servitization is a higher level strategy, the stakeholders in the IS business may not be able to understand the concept and relevant benefits, particularly the front tier employees who may have a narrow focus on individual responsibilities rather than understanding the 'whole picture'. This would cause their understanding of servitized offerings to remain unclear and send vague messages to business customers. To address this, the senior management needs to invest considerable effort in intensive training to ensure the employees are fully educated. In the case of PS suppliers, they have identified a certain level of resistance from employees to the

changes that are associated with the adoption of servitization, as the latter are personally reluctant to change the process that they have been doing for decades, and more importantly, they perceive that the service growth could eliminate the contribution of product business to the overall business performance. This is because they possess a conventional view on the product and service, in which the value of the service is realised by fixing the product that is broken. These arguments suggest that the OS challenges are exhibited at a similar level in the two categories. Table 5-9 combines the summative evidence from the within-case analysis.

Table 5-9 Comparison of organisational structure challenges for the two groups

| | IS Providers | PS Suppliers |
|---------------------------|---|--|
| Summative evidence | <ul style="list-style-type: none"> Managing the product and service team separately ('silo management') prevents inter-departmental collaboration The stakeholder's lack of a clear understanding on the servitization concept and strategy prevents the shift of the business culture from product-centric to solution-centric | <ul style="list-style-type: none"> The employee's resistance to the change of BM and operation process prevents the shift in business culture Internal competition among the service and product team inhibits the internal-departmental collaboration |

5.4.2.2 Business model (BM) challenges

In terms of the BM challenges, the within-case analysis indicates that IS providers predominantly perceive the identified challenges, while PS suppliers experience fewer challenges in this category. In the IS business, the company claims that modifying the entire BM to support the development and delivery of IS is a critical challenge, as this is an ongoing process that requires the involvement of business customers in order to refine and improve the BM. Specifically, this challenge is manifested through several sub-challenges. First, the design of the value proposition of solution-oriented offerings is hard to be aligned with the customer's needs and expectations, which is caused by the fact that the provider and customer tend to perceive the value in a different way. From an operational perspective, managing and balancing resources in the solution business could be challenging when the provider experiences a 'peak time' that requires more labour to support the delivery of the solution. In contrast, these BM challenges seem not to be evident in the PS supplier, as providing support services does not require substantial modifications to the entire BM. Instead, they are seeking to develop a service business parallel to the product business, where they highlight that the product sales approach is not suitable for selling services considering that selling services requires different skills and business mentalities. Therefore developing a new

sales channel is the only BM challenge that is identified in the PS business. Table 5-10 details the summative findings from the two groups, which suggest that IS providers perceive more challenges than PS suppliers in this category.

Table 5-10 Comparison of business model challenges for two groups

| | IS Providers | PS Suppliers |
|---------------------------|---|---|
| Summative evidence | <ul style="list-style-type: none"> • Modifying the entire BM to support the solution business is a critical challenge, as the company needs to make changes in different areas of the business and ensure the BM is aligned with the customer's business needs • Designing a value proposition to suit customer's needs is challenging as there is a mismatch between the provider and customer in terms of value perception • Planning and managing internal resources is a challenge, given that the solution delivery may experience a 'peak time' when the provider requires more human resources to support the solution delivery | <ul style="list-style-type: none"> • The PS supplier needs to develop a separate service sales channel as selling services requires different skillsets and business mentalities |

5.4.2.2.3 Development process (DP) challenges

The DP challenges include the issues of creating an integrated process for developing servitized offerings, measuring the performance of the offering and engaging customers in the process. According to the within-case analysis, the challenges exhibit substantially differently in the two groups. In the 1st case, IS providers highlight the concern of developing an integrated process as the silo management approach that they adopted could hinder the level of integration in the DP. Besides, they are struggling to develop a set of performance measurement metrics to evaluate the performance of the solution, as the system involves multiple business units, which has increased the complexity of the assessment. From the PS supplier's perspective, these challenges are not perceived in their business. However, they face the challenge of engaging customers in the DP which could be beneficial for them to obtain some feedback on services before they launch them onto the market. This is because the customers perceive this kind of engagement as being beneficial only to the provider as the service is not customized for a particular customer. This finding is contrary to the IS provider, as the business customers are more likely to be engaged in the solution business, which could offer distinctive value. Table 5-11 shows the summative evidence from the two groups.

Table 5-11 Comparison of development process challenges for the two groups

| | IS Providers | PS Suppliers |
|---------------------------|--|--|
| Summative evidence | <ul style="list-style-type: none"> • Creating an integrated DP to support the development of an integrated solution is prevented by the silo management of the product and service business • The complex nature of IS makes it difficult to measure the overall performance of the offering • The applicable toolkit for supporting the solution development is lacking and underdeveloped | <ul style="list-style-type: none"> • Insufficient customer engagement in the service DP causes the PS supplier to have a lack of customer understanding |

5.4.2.2.4 Customer management (CM) challenges

The CM challenges exhibit at a similar level in the two groups. First, both of them acknowledged that they found it challenging to address the customer needs, but this issue is reflected differently in the two groups. The IS provider claims that there is gap in perceiving the value and concept of servitization between the provider and customer, where the customers may remain sceptical about the solution contracts when they are unfamiliar with the servitization and benefits. On the other hand, insufficient customer engagement in the DP leads to the PS supplier’s lack of customer understanding, which hinders the supplier’s ability to satisfy the customer. In terms of customer expectations, both the IS provider and PS supplier claim that customers always have a higher expectation of the services, and underestimate the cost of ‘doing things’. Therefore they often negotiate the price or add more services in either the service or solution contract to maximize their benefits.

In addition to the common challenges, they encounter some different issues regarding the customer relationship. IS providers stress that engaging customers as a value co-creator is mutually beneficial to both parties; however, customers sometimes are not engaged appropriately, especially when it comes to data sharing. This is because the customer is lacking in trust and commitment in this relational process, where this may potentially trigger some difficulties in the IS delivery as the provider may need data to support the operation. In the case of the PS supplier, the lack of communication is a challenge that could cause the customer not to perceive the value of services in the expected way due to vague messages or the provider talking to the wrong person in the customer team. In addition, the PS supplier faces potential competition from business customers, especially when both of them have a strong service capability or target the same segment of end user, which could cause considerable tension in the relationship management. Table 5-12 shows the summative evidence from the within-

case analysis, which suggests that the OS challenges exhibit a similar level in the two businesses.

Table 5-12 Comparison of customer management challenges for two groups

| | IS Provider | PS Supplier |
|---------------------------|--|---|
| Summative evidence | <ul style="list-style-type: none"> • There is a gap between the provider and customer in the way of perceiving the value of servitized offerings, thus the provider finds it difficult to demonstrate how the offering matches the customer's needs and expectations • The lack of commitment from the customer's side in the co-creation prevents the effective delivery of solutions, such as the customer being reluctant to share operational data with the provider | <ul style="list-style-type: none"> • Understanding customers' needs and setting clear expectations are hard to achieve due to the lack of customer engagement in the DP • The lack of effective communication causes some misunderstandings of the value created by services on the customer's side • The supplier and business customer may compete in the same market (e.g. service capability and access to the end user), which causes some tensions in the relationship |

5.4.2.2.5 Risk management (RM) challenges

Finally, the IS provider and PS supplier perceived a different level of RM challenges. Indeed, it is evident that IS providers encounter more operational challenges, which comprises the previous challenges in different business areas. In addition, the IS provider sharing operational risks with business customers would aggregate the operational risks to a greater extent. In addition, the evidence shows that the IS business involves huge financial uncertainties that stem from heavy upfront investments, and financial penalties that are attached to the contract could trigger financial risks inside the business. These two types of internal risks certainly increase the challenge of managing risks. In contrast, PS suppliers have a relatively low risk profile. Although there are some challenges, as identified above, involved in the service business expansion, where the company encounters fewer challenges and uncertainties compared with the IS provider. Table 5-13 summarises the cross-case analysis result, which indicates that IS providers face a higher level of RM challenges than PS suppliers.

Table 5-13 Comparison of risk management challenges for the two groups

| | IS Providers | PS Suppliers |
|---------------------------|--|--|
| Summative evidence | <ul style="list-style-type: none"> • The four servitization challenges identified above increase the level of operational risks in the business • The provider needs to share some risks with the customer to realise the value of servitized offerings and this could increase the level of operational risks • The level of financial risks is increased due to heavy upfront investments and potential financial penalties involved in the IS contract | <ul style="list-style-type: none"> • The four servitization challenges identified above increase the level of operational risks in the business |

5.5 Chapter summary

This chapter presented the findings of the qualitative case study that was designed as a follow-up empirical study to the quantitative survey. It began with the findings of within-case analysis of the two servitization categories and was followed by the cross-case analysis to compare the findings. Overall, the most notable finding of this chapter is that servitization benefits and challenges exhibit at a different level in the two groups, where the IS provider in general perceive more benefits and challenges than the PS supplier.

Table 5-14 presents the summative findings of the cross-case analysis. With respect to the servitization benefits, the IS provider with a strategic focus on being an integral part of customers indeed enjoys more benefits than the PS supplier that seeks to support the functional use of products. The IS provider also retains marketing benefits through a close collaboration with customers in the solution delivery, which offers them opportunities to gain better customer understandings and effectively respond to their needs through value co-creation. In contrast, the marketing benefits are manifest to a less extent in PS suppliers, as offering support services does not require intensive interactions with customers. The financial benefits are similar in the two categories as both of them claim that moving towards servitization creates additional stable revenues. Regarding the challenges, the data suggest that IS providers predominantly encounter the identified challenges from all aspects, while PS suppliers have fewer challenges in some areas, such as the BM and DP. This implies that servitization benefits and challenges are exhibited differently according to the strategic focus of the business, and more importantly, seeking to provide highly integrated solutions certainly leads to more challenges in the business. In the next chapter, the findings of the two empirical phases (quantitative and qualitative) are connected together and discussed with reference to the current literature that firstly informed this research.

Table 5-14 Summary of cross-case analysis

| Constructs | Brief comparison (Evidence taken from Appendix 11) |
|--|--|
| Strategic benefits (SB) | Both cases have perceived that providing servitized offerings secures a leading position of the company in the market competition. However, IS providers claim an additional benefit as providing integrated solutions increases the overall operational efficiency due to monitoring the equipment and ensuring effective communication with customers. |
| Financial benefits (FB) | Both cases perceived the financial benefits at a similar level, as they mutually claim that providing servitized offerings establishes a new channel for generating stable revenues. |
| Marketing benefits (MB) | <p>The marketing benefits exhibit at a similar level in both cases, as they acknowledged that shifting towards servitization allows them to respond effectively to the market demand and build close relationships with customers.</p> <p>However, IS providers enjoy more benefits as they seek to engage customers as a value co-creator, where they could work with customers side by side to enhance trust in the relationship and share resources to support the IS delivery.</p> |
| Organisational structure (OS) challenges | <p>The OS challenges appear to be similar in the two categories, but they are manifested in different ways:</p> <ul style="list-style-type: none"> • Inter-departmental collaboration in IS providers is inhibited by the silo management in which product and service teams are managed separately. In PS suppliers, the teams focus on competing with each other on financial performance causing a loss of focus on achieving mutual strategic goals • The shift of business culture is ineffective in IS providers, as the stakeholders need ongoing education to understand servitization. In PS suppliers, the culture change is prevented by the employees' resistant to the changes that are associated with the adoption of servitization |
| Business model (BM) challenges | <ul style="list-style-type: none"> • The BM challenges are reflected more obviously in IS providers, as they encounter extensive challenges in modifying the overall BM, designing the value proposition and utilising the internal resources • In the PS supplier, the challenge appears less significant as the company only faces a challenge in redeveloping a service sales channel |
| Development process (DP) challenges | <p>The DP challenges are exhibited differently in the two categories.</p> <ul style="list-style-type: none"> • The IS provider encounters more challenges in this area, including the issues regarding the development of an integrated process, design of performance assessment metrics and the application of a relevant toolkit • The PS supplier faces only one significant challenge that relates to the insufficient customer engagement in the DP |
| Customer management (CM) challenges | <p>The IS provider and PS supplier show a similar level of CM challenges, in which both of them highlight that ineffective communication and lack of understanding of customer needs and expectations are critical challenges in managing the relationship.</p> <p>In addition, they face some different challenges. IS providers highlight that the customer is lacking in commitment to the relational process which could prevent the value co-creation in the solution delivery. In contrast, PS suppliers are aware that they may face potential competition from their business customers, and this could cause some tensions in the relationship.</p> |
| Risk management (RM) challenges | <ul style="list-style-type: none"> • The RM challenges are strongly perceived by the IS provider, as both operational and financial risks are evident in the case • The RM challenges are less evident in the PS supplier as they do not encounter obvious financial risks or share operational risks with their customers |

6 DISCUSSION

6.1 Chapter overview

This chapter synthesises the findings of the quantitative and qualitative studies, and discusses them with reference to the current literature. Given that this study has a quantitative emphasis and the qualitative study is complementary, this chapter is structured around the performance implication of servitization challenges and their linkages to the servitization benefits and business performance (refers to RQ1 as the main focus in the quantitative phase). The qualitative findings on the manifestation of challenges in servitized businesses with different strategic focuses (refers to RQ2) are embedded to interpret and explore the survey findings. This complies with the mixed research design (as illustrated in Chapter 3 Methodology) adopted in this study (Creswell & Plano-Clark, 2011), where two empirical phases were conducted and analysed separately (the findings of each phase are shown in Chapters 4 and 5), and the results are connected and discussed in this chapter to demonstrate a rounded view on the entire project. Figure 6-1 shows the structure of this chapter. The discussion in section 6.2 is around the impacts of servitization challenges on the benefits (strategic, financial and marketing) and section 6.3 focuses on the correlation between servitization benefits and business performance. In section 6.4, a refined conceptual model is developed to reflect the integrated findings and to highlight the novel contribution of this study.

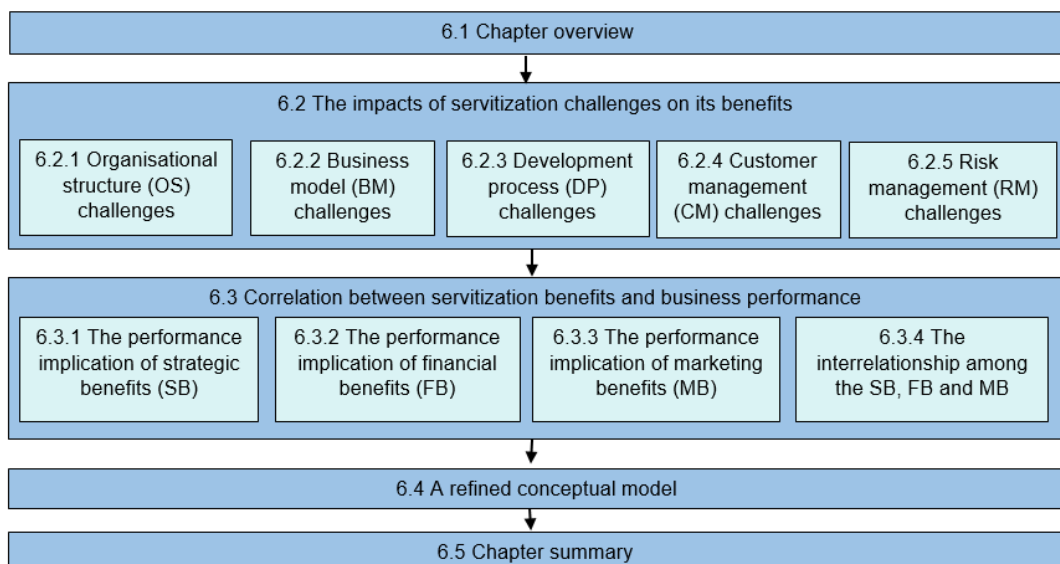


Figure 6-1 The structure of the discussion chapter

6.2 The impacts of servitization challenges on its benefits

This section discusses the findings that relate to the impacts of servitization challenges on the associated benefits, which is constituted as the first part of the theoretical model in Figure 2-6 in section 2.6.3. Considering the quantitative survey plays a dominant role in this study, the first part of the discussions under each heading starts with the quantitative findings, in which the relevant qualitative findings are embedded to offer some explanations. In the second part of the discussion under the same heading, the qualitative findings focus on the manifestations of challenges in different servitized businesses (IS provider vs. PS supplier).

6.2.1 Organisational structure (OS) challenges

Hypothesis 1 suggested that the servitized companies overcoming OS challenges has positive impacts on the realisation of SB, FB and MB. According to the survey results, the relationship between OS and MB (H1c) was supported, while the other relationships (H1a & b) were unsupported. The OS challenges refer to the internal challenges facing the company, which comprises the shift in business culture (e.g. Alghisi & Saccani, 2015; Finne et al., 2013), communication with internal and external stakeholders (e.g. Baines, Lightfoot, & Kay, 2009; Kinnunen & Turunen, 2012), retaining service expertise through development of service capability (e.g. Homburg et al., 2003), and fostering inter-departmental collaboration (e.g. Kowalkowski et al., 2015; Lenka et al., 2017). These manifestations were partially confirmed by the case study findings, in which the qualitative data have confirmed that silo management leads to a lack of inter-departmental collaboration between the service and product teams, and the shift of business mindset is prevented by ineffective communications and employees' resistance to change. This means only three out of four indicators used in the survey are reflected in the case study findings.

To further explore the unsupported relationship in the quantitative findings, the case study findings provide some insights by making a distinction between servitized businesses with different strategic focuses. The results indicate that the IS provider and PS supplier, each as a single case, face a similar level of OS challenges, but the manifestation is slightly different. This is in line with a recent study, in which Kreye (2018a) investigates how different servitization uncertainties (from the aspects of organisational, relational, environmental and technological) exhibit in the settings of maintenance services and performance-based services respectively. Her findings demonstrate that organisational uncertainties, such as operational differences in production and service businesses, internal flexibility to change and processing

information are similar in the two businesses, which have comparable findings to this study.

In this study, with regard to the shift of mindset, IS providers claim that ineffective communication with stakeholders causes them to have a lack of a clear understanding of servitization. From the customer point of view, they struggle to understand the idea of integrated solutions (Ferreira et al., 2013; Reim et al., 2015) and relational value co-creation (Martinez et al., 2010). From the employee perspective, they do not possess a clear strategic view of servitization, which inhibits their ability to process information and provide solution-oriented offerings (Kreye, 2018a). This implies that the companies that are unable to shift the mindset effectively may affect the quality of servitized offerings, which could directly impact on the customer satisfaction. This confirms the survey finding (*H1c* was supported) that addressing OS challenges could contribute to the realisation of marketing benefits. On the other hand, PS suppliers highlight that employees' resistance to the servitization associated changes prevents the shift in business culture. This finding reinforces Lenka et al.'s (2017) findings, that companies adopting a servitization strategy encounter resistance at the individual level, and that the latter are particularly reluctant to the changes in strategic, structural, cultural and procedural areas.

Regarding the inter-departmental collaboration, IS providers pinpoint that the heritage of managing production and service separately in the old, product-centric BM causes a lack of internal synergy and value co-creation towards the common business goals in the solution business. This could be explained by the argument on conflictive co-existence of product and service orientations in the servitized business, in which the company is unable to achieve sustainable business growth if they are not able to address both orientations (Lenka et al., 2018). This is because the product and service orientations are contradictory in nature, such as product-oriented firms embrace structured and standardized business processes, and solution-oriented firms embrace a high level of flexibility and customization (Kowalkowski et al., 2015; Windahl & Lakemond, 2010).

Although PS suppliers are not seeking a highly integrated structure as much as they are a solution business, they still find it difficult to promote internal collaboration between the service and product teams. The qualitative data suggest that this is likely to be caused by the internal competition regarding financial performance, where the service business often generates more revenues than others. This is indicative of a lower contribution of the product team to the overall firm performance, and therefore creates tension in the organisation. At a strategic level, the company may result in

having opposing pressures when trying to retain excellent performance in both areas (Lenka et al., 2018). This finding is less evident in the current research, as prior studies mainly focus on relational tensions in the provider and customer context (e.g. Kreye, 2017b; Tóth et al., 2018), rather than the internal collaboration, which advances our understanding of the collaboration issue at the departmental level.

Overall, it could be claimed that the OS challenges that relate to the shift of business culture and departmental collaboration are perceived at the same level in different servitized businesses. However, the manifestations are different in the IS provider and PS supplier, depending on the strategic focus of the business. The qualitative findings indicate that the measuring items of OS used in the survey did not fully address the manifestations of the challenge, which potentially explained the unsupported relationship between the OS and SB/FB. Moreover, the survey responses combined the views from the two types of servitized businesses, in which the different views may affect the statistical results.

6.2.2 Business model (BM) challenges

Hypotheses 2a, b and c proposed that addressing BM challenges could lead to the realisation of benefits (strategic, financial and marketing) respectively, in which H2a and c were supported while H2b was unsupported. A further investigation of the measuring items of BM challenges indicates that the challenge was reflected through the modification of the overall BM (e.g. Barquet et al., 2013; Ferreira et al., 2013), designing the value proposition (e.g. Barnett et al., 2013; Martinez et al., 2010), resource alignment (e.g. Barquet et al., 2013; Zarpelon Neto et al., 2015), supplier collaboration (e.g. Finne & Holmström, 2013; Parida et al., 2014), and costing and pricing mechanisms (e.g. Barquet et al., 2013; Malleret, 2006). However, these indicators were developed from prior studies mainly focus on the advanced product-service provisions, such as PSS and integrated solution, and relate to the support services. For instance, Barquet et al. (2013) explore how the BM concept is deployed to support the adoption of PSS, and Martinez et al. (2010) investigate the challenges facing manufacturing companies when designing the value proposition of PSS. This implies that these identified challenges may not be an appropriate indicator for measuring the challenges facing the PS supplier. In addition, only one of the measuring items relates to the finance while the others mainly considered the aspects of operation and marketing, which may not be sufficient to explain the relationship between the BM and FB. It is therefore we sought to explore this further through the multiple case study.

The qualitative data generally confirmed the existence of BM challenges, as the manifestations are evident in the IS provider but not in the PS supplier. In the case of the IS provider, they perceive a high level of BM challenges in modifying overall BM to support the solution business, as the company needs to adopt many changes in different parts of the business (e.g. Barquet et al., 2013; Kindström & Kowalkowski, 2014; Kujala et al., 2010). More specifically, the IS provider highlights that designing appealing value propositions to fulfil customer needs is one of the sub-challenges, as moving towards servitization has fundamentally changed the value from simply supplying manufactured goods to providing bespoke business solutions, which requires a clear understanding of customer needs and strong service capabilities (Baines & Lightfoot, 2009; Brady et al., 2005; Mathieu, 2001a). To support the value delivery, IS providers encounter more challenges in resource alignment among the business units and development of service capabilities (e.g. Barquet et al., 2013; Raddats et al., 2015; Ulaga & Reinartz, 2011). This is in line with Sousa and da Silveira (2017), who state that adopting a solution-oriented servitization strategy requires the company to develop strong service capabilities in order to achieve sales growth. The finding also supports Huikkola et al. (2016) who further state that the servitized business needs to create effective resource alignment internally to support the transformation.

In contrast, PS suppliers have fewer challenges in this category, in which the only claim is about the development of a service sales channel. Given that the customer interaction in servitized companies has changed from purchasing goods to services and solutions, this transfers huge demands to the service sales team (Storbacka et al., 2009), as selling services requires different approaches and mentality from the traditional product sale (Tuli et al., 2007; Ulaga & Loveland, 2014). More importantly, the prior findings show that the product sales team is not willing to take on extra demands to sell intangible offerings (Ulaga & Reinartz, 2011), as customers remain doubtful about the actual value of servitized offerings. These findings were confirmed in the qualitative case study, where PS suppliers emphasise that the expansion of the service sales team is mainly due to product sales people not being motivated to sell services, as they perceive selling products is more straightforward and easier to generate orders.

In short, the above discussion suggests that there is a huge gap between the level of BM challenges for the IS provider and PS supplier, as the former have encountered more challenges in this category while the latter seem to face little challenge in the same area. More importantly, the findings mainly demonstrate that the BM challenges have direct impacts on the operations and marketing, where its linkage to the FB is not evident in the case study. This is in line with our survey findings that overcoming BM

challenges in the servitized business could lead to the realisation of SB and MB, and offers an explanation to its unsupported relationship with FB.

6.2.3 Development process (DP) challenges

Hypothesis 3 suggested that the servitized companies overcoming DP challenges contributes to the realisation of benefits, in which its correlation with strategic benefits (H3a), financial benefits (H3b) and marketing benefits (H3c) was not supported. This disconfirmed our assumptions that addressing the relevant DP challenges, such as the lack of integrated DP, applicable toolkits, performance measurement and customer management, enables the company's capabilities to retain its leading position (SB) and secure expected financial returns (FB) (e.g. Burton et al., 2017; Gebauer et al., 2010b; Gremyr et al., 2014). In addition, the underlying argument of the unsupported relationship between DP challenges and MB refers to that the companies address the customer engagement issue could lead to the effective design of servitized offerings, and therefore they may retain the customer interest and loyalty (Bettencourt and Brown, 2013). Given that the survey responses were not clustered to consider different servitization types, it is hard to identify how the different strategic focuses could affect the perception of DP challenges. To explore this further, we now look at the case study findings.

Overall, the qualitative phase has confirmed that DP challenges appeared significantly different in the two categories. In the solution business, senior management places emphasis on the challenges of integrating product and service development processes, as adopting silo management to retain strategic growth in both areas prevents the development of an integrated system and process (Burton et al., 2017; Lenka et al., 2018). Gremyr et al. (2014) highlight that the service development often follows a recombinative innovation approach, which is fundamentally different from radical innovation in the product development. The former limits the changes in the technical areas that either combine the features of different services or take apart features of an existing service, whereas the latter requires fundamental changes of the concept and design of the extant product (Gremyr et al., 2014). The two different innovation modes require a different skillset, process and knowledge, as both areas involve distinctive challenges (e.g. Burton et al., 2017; Gremyr et al., 2014). A typical challenge would be that the service development focuses on customer needs and relational interactions, while the product development prioritizes technical characteristics and functional uses of products. These differences and conflicts certainly make it challenging to develop such an integrated DP in the servitized business (Lenka et al., 2018). This is confirmed by the qualitative findings of this study, that the engaged companies still develop

services on an *ad hoc* basis, as they need more time to work on bringing the processes together.

In addition, the case study results also identify the lack of performance measurement for assessing the integrated solution as another challenge. Although the notion of value-in-use has been broadly understood in the servitized context, there is still a knowledge gap in operationalising and measuring the value in both theory and practice (Macdonald et al., 2011). There are some value assessment tools that have been developed, but their application had been mainly in the product offerings rather than the solution offerings (Anderson et al., 2006; Keränen & Jalkala, 2013). Moreover, the servitization literature shows that simply measuring the performance of product and service separately is insufficient for assessing the overall value of the bundled solution, as business customers do consider their relationship and interactions with solution providers when assessing the value (Ulaga et al., 2006). This study's findings are in line with the literature that developing a comprehensive performance measurement system is truly a challenge in the solution business, which needs ongoing development to address it.

On the other hand, PS suppliers perceived DP challenges at a lower level, as the only challenge is about the insufficient customer engagement in the DP. Engaging customers in the service development is a part of value co-creation (Ranjan & Read, 2014), which has grown into a critical research area in servitization after Vargo and Lusch (2004b) highlighted the rising importance of co-creative service dominant logic in the marketing domain. To support the value co-creation, the prior studies emphasise that customers' contribution to the design is crucial, in which they should play an active role in the DP to share knowledge and expertise (e.g. Jaakkola & Hakanen, 2013; Parry et al., 2012). However, engaging customers in the DP is challenging due to the chain effects of CM challenges (Kreye, 2017b, 2018b), which are discussed in the next section. In addition, the underlying cause could be that the customers struggle to see the benefits of working with PS suppliers, as support services are mainly standardized and limited to customization.

In summary, although the existence of DP challenges has been demonstrated in the qualitative findings, its correlation to the benefits was not supported. This could be explained by the fact that most companies confessed that they are in the initial stage of developing an integrated process for the servitized offering, and they are expecting to address more challenges as they move forward in time. This implies that they haven't yet overcome the relevant challenges and thus the hypotheses were not supported by the data.

6.2.4 Customer management (CM) challenges

Hypotheses 4a, b and c suggested that overcoming CM challenges have positive impacts on SB, FB and MB respectively; however, the relationships were unsupported by the survey data. Further investigation into the indicators of CM reflects that the challenge was examined from the aspect of fulfilment of customer needs (e.g. Demeter & Szász, 2013; Tuli et al., 2007), ownership transfer (e.g. Baines et al., 2007; Ng & Nudurupati, 2010), long-term relationship management (e.g. Barnett et al., 2013; Tukker, 2015), value co-creation (e.g. Ranjan & Read, 2014) and information sharing (e.g. Kreye et al., 2015). It was initially surprising to find that the proposed relationships were disconfirmed in the survey, as the extensive literature indicates that servitized businesses encounter various relational issues when dealing with business customers and addressing these issues would contribute to the achievement of relevant benefits (Kreye, 2017b, 2018b; Martinez et al., 2010). Specifically, the issues such as the lack of trust between the provider and customer, the insufficient commitment in the value co-creation, the customer's reluctance to share information, and the different perceptions of value have substantially increased the levels of uncertainty and created the tensions in the customer relationship (e.g. Kreye et al., 2015; Matthyssens & Vandembemt, 2008). With this doubt in mind, the CM challenges have been further explored in the qualitative phase.

The qualitative results demonstrate a high level of CM challenges in the two types of servitized businesses, which support the findings by Kreye (2018a) that the company providing outcome-based contracts and maintenance services encounters a similar level of relational uncertainties. Her study conceptualises the relational uncertainties in terms of value co-creation, disagreements and conflicts among the provider and customer, the customer's lack of responsibilities and commitments, and the customer's changing demand (Kreye, 2018a), which are in line with some of this study's findings. However, the unit of analysis in Kreye (2018a) is actually different servitized offerings (performance-based services and maintenance services), which is different from this study that classifies servitized businesses at a strategic level. Given that most IS providers offer integrated solutions and support services simultaneously to address different customer needs, it is hard to identify which challenge is associated with which specific offering. In the light of this, this study contributes to the theory development in this area by investigating this topic from a different angle. The case study findings on the two groups are now discussed in turn.

The case study findings indicate that IS providers encounter three CM challenges, i.e. the mismatch value perception between providers and customers, changing customer expectations and ineffective value co-creation, which resonate well with the current

debate in CM challenges. In the solution business, customers' perceptions of value-in-use are completely different from the value-in-exchange in the product business, as they also consider the quality of their interactions with IS providers (Ulaga et al., 2006), and the effectiveness of processes and integration of resources in both organisations (Macdonald et al., 2016), when evaluating the value in use. Moreover, Vargo and Lusch (2016) highlight that the value of solution offerings perceived by business customers varies across individuals within the organisation, which makes it difficult to assess the value if there are many people involved in the solution procurement. These arguments are aligned with this study's findings that the value perceptions between customers and providers are mismatched as they take different views in the value appraisal, which could lead to the consequence that the servitized offerings are designed in a way that is not appealing to the customer. In addition, the unclear customer expectation is another challenge in the solution business, as the customer may change their requirements and expectations during the development and delivery of IS (Hawkins et al., 2015), which are identified as a key construct of relational uncertainties by Kreye (2018b) in her empirical study. In terms of value co-creation, customers are reluctant to share data with solution providers, thus eliminating the provider's capabilities of delivering solutions, which confirms the findings by Kreye et al. (2015) that a deficiency in trust, commitment, information sharing and joint approach to the problem solving cause more relational uncertainties in the solution business.

In comparing this with the IS provider, PS suppliers encounter a similar level of challenges in this area, and the key issues include unclear customer needs/expectations, ineffective communication and potential market competition. First, the lack of customer engagement in the DP (as discussed in DP challenges) causes a lack of clear customer needs and expectations, which leads to the value proposition of services not being attractive to customers (Burton et al., 2017). Second, ineffective communication is regarded as a challenge when the provider cannot communicate the value of the service to the customer in the right way and to the right person, and when the customer is unlikely to understand the value of services (Alghisi & Saccani, 2015; Brax, 2005). Last, the qualitative findings indicate that PS suppliers may encounter potential competition from business customers, where they may compete in the same market in terms of service capabilities and access to the end user. This finding reinforces the existence of 'coopetition' in inter-organisational relationships where the provider and customer collaborate and compete with each other simultaneously (Bengtsson & Kock, 2014), which is identified as a trigger to relational tensions in servitized businesses (Tóth et al., 2018).

Although the impacts of CM challenges were not supported in the survey, the case study findings proved their existence in servitized businesses, and their manifestations are varied according to the strategic focus of the firm and the level of customer engagement in the business. This potentially explains the unsupported relationship between CM challenges and associated benefits, in which the different perceptions of the two groups may increase the variations in the survey responses and cause the relationship to be unsupported.

6.2.5 Risk management (RM) challenges

Hypothesis 5 proposed that overcoming RM challenges are positively correlated to the realisation of servitization benefits, in which its relationship with SB (*H5a*), FB (*H5b*) and MB (*H5c*) was unsupported by the survey data. The RM challenges were measured from the aspect of internal operations risks (e.g. Hypko et al., 2010; Kreye, 2017a, 2018a; Nordin et al., 2011), internal financial risks (e.g. Benedettini et al., 2017; Gebauer et al., 2005) and external business environmental risks (Kreye, 2018a; Matthyssens & Vandenbempt, 2008). The underlying argument of RM challenges is that all challenges identified in different areas (e.g. OS, BM, DP and CM) could trigger many changes and uncertainties within the organisation (e.g. Kreye, 2018b; Nordin et al., 2011; Reim et al., 2016). Based on the literature review, it is anticipated that addressing these challenges enable companies' abilities to deliver servitized offerings as well as retain competitive advantage, financial stability and customer loyalty. It is surprising that the correlation between the RM challenges and relevant benefits was not supported, considering that the prior studies indicate that moving towards servitization could increase the uncertainties in the different areas within the firm (Benedettini et al., 2017; Gebauer et al., 2005; Neely, 2008) and overcoming them should enable the realisation of benefits according to the underlying philosophy of TOC. To explore this, we sought an explanation in the case study findings.

According to the case study findings, both IS providers and PS suppliers suffer some RM challenges; however, the former obviously encounters more challenges (in terms of operational and financial) than the latter. From an operational perspective, the risks stem from the challenges in different areas of the business. As demonstrated in the cross-case analysis, the two categories suffer a similar level of OS and CM challenges, while IS providers face more challenges than PS suppliers in other areas – BM & DP. For instance, IS providers need to renovate the entire BM to facilitate the solution business (e.g. Barquet et al., 2013; Ferreira et al., 2013) and address different issues in the DP (e.g. Burton et al., 2017). Moreover, providing business solutions requires the provider to take more responsibility for (Oliva & Kallenberg, 2003) and share risks with business customers to retain profitability on a risk and reward basis (Hou & Neely, 2017;

Johnstone et al., 2009). This, along with the internal uncertainties as discussed above, certainly aggregate the level of operational risks inside the IS provider.

From a financial perspective, IS providers are contracted for delivering pre-agreed performance, where the financial penalties are attached in case of performance failure (Baines et al., 2010; Hypko et al., 2010). This implies that failing to deliver a contracted performance could cause financial losses on the provider's side. In addition, providing integrated offerings focuses on creating more value in one single large contract, and failure to do so could lose sales (Nordin et al., 2011). These uncertainties significantly destabilise the financial performance within the company. Moreover, the findings in this study further advanced Nordin et al.'s (2011) work, in which they confirmed a positive relationship between the risks (in terms of operational and financial) and different kinds of services (in terms of customization, bundling and extended range of services). However, they only compare and contrast the risk profile at a service offering level, whereas the case study in this thesis classifies the company at a strategic level, which helps in clarifying how the adoption of a servitization strategy in product-centric companies relates to the level of risks.

In contrast, PS suppliers encounter a lower level of RM challenges, which they only concern about operational risks that stem from the identified challenges mainly regarding the area of OS and CM (the case study findings indicate that PS supplier face most challenges in the two areas). This aligns with Kreye (2018a) that organisational and relational uncertainties are common challenges in servitized businesses, despite the complexity of service offerings. With respect to financial risks, they are not evident in PS suppliers, as the majority of interviewees claim that the financial investment for the service expansion is controllable and the potential returns are considerable. This finding is in contrast to Nordin et al. (2011) who state that manufacturing companies expanding their service range increase their level of financial risks as there is more working capital involved in the development of the business scope. The reason that the author came to this different conclusion is because this study investigates the servitization from a comprehensive view, where the benefits and different challenges are considered and the RM challenge is one of them. However Nordin et al. (2011) with their single emphasis on the risk perspective of expanding the service range have potentially ignored the benefits of servitization that may offset the risks.

In short, our qualitative findings demonstrate that RM challenges exhibit substantially differently in IS providers and PS suppliers, in which the former encounter more challenges in operational and financial areas, and the latter have fewer operational

risks and there is no evidence of financial risks. This potentially offers an explanation to the unsupported relationship between the RM and benefits, as the different perceptions of the two groups may affect the survey results.

6.3 Correlation between servitization benefits and business performance

This section focuses on the correlation between the servitization benefits and business performance as the 2nd part of the theoretical model in Figure 2-6 in section 2.6.3. The structure of this section follows the same direction as above, starting from the quantitative survey findings, and the qualitative case study findings are embedded in order to explain and explore the survey results.

6.3.1 The performance implication of strategic benefits (SB)

The impact of strategic benefits (SB) on the business performance (BP) (*Hypothesis 9a*) was confirmed by both quantitative and qualitative data. In the quantitative survey, the indicators of SB relate to the sustainable competitive advantage, product differentiation, setting barriers for competitors, overcoming low-cost competition and gathering customer feedback for further technical advancement (e.g. Baines & Lightfoot, 2009; Johnstone et al., 2009; Raddats & Easingwood, 2010), which are aligned with the strategic goal of companies and therefore support the achievement of overall BP (Zhang & Banerji, 2017). This finding was further confirmed by the qualitative study, in which both IS providers and PS suppliers claim that moving towards servitization increases the market share by building a new market on top of the product business (e.g. Fischer et al., 2012; Raddats & Easingwood, 2010) and securing a leading position of the company through inimitable offerings (e.g. Cusumano et al., 2015; Raddats et al., 2015). In addition, IS providers highlight an additional benefit – that interacting with customers regularly through servitized business and monitoring the equipment performance is advantageous for improving overall efficiency and future product/service innovation (e.g. Brax & Jonsson, 2009; Goffin & New, 2001).

6.3.2 The performance implication of financial benefits (FB)

Unlike SB, the proposed relationship between financial benefits (FB) and BP (*Hypothesis 9b*) was unsupported by the survey. The FB is reflected through creating an additional channel of revenue generation (e.g. Johnstone et al., 2009; Mathieu, 2001b; Slack, 2005), generating stable revenues (e.g. Gebauer, 2008; Raddats et al., 2016) and balancing the effects of economic cycles on the product business (e.g. Gebauer & Fleisch, 2007; Raddats & Easingwood, 2010). These indicators reflect the potential financial gains of servitization; however, the existing studies demonstrated that the servitized businesses may not receive expected returns in time due to costly upfront investments and potential financial uncertainties involved in the servitization

(Gebauer et al., 2005; Matthyssens & Vandenbempt, 2008). A recent study by Benedettini et al. (2017) suggested that product-centric companies offering more services is not necessarily increasing the chances of business survival and they should carefully consider business diversification to decrease the likelihood of bankruptcy. The unsupported relationship between FB and BP in this study potentially supports the prior findings that the servitization benefits may not be directly contributing to the firm's performance.

On the other hand, the case study findings indicate that both IS providers and PS suppliers perceived FB at a high level, and they claim that servitization creates an additional source for generating stable incomes (e.g. Eggert et al., 2011; Raddats et al., 2016). However, this finding does not reflect the financial uncertainties associated with the servitization benefit, as participants were asked about the benefits and challenges separately in the interview, rather than looking at the 'whole picture' (how servitization challenges affect the financial performance). This difference between the quantitative and qualitative findings supports the argument by Oliva (2016) that more quantitative studies are desired in the servitization research to advance our understanding of underlying relationships. More importantly, this varied result implies that servitized businesses may not achieve FB, leading to an improved BP if they are unable to overcome the relevant challenges that inhibit the benefits.

6.3.3 The performance implication of marketing benefits (MB)

Similarly to the FB, the proposed relationship between the marketing benefits (MB) and BP (*Hypothesis 9c*) was unsupported in the survey data. The MB refers to the servitized company building and maintaining close relationships with business customers to 'lock' them into the business (Gebauer & Fleisch, 2007; Gebauer et al., 2006). Realising these benefits requires the provider to possess relational capabilities, such as facilitating information exchange by building trust with customers, and addressing conflicts/disagreements in a speedy manner (Kreye et al., 2015). However, a recent study by Kreye (2017b) shows that many servitized businesses encounter relational uncertainties in their relationship with customers, which are due to the company's inability to predict or explain customers' actions. This confirmed prior findings that forming a close relationship with customers and being highly dependent on their commitments and capabilities could lead to the consequence of unintended customer behaviours and raise more disagreements (Hakanen et al., 2017; Kuijken et al., 2017; Yang et al., 2017). This implies that MB may be offset by uncertainties and challenges in managing customer relationships, and therefore its positive impacts on BP could be minimized.

On the other hand, the qualitative findings of this study demonstrate that servitization helps companies in gaining a better understanding of customer needs and engaging them in the business through the establishment of close ties (Brax & Jonsson, 2009; Johnstone et al., 2009). However, the case study findings also highlight some CM related challenges in the two categories. Similar to the FB, the difference between the quantitative and qualitative results indicates that the servitized business may not achieve expected MB and BP if they are unable to address relevant challenges in the business.

6.3.4 The interrelationship among the SB, FB and MB

The interrelationships among SB, FB and MB (*Hypotheses 6, 7 & 8*) were strongly supported by the data. *H6* proposed that SB positively influences both FB and MB, and the supported relationship validated the argument that companies that have successfully adopted a servitization strategy and overcome the challenges are more likely to accomplish stable financial growth and retain customer loyalty (Baines & Lightfoot, 2013; Raddats et al., 2016; Zhang & Banerji, 2017). In contrast, the company that is unable to secure SB is less likely to retain FB and MB. *H7* shows that FB positively contributes to the achievement of SB and MB, reflecting that a strong financial performance secures the leading position of the company by financially supporting the business growth and product/service innovation to meet customers' needs (e.g. Cusumano et al., 2015; Slack, 2005). *H8* suggests that MB positively affects SB and FB. This is expected, as forming a close tie with business customers establishes mutual trust and aligns the strategic goals of the company and customer to achieve mutual benefits (Kreye, 2017b; Kreye et al., 2015; Ng et al., 2013). The interrelationship is further reinforced by the case study findings, as both IS providers and PS suppliers perceived all the benefits. These findings are in line with Raddats et al. (2016), Mathieu (2001b) and Baines and Lightfoot (2009), who state that these benefits drive the adoption of a servitization strategy, and the company could achieve better performance if the benefits are managed to be realised simultaneously.

The interrelationships potentially confirm that FB and MB have indirect contributions to BP through the mediating role of SB, as the benefits reinforce each other (this is confirmed by the mediating analysis in Chapter 4 Survey Findings). More importantly, this finding proves that FB and MB are antecedents of SB. This is reasonable if the company's ultimate business objective is to retain its leading position in the competitive market, and it needs support by steady financial growth and effective CM. Rather than arguing the trade-off among FB, MB and SB, this study highlights that they are all crucial to the BP. In other words, achieving SB alone is not sufficient to attain outstanding BP without positive contributions from both financial and marketing aspects.

6.4 A refined conceptual model

A basic conceptual model (Figure 4-4) was developed in the survey findings chapter to demonstrate the key quantitative findings. In general, the model indicates that BM has direct impacts on SB and MB while OS is correlated to MB. Considering that the interrelationships among the benefits are strongly supported by the data, the challenge that relates to SB could also affect the realisation of FB and MB. It is therefore concluded that OS and BM are correlated to all benefits. Furthermore, based on the supported relationship between SB and BP, the findings imply that OS and BM challenges are indirectly affect the BP via the mediating role of SB. Although the performance impacts of other challenges were not strong in the survey data, many more insights were generated in the case study findings, which are integrated into a refined conceptual model, as shown in Figure 6-2, demonstrating the novel contribution of this study.

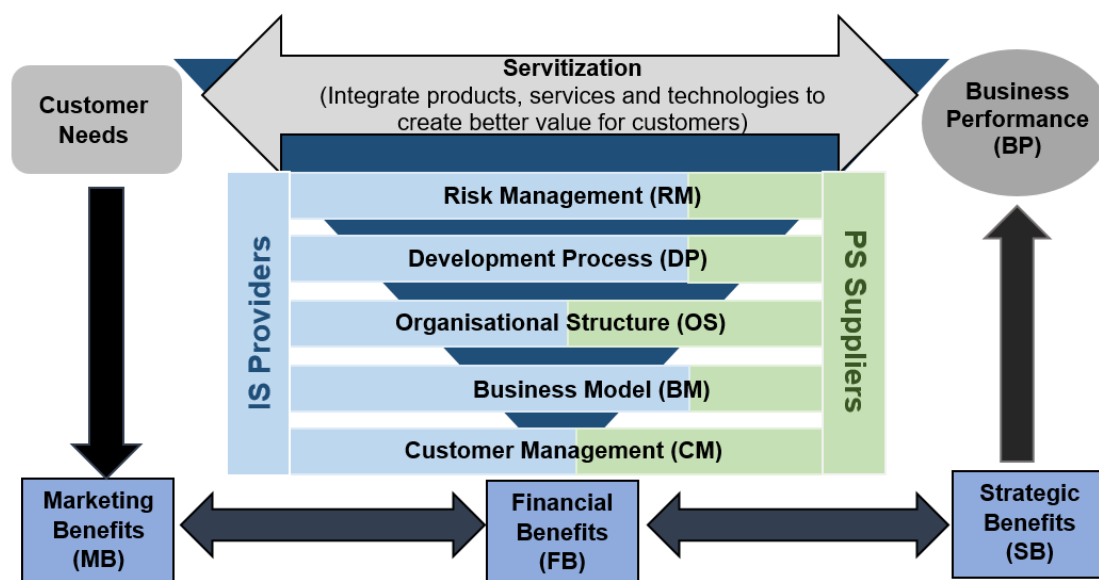


Figure 6-2 A refined conceptual model

According to Figure 6-2, this study focuses on the servitization that is defined as an *overarching strategy that is adopted by the product-centric company to align its business objective to the customer needs, through which the company delivers value-in-use for business customers through an integration of products, services, technologies and customer interactions* (this definition was introduced in the literature review chapter to reflect the author's understanding). This strategic alignment enables the company to achieve superior business performance by retaining a close relationship with customers in the long-term (marketing benefits), creating an additional

source of generating revenues (financial benefits) and securing a leading position in the market competition (strategic benefits). These benefits reinforce each other as well as collectively contribute to the overall performance of the servitized business.

In terms of challenges, there are five challenges studied in this work that relate to the organisational structure, business model, development process, customer management and risk management. The quantitative findings indicate that the impacts of OS and BM challenges on BP were confirmed to be significant, while the others (DP, CM and RM) were unsupported. This supports our hypotheses that the servitized companies overcoming the relevant challenges could achieve the servitization benefits as well as better BP. Building on these quantitative findings, the unsupported relationships were further explored in the qualitative study, in which the results advance our understanding by distinguishing between the manifestation of challenges in the different servitized businesses – IS providers and PS suppliers. Although the five challenges had proved to exist in the two groups, the IS provider suffers more challenges than the PS supplier in areas of RM, DP and BM, and they perceive a similar level of OS and CM challenges. In the middle of the model, the different colours demonstrate to what extent each challenge exhibits in the two groups. These findings contribute to the advancement of servitization research, especially the challenge context, and the detailed contribution to theory and practice is discussed in the conclusion chapter.

6.5 Chapter summary

This chapter integrated and discussed the quantitative and qualitative findings with respect to the extant literature, which leads to the refinement of a conceptual model that highlights the key findings of the whole research project. More importantly, the findings verify, contrast and further extend the prior studies on servitization research with regard to the performance implication of servitization challenges.

The next chapter provides a formal conclusion of this study, which summarises the key findings, contributions and research limitations, and suggests directions for future studies.

7 CONCLUSION

7.1 Chapter overview

This chapter provides a formal conclusion to this study. It starts with summary of key research findings that reflects how this study addresses the RA and RQs (section 7.2). Following this, the theoretical contributions (section 7.3) are highlighted, which leads to the discussion of managerial implications (section 7.4). Furthermore, the limitations (section 7.5) of this study are discussed and a few avenues are suggested for future research (section 7.6).

7.2 Summary of key findings

This research project aims to *explore the impacts of servitization challenges on business performance and how they are different in the servitized businesses with different strategic focuses*. In so doing, two supplementary RQs shown below were developed to achieve this aim.

RQ1: How do servitization challenges affect the realisation of servitization benefits (strategic, financial, and marketing) leading to superior business performance?

RQ2: How are the challenges different in businesses with different strategic focuses (IS providers vs. PS suppliers)?

To answer the two RQs, this project adopted a three-step research methodology. First, an SLR was conducted to establish a theoretical model (Figure 2-6 in section 2.6.3), which illustrates the hypothetical relationships among the servitization challenges (OS, BM, DP, CM and RM), benefits (SB, FB and MB) and business performance. This serves as a guiding framework for the empirical studies. Second, a quantitative study was carried out to validate the model with industrial management representatives through a web-based survey. The results show that OS and BM challenges have impacts on the business performance through the mediating role of servitization benefits, while the impacts of other challenges (DP, CM and RM) are not significant, which addressed RQ1. The key findings of the quantitative study led to the emergence of a basic conceptual model in Figure 4-4 in section 4.6. To further explain and explore the survey results, a multiple case study was conducted, in which the qualitative findings help in interpreting the results from the previous phase and further exploring how challenges are varied in servitized businesses with different strategic focuses, which addressed both RQ1 and 2. The results of the two empirical phases were synthesised and discussed in relation to the extant literature, and key insights were incorporated into a refined conceptual model (see Figure 6-2). In the light of these, the following sections highlight the theoretical and practical contributions of this study.

7.3 Theoretical contributions

This study makes a theoretical contribution to the servitization literature particularly to further extend the prior understanding of servitization challenges in several ways.

First, it provides a comprehensive overview of the servitization challenges based on the results of an SLR. This responds to Baines et al. (2017) that the existing servitization literature is mainly fragmented and discursive, in which scholars have looked at servitization challenges from different angles without connecting them in a rich picture. Furthermore, the author categorized the servitization challenges according to the emerged themes in the SLR results, which covers the mature concepts in the current body of knowledge, such as OS (e.g. Alghisi & Sacconi, 2015; Lenka et al., 2017), BM (e.g. Barnett et al., 2013; Barquet et al., 2013), DP (Burton et al., 2017; Nudurupati et al., 2016), CM (e.g. Kreye, 2017b; Kreye et al., 2015) and RM (e.g. Nordin et al., 2011; Reim et al., 2016). More importantly, this study seeks to explore the performance implications of servitization challenges through the development of a theoretical model that demonstrates the underlying relationships among the challenges, associated benefits and business performance.

Second, building on the theoretical model, the study has further advanced the theory building in the servitization challenge literature by verifying the hypothetical relationships through a quantitative survey. This study is the first piece of work that explores the relationship between the challenges, benefits and BP in the servitization research, and two insights are generated:

1. This study proved that strategic benefits make a direct contribution to the firm's performance, whereas the contribution of financial and marketing benefits are indirect. In addition, the interrelationship among the three benefits was confirmed, implying that they reinforce and complement each other.
2. This study suggested that the servitized companies overcoming OS and BM challenges have direct impacts on the relevant benefits, while the impacts of other challenges are not statistically significant. These findings partially confirmed the prior findings and extend the knowledge through the theory testing.

Third, the study generated some insights into the manifestation of challenges in servitized businesses with different strategic focuses. Given that the majority of existing studies investigated the challenges from a single perspective (in terms of challenge type and/or servitization type) (e.g. Hou & Neely, 2017; Ng & Nudurupati, 2010; Reim et al., 2016), this study demonstrates a complete view of how various challenges exhibit in different types of servitized businesses. To differentiate the business types, a

typology was developed to classify the business type (IS providers and PS suppliers) according to the strategic focus of the company's BM and the level of customer engagement. The conclusions show that IS providers and PS suppliers face a similar level of challenges in the areas of OS and CM, while the former encounter more challenges in RM, BM and DP. From a methodological perspective, adopting a mixed method design, especially conducting the qualitative study to complement and explore the quantitative survey findings, has provided a rounded perspective on the topic.

These theoretical contributions are transferable to the practice, leading to the generation of a few managerial implications.

7.4 Managerial implications

This study provides important managerial implications for senior management in servitized companies and product-centric companies that are considering moving towards servitization. Overall, the refined conceptual model offers a comprehensive overview on how adopting servitization aligns the company's overall performance and customers' needs, and more importantly, demonstrates the related benefits and challenges in the servitized businesses that seek different strategic focuses. This helps managers to effectively direct their managerial focus when adopting the servitization strategy, as addressing each challenge requires different skillsets and management approaches. In addition, it provides a guidance for developing training programmes within the company to improve internal capabilities and operational excellence to support the business transformation.

For the IS provider that aims to be an integrated partner of their customers, managers should pay more attention to OS, BM, DP, CM and RM, as developing and delivering solution-oriented offerings triggers many uncertainties in these areas. To address the relevant challenges, managerial attention should be directed to the internal collaboration between the production and service teams, renovation of BM to support the solution business, reconfiguring the DP, and mitigating different kinds of risks. From an external perspective, the provider's dependency on the business customer increases as they work together, and this causes some challenges in managing the relationship due to the relational uncertainties that stem from a deficiency of trust and commitment. To address this, managers should focus on retaining close ties with business customers through effective communication and build trust with them to enable the value co-creation in the long-term business.

On the other hand, for PS suppliers, in an attempt to support business customers through a broad range of services, the managerial attention should mainly focus on OS and CM, which is where the most challenges are exhibited. Regarding the OS

challenges, the potential conflicts between the product and service teams should be minimized and an effective change management approach adopted to address the employees' reluctance to accept the changes of BM and processes. In terms of CM, getting customers involved in the business is key to possessing a better understanding of their needs and building relationships through the service delivery.

In addition, this study also provides some insights for the product-centric company that is in the planning stage of adopting servitization. The refined conceptual model offers a comprehensive view of how the benefits and challenges are associated with different types of servitized businesses, which would assist managers with their decision making by showing the whole picture.

7.5 Research limitations

This study contains some limitations just like any other research, these are reflected in the methodological design and the way in which this research was conducted.

Although an SLR was undertaken to develop the construct of challenges and establish a theoretical model, this procedure follows a deductive approach, in which the author's subjective view plays a dominant role. This may result in these challenges being categorised by other researchers in different groupings and come up with another set of challenges. However, as the author demonstrated in the literature review chapter, the construct and relevant indicators of challenges were developed using a systematic approach with a justification of how each indicator relates to the expected construct. Also, the statistical analysis results of the measurement model in the survey findings chapter proved the reliability of constructs and indicators.

A similar issue can be prevalent in the qualitative phase, especially in the coding and interpretation of the results, as the author brings subjectivity and assumptions into the process. This limitation was addressed through the application of a rigorous qualitative data analysis procedure. In addition, the author provided a number of quotations in the case study findings to illustrate the relevancy of constructs and discussed them in relation to the survey findings and extant literature, which proved the credibility of her research findings.

Although adopting a mixed research method may eliminate the potential drawbacks of quantitative and qualitative studies, it does not mean this study is flawless. For example, a common limitation would relate to the sample size; the actual number of participants in both phases are relatively small in this study. However, as the author demonstrated in the survey findings chapter, 96 responses were sufficient for the model testing, and the technique '5000 bootstrapping' applied in this study enlarges the sample size in the statistical analysis in order to retain a precise result (the bigger the sample size, the

more accurate the result). On the other hand, 13 interviews seem to be a small number in the case study. However, considering the case study is complementary to the survey in this study, the amount of information generated in the interviews is sufficient to provide many primary insights. This is demonstrated by the extant findings in both the case study findings chapter and discussion chapter. Moreover, the interviewees were mostly senior managers who possess solid knowledge of the overall business as well as servitization, and the author's impression of them is that they were open-minded and willing to share their extensive managerial experiences. Their participation indeed increased the credibility of this study.

7.6 Future research

This study could be further extended in a number of ways. First, considering that the business performance was only measured from an economic perspective in the quantitative survey, extending the scope of BP to cover the marketing and strategic perspectives could be a possible next stage to further investigate the performance implication of servitization challenges using a quantitative method.

Second, future research should further explore how the manifestation of challenges links to different servitized businesses with a larger sample size, such as adopting a survey method. The case study findings in this thesis show that the strategic focus of servitized businesses (IS providers and PS suppliers) could be correlated to the different types of challenges, which could be developed into a set of testable hypotheses.

Third, further work could look into the company's capabilities and solutions for managing the identified challenges. This study suggests that OS, BM, DP, CM and RM involve challenges in each area and they require different management approaches. Therefore further extending this framework by undertaking research on suitable management capabilities for each area would be necessary to promote the theory development in this area and assist the industrial practitioners in overcoming the challenges in the servitization journey.

Last, the next possible extension could be a replication of this study in a different country, as servitization of manufacturing in developing countries (e.g. China and Brazil) have been a growing trend and little research has been carried out (Gebauer et al., 2012). It would be interesting to compare and contrast the results from developing and developed countries. Moreover, the operationalisation of key constructs was developed and tested in this study, which could serve as a theoretical basis for future work to be built upon.

7.7 Chapter summary

This chapter summarises the research project from various aspects. It firstly reviewed the key findings of this study with a reflection on how the RA and RQs have been fulfilled. After this, the contributions of this study were demonstrated both from theoretical and practical perspectives, following by the final criticism of the research design and the way in which this research was conducted. Last, several research directions were suggested for future work.

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Appendix 1

Questionnaire

INTRODUCTION

Thank you for taking time to answer this survey.

This survey aims to understand the benefits and challenges of adopting servitization in product-centric companies. To help you understand the terminology used in this survey, I provided some definitions along with basic examples.

Servitization refers to the transformation of a product-centric business that competes through a combination of manufactured goods and services, rather than products alone.

Servitized offerings refer to support services and integrated solutions that are provided by the company. Typically, the **support service** refers to standard services that support the functional use of the product, such as maintenance, overhaul, warranty and long-term service contracts. The **integrated solution** refers to an integrated system of products, services and management techniques that is designed to support industrial customers' businesses. A typical example of integrated solutions is Rolls Royce now selling a 'TotalCare' bundle rather than selling aero engines alone. The customer is only paying for the flying miles delivered by the aero engine, and Rolls Royce is responsible for maintaining the product and making sure it can continuously deliver the power.

Please be aware that this study investigates the challenges facing different types of servitized companies in the UK, and you can still answer this survey even if your company does not provide the integrated solution at the moment. If you have any questions about this study, please feel free to contact me.

Thank you,

Wanrong Zhang

Email: wanrong.zhang@warwick.ac.uk

Tel: +44-(0)24-7652-8391

SECTION 1: About you and your company

Q1 Which industry does your company fit into?

- Electronic equipment
- Aerospace & defence
- Metal products (not machinery)
- Transport equipment
- Medical systems
- Publishing & printing
- Information technology
- Chemicals
- Rubber & plastic products
- Wood (and paper products)
- Mining and quarrying
- Other

Q2 What is the size of your company?

- 5000+ employees
- 1000-4999 employees
- 500-999 employees
- 250-499 employees
- 0-249 employees

Q3 What is your company's annual turnover?

- >£1,000M
- £750-1,000M
- £500-749M
- £250-499M
- £100-249M
- <£100

Q4 What percentage of your company's turnover comes from your service (including integrated solutions)?

- >71%
- 51-70%
- 30-50%
- 11-30%
- 0-10%

Q5 What is your current job role in your company?

SECTION 2: About the benefits of servitization

Q6 Why did your company move towards servitization or consider moving towards servitization? Please indicate your agreement with following statements.

(1 Strongly disagree, 2 Moderately disagree, 3 Slightly disagree, 4 Neither agree nor disagree, 5 Slightly agree, 6 Moderately agree, 7 Strongly agree)

- We want to increase our revenues
- We want to increase declining sales on our core products
- We want to create new channels for our revenue growth
- We want to respond to our customer needs (e.g., reducing their operation costs/risks, supporting their core business by taking over processes that were performed by the customers themselves)
- We want to increase our customer satisfaction
- We want to establish a cooperation brand image
- We want to retain our customers through long-term relationship building (e.g., through long-term service/solution contracts)
- We want to increase the differentiation of our offering
- We want to create barriers to our competitors
- We want to reduce price-based competition on our core business product
- We want to gather feedback for further technical improvement/innovation (e.g., gathering operation data by monitoring on-site equipment and analysing data for future R&D)
- We want to retain competitive advantage in market competition

SECTION 3: About the challenges of servitization

Q7 What are the main challenges faced by your company when adopting the servitization strategy? Please indicate your agreement with following statements.

(1 Strong disagree, 2 Moderately disagree, 3 Slightly disagree, 4 Neither agree nor disagree, 5 Slightly agree, 6 Moderately agree, 7 Strongly agree)

Challenge 1: About the Organizational Structure

- We found it difficult to shift our mindset from production-centric to customer-centric (e.g. our employees think we are still supplying core products with add-on services)
- We found it difficult to communicate the concept of servitization to our customers and employees (e.g. misinterpreting the language used)
- We found it difficult to retain service specialists (e.g. develop service capabilities through the recruitment of skilled service professionals)
- We found it difficult to achieve synergy among service and production teams

Challenge 2: About the Business Model

- We found it difficult to tailor our entire business model to support the servitization strategy (*The key elements of the business model include the value proposition, customer segmentation, resource, supply chain network, price and cost)
- We found it difficult to design services that are effectively matched to customer needs
- We found it difficult to balance the resource utilisation between product and service teams
- We found it difficult to price the servitized offerings
- We found it difficult to cost the development and delivery processes of servitized offerings

Challenge 3: About the Development Process

- We found it difficult to develop an integrated development process to support the development of servitized offerings
- We found it difficult to apply appropriate tools & methodologies to support the development of servitized offerings
- We found it difficult to measure the 'performance' of servitized offerings
- We found it difficult to engage customers in our development process to gather feedback on the servitized offering

Challenge 4: About Customer Management

- We found it difficult to sell our servitized offerings before customers fully understood the benefits
- We found it difficult to market servitized offerings when customers do not accept that ownership of the core product is not transferred while only the performance/outcome of the product is delivered
- We found it difficult to retain a long-term stable relationship with customers (e.g. the stability of the relationship relies on our performance, which must be excellent and consistent)
- We found it difficult to collaborate with customers as they do not see our service personnel as a part of their team
- We found it difficult to collaborate with customers as they do not want to share their data with us (e.g. new technology and core operational data)

Challenge 5: About Risk Management

- We found it difficult to manage the operational risks of providing servitized offerings (e.g. all challenges shown above increase the level of internal risks within the company)
- We found it difficult to manage the financial risks of providing servitized offerings due to heavy upfront investments and increased operation costs
- We found it difficult to manage the external risks (e.g. dynamic market trend, fierce competition, regulation and technology innovation)

SECTION 4: About your business performance

Q8 What has been your company's business performance in the past five years?

(1 Almost never met the targets, 2 Usually not met the set targets, 3 Rarely met the set targets, 4 Sometimes met the set targets, 5 Often met the set targets, 6 Usually met the set targets, 7 Almost always met the set targets)

- During the last five years, our net profit has been *
- During the last five years, our revenue targets have been *
- During the last five years, our market-share targets have been *
- During the last five years, our return on investment has been *

This is the end of the survey. Thank you!

By submitting this response, you have given your consent for using the data.

Please leave your contact details for requesting a free-of-charge survey report, or participating in a follow-up interview; please see the next page for more details.

Call for interview participants:

Would you like to receive more insights from my research?

You are invited to attend a follow-up interview, which aims to investigate the challenges that face the product-centric company that has adopted the servitization strategy to achieve the business growth, thus I would like to explore the following questions:

- What drives conventional product-centric companies to move towards servitization?
- What are main challenges that face the company during the servitization process?

The plan is to interview 25 managers from different companies to gain an in-depth perspective on this important topic. If you are interested in attending the interview, please tick the box below. I will arrange a 45 mins meeting or telecon with you later at a convenient time and date to you. A free-of-charge report will be supplied to you after this.

Please note that we are strictly following the ethical rules; all participants will remain anonymous and we will not seek any information regarding commercial confidentiality. All conversations will only focus on the questions that are relevant to the research.

Would you like to attend?

- Yes, I would like to attend
- No, because _____

For a free copy of the survey report/further contact for a research interview, please leave your full name, company name, email address & telephone number. Thank you.

Appendix 2

Survey cover letter

Dear (Title and Name)

Hope you are well.

I am a Doctoral researcher at **Warwick Manufacturing Group (WMG)** in the **University of Warwick** investigating the potential challenges facing by companies when adopting servitization strategy to deliver value in use for business customers through integrating services with products.

I would like to invite you to take part in a short online survey, which will take 10 mins. The following information will guide you through the process.

The benefits:

1. This survey has been sent to senior managers in UK companies that have developed a significant service capability in order to achieve a rounded perspective on this topic
2. A **survey report*** and **£2 donation to the Cancer Research UK** will be supplied by your completed survey; the receipt of donation will be with the report

**Both reports are free-of-charge, and will be supplied via emails.*

Confidentiality:

The survey questions used in this research have been approved by Biomedical & Scientific Research Ethics Committee (BSREC) at the University of Warwick (Ref No. **REGO-2016-1081**). All data collection activities are confidential, your name and your company brand will be removed from all publications resulting from the research.

How to take part:

[Take the survey](#)

It would be very much appreciated if you could kindly forward the message to you colleagues and friends who are relevant to this study, so we could generate a large data set to perform a valid analysis.

If you have any questions or would like further information, please do not hesitate to contact me (see signature below for contact details).

Thank you for your help.

Kind Regards,

Wanrong Zhang

Wanrong Zhang (Frances)
Doctoral Researcher, MSc, BSc (Hons) | WMG | University of Warwick
wanrong.zhang@warwick.ac.uk | Tel: +44-(0)24-7652-8391
IDL Building | Coventry | CV4 7AL | UK

Appendix 3

Cancer Research donation receipt

4/19/2017

Cancer Research UK

Together we'll beat cancer sooner. If you are unable to read this message, please [click here](#).
Please do not reply to this email. To contact us [click here](#).



Thank you

Dear Wanrong

Thanks so much for donating to Cancer Research UK and joining us in the fight to beat cancer sooner.

Your donation has been processed successfully.

| Donation amount | Donation reference | Date |
|-----------------|--------------------|------------|
| £192.00 | MF1G0N3QYQY | 19-04-2017 |

Claire Wilson
Head of Supporter Services and Operations



You have received this email as a result of a recent donation, registration or specific request.

Our supporters are at the heart of everything we achieve at Cancer Research UK.
[Read our Fundraising Promise.](#)

This email is from [Cancer Research UK](#). Cancer Research UK is a registered charity in England and Wales (1089464), Scotland (SC041666) and the Isle of Man (1103). A company limited by guarantee. Registered company in England and Wales (4325234) and the Isle of Man (5713F). Registered address: Angel Building, 407 St John Street, London EC1V 4AD.

Appendix 4

Interview invitation email

Dear (Title and Full Name),

Hope you are well.

You received this email because you completed a research survey as a part of my doctoral study in Warwick Manufacturing Group (WMG) at the University of Warwick. The survey investigated the challenges of servitization in product-centric companies, and you signed up for the follow-up interview.

This interview seeks to explore the service orientation of your organization, and the challenges and benefits of adopting servitization strategy, which will take approximately 45 mins. I would like to emphasize that I am not seeking information that might be regarded as commercially confidential. In addition, all of participants/organisations will remain anonymous in the data analysis and resultant publications.

The **Participant Information Leaflet** and **Interview Questions** are attached for your consideration.

I would like to arrange a meeting with you, in which two options are available as follows.

1. You are welcome to visit us in WMG (<http://www2.warwick.ac.uk/fac/sci/wmg/>); we will arrange the meeting facility and host you a tour of the department.

We recommend this option as WMG is well known for research into areas such as 3D printing, electronic batteries, Nanotechnology and supply chain research. Here is our address:

WMG, International Manufacturing Centre, University of Warwick, Coventry, CV4 7AL

2. We can arrange a telecon via Skype.

Please reply to this email with your preference and an appropriate time (Skype include Saturday & Sunday). Your help is hugely appreciated!

Warmest regards,

Wanrong Zhang

Wanrong Zhang (Frances)
Doctoral Researcher, MSc, BSc (Hons) | WMG | University of Warwick
wanrong.zhang@warwick.ac.uk | Tel: +44-(0)24-7652-8391
IDL Building | Coventry | CV4 7AL | UK

Appendix 5

Interview protocol

A. Interview Checklist

Items to bring into the interview:

- 1 Business Cards ✓
- 2 Interview protocol ✓
- 3 Blank Sheets ✓
- 4 Pens to take notes ✓
- 5 Digital recorder ✓
- 6 Extra batteries ✓

B. Introduction to the Interview

My name is Wanrong Zhang and I am a doctoral researcher at Warwick Manufacturing Group (WMG). Thank you for agreeing to participate in this study. This interview aims to explore the service strategy of your organisation, and investigate the benefits and challenges of moving towards servitization. To this end, we are not seeking any information that may be regarded as commercially confidential. All of the information from this interview will only be used for my research. Your name and your organisation's name will be removed in the analysis and resultant publications.

With your agreement, I would like to record this interview. Are you comfortable with this?

(Personal note: inform the interviewee that he/she will be required to sign the consent form after the interview)

C. Interview questions

Section 1: General questions

Q1: What is your role and responsibility in the company?

Q2: Could you please tell me briefly about your company and the industry you operate within?

Q3: How do you see the business performance of your company over the past five years?

Section 2: Service-related questions

Q4. What type of services do you offer?

- What base service do you offer (e.g. product provision, spare parts, warranty)?

- What intermediate service do you offer (e.g. maintenance, help desk, repair, overhaul, delivery, and training)?
- What advanced service do you offer (e.g. customer support agreement, risk and reward sharing contract, outcome based contract, integrated solution)?

Q5. What are the main motivations (benefits) of providing services?

- Strategic (Retaining competitive position in the market)
- Financial (Generating regular incomes from service offerings)
- Marketing (Addressing customer needs)

Q6. What percentage of total revenues (per annual) do you generate from services?

Section 3: Challenge-related questions

Q7 What are/were the challenges for implementing services in your company?

a. Organisational structure

Probe: Any challenges relate to the following area?

- Shift of business culture
- Communicating the concept to the stakeholder
- Development of service capability
- Inter-departmental collaboration

b. Business model

Probe: Any challenges relate to the following area?

- Modifying the overall business model
- Development of value proposition
- Resource utilisation
- Costing
- Pricing
- Supply chain network

c. Development process

Probe: Any challenges relate to the following area?

- Development of an integrated system/process

- Application of toolkit
- Performance measurement system
- Customer engagement

d. Customer management

Probe: Any challenges relate to the following area?

- Understanding customer needs
- Ownership issue in service/solution contract
- Customer relationship management (long-term)
- Value co-creation
- Information sharing

e. Risk management

Probe: Any challenges relate to the following area?

- Operational risks
 1. Are above challenges increase the level of operational risks?
 2. Do you share some risks with customers to realise the value of servitized offering? How does this impact on your overall risk management?
- Financial risks (Upfront investment, operation costs, financial penalties in the solution/service contract)
- External risks

Is there any challenge that is covered in the interview?

D. Ending the Interview

- In your opinion, are there any issues that were overlooked that I should have covered?
- Could I contact you in case I need to ask further questions to clarify my understanding?
- Would you like to receive an interview report?
- *Sign the consent form, and give a copy to the participant.

Appendix 6

Initial version of the code book

Background information

- Role and responsibility
- General information
- Business sector
- Core business

Business performance

- Overall business performance
- Financial key performance indicators
- Operational key performance indicators
- Marketing key performance indicators

Service offerings

- Advanced services (Integrated solution)
- Intermediate services
- Base services

Servitization benefits

Strategic benefits (SB)

- Market position
- Market shares
- Product differentiation
- Technical improvement

Financial benefits (FB)

- Stable revenues
- Additional channel
- Overcome the low-cost product competition

Marketing benefits (MB)

- Customer needs
- Better understand customers
- Long-term relationship

Servitization challenges

Organisational structure (OS)

- Culture change
- Communication with stakeholders
- Skilled labours
- Inter-departmental collaboration

Business model challenges (BM)

- Modifying the overall business model
- Value proposition
- Resource utilization

- Costing mechanism
- Pricing mechanism
- Supply chain partners

Development process (DP)

- Integrated development process
- Internal consensus
- Internal strategic alignment
- Development toolkit
- Performance measurement
- Customer engagement in the development

Customer management (CM)

- Matching customer needs
- Ownership transfer
Long-term relationship building
- Value perception
- Value co-creation
- Information sharing

Risk management (RM)

- Operational risks
- Financial risks
- External risks

Final version of the code book

Note: Highlighted texts indicate that the code was changed with respect to the initial code book.

Background information

- Role and responsibility
- General information
- Business sector
- Core business (Product)
- Core business (Service)

Business performance

- Overall business performance
- Financial key performance indicators
- Operational key performance indicators
- Marketing key performance indicators

Service offerings

- Advanced services (Integrated solution)
- Intermediate services
- Base services

Servitization benefits

Strategic benefits (SB)

- Market position
 - a. Market shares
- Product differentiation
- *Operational efficiency*

Financial benefits (FB)

- Stable revenues
- Additional channel of revenue generation
- ~~Overcome the low-cost product competition~~

Marketing benefits (MB)

- Customer needs
- Better understand customers
- Customer engagement (long-term)
- *Connecting to the end user*

Servitization challenges

Organisational structure (OS)

- Culture change
- ~~Communication with stakeholders~~
- ~~Service capabilities~~
- Inter-departmental collaboration

Business model challenges (BM)

- Modifying the overall business model
- Value proposition
- Resource utilization
- ~~Costing mechanism~~
- ~~Pricing mechanism~~
- ~~Supply chain partners~~
- *Internal sales channel (service)*

Development process (DP)

- Integrated development process
- ~~Internal consensus~~
- Internal strategic alignment
- Application of toolkit
- Performance measurement
- Customer engagement in the DP

Customer management (CM)

- Customer needs and expectations
- *Communication*
- ~~Ownership transfer~~
- Long-term relationship building
 - a. Market competition
 - b. Performance reliability
- ~~Value perception~~
 - a. *Changing demands*
- Value co-creation
 - a. *Information sharing*

Risk management (RM)

- Operational risks
 - a. *Health and safety risks*
 - b. Risk sharing
- Financial risks
 - a. *Upfront investment*
 - b. Financial penalties
- ~~External risks~~
 - a. ~~Marketing competition~~
 - b. ~~Business culture~~

Appendix 7

Exhibit 1.7 Sample Size Recommendation in PLS-SEM for a Statistical Power of 80%

| Maximum Number of Arrows Pointing at a Construct (Number of Independent Variables) | Significance Level | | | | | | | | | | | |
|--|------------------------|------|------|------|------------------------|------|------|------|------------------------|------|------|------|
| | 10% | | | | 5% | | | | 1% | | | |
| | Minimum R ² | | | | Minimum R ² | | | | Minimum R ² | | | |
| | 0.10 | 0.25 | 0.50 | 0.75 | 0.10 | 0.25 | 0.50 | 0.75 | 0.10 | 0.25 | 0.50 | 0.75 |
| 2 | 72 | 26 | 11 | 7 | 90 | 33 | 14 | 8 | 130 | 47 | 19 | 10 |
| 3 | 83 | 30 | 13 | 8 | 103 | 37 | 16 | 9 | 145 | 53 | 22 | 12 |
| 4 | 92 | 34 | 15 | 9 | 113 | 41 | 18 | 11 | 158 | 58 | 24 | 14 |
| 5 | 99 | 37 | 17 | 10 | 122 | 45 | 20 | 12 | 169 | 62 | 26 | 15 |
| 6 | 106 | 40 | 18 | 12 | 130 | 48 | 21 | 13 | 179 | 66 | 28 | 16 |
| 7 | 112 | 42 | 20 | 13 | 137 | 51 | 23 | 14 | 188 | 69 | 30 | 18 |
| 8 | 118 | 45 | 21 | 14 | 144 | 54 | 24 | 15 | 196 | 73 | 32 | 19 |
| 9 | 124 | 47 | 22 | 15 | 150 | 56 | 26 | 16 | 204 | 76 | 34 | 20 |
| 10 | 129 | 49 | 24 | 16 | 156 | 59 | 27 | 18 | 212 | 79 | 35 | 21 |

Source: Cohen (1992): A Power Primer. Psychological Bulletin 112: 155–159.

Appendix 8

Two sample T test result

| | | Levene's Test for Equality of Variances | |
|-----|-----------------------------|---|------|
| | | F | Sig. |
| FB1 | Equal variances assumed | 2.138 | .147 |
| | Equal variances not assumed | | |
| FB2 | Equal variances assumed | .050 | .823 |
| | Equal variances not assumed | | |
| FB3 | Equal variances assumed | 2.455 | .121 |
| | Equal variances not assumed | | |
| MB1 | Equal variances assumed | .508 | .478 |
| | Equal variances not assumed | | |
| MB2 | Equal variances assumed | 1.146 | .287 |
| | Equal variances not assumed | | |
| MB3 | Equal variances assumed | 1.131 | .290 |
| | Equal variances not assumed | | |
| MB4 | Equal variances assumed | 3.633 | .060 |
| | Equal variances not assumed | | |
| SB1 | Equal variances assumed | 3.256 | .074 |
| | Equal variances not assumed | | |
| SB2 | Equal variances assumed | .650 | .422 |
| | Equal variances not assumed | | |
| SB3 | Equal variances assumed | 2.445 | .121 |

| | | | |
|-----|-----------------------------|-------|------|
| | Equal variances not assumed | | |
| SB4 | Equal variances assumed | 2.844 | .095 |
| | Equal variances not assumed | | |
| SB5 | Equal variances assumed | 2.632 | .108 |
| | Equal variances not assumed | | |
| OS1 | Equal variances assumed | 1.314 | .255 |
| | Equal variances not assumed | | |
| OS2 | Equal variances assumed | .020 | .889 |
| | Equal variances not assumed | | |
| OS3 | Equal variances assumed | .024 | .878 |
| | Equal variances not assumed | | |
| OS4 | Equal variances assumed | .001 | .979 |
| | Equal variances not assumed | | |
| BM1 | Equal variances assumed | .811 | .370 |
| | Equal variances not assumed | | |
| BM2 | Equal variances assumed | .416 | .521 |
| | Equal variances not assumed | | |
| BM3 | Equal variances assumed | .048 | .827 |
| | Equal variances not assumed | | |
| BM4 | Equal variances assumed | .318 | .574 |
| | Equal variances not assumed | | |
| BM5 | Equal variances assumed | .220 | .640 |
| | Equal variances not assumed | | |
| BM6 | Equal variances assumed | .006 | .939 |
| | Equal variances not assumed | | |

| | | | |
|-----|-----------------------------|-------|------|
| DP1 | Equal variances assumed | 1.941 | .167 |
| | Equal variances not assumed | | |
| DP2 | Equal variances assumed | 3.658 | .059 |
| | Equal variances not assumed | | |
| DP3 | Equal variances assumed | 2.038 | .157 |
| | Equal variances not assumed | | |
| DP4 | Equal variances assumed | .145 | .704 |
| | Equal variances not assumed | | |
| CM1 | Equal variances assumed | .248 | .619 |
| | Equal variances not assumed | | |
| CM2 | Equal variances assumed | .715 | .400 |
| | Equal variances not assumed | | |
| CM3 | Equal variances assumed | .049 | .825 |
| | Equal variances not assumed | | |
| CM4 | Equal variances assumed | .046 | .831 |
| | Equal variances not assumed | | |
| CM5 | Equal variances assumed | .152 | .697 |
| | Equal variances not assumed | | |
| RM1 | Equal variances assumed | 1.093 | .299 |
| | Equal variances not assumed | | |
| RM2 | Equal variances assumed | .310 | .579 |
| | Equal variances not assumed | | |
| RM3 | Equal variances assumed | .421 | .518 |
| | Equal variances not assumed | | |
| BP1 | Equal variances assumed | .001 | .976 |

| | | | |
|-----|-----------------------------|-------|------|
| | Equal variances not assumed | | |
| BP2 | Equal variances assumed | 1.084 | .300 |
| | Equal variances not assumed | | |
| BP3 | Equal variances assumed | .173 | .678 |
| | Equal variances not assumed | | |
| BP4 | Equal variances assumed | .000 | .989 |
| | Equal variances not assumed | | |

Appendix 9

Summary of measurement scales

| Constructs/measured items | Item loading | CR | AVE |
|---|--------------|-------|-------|
| Organisational structure (OS) (1) Strongly disagree, (2) Moderately disagree, (3) Slightly disagree, (4) Neither agree nor disagree, (5) Slightly agree, (6) Moderately agree, (7) Strongly agree | | 0.905 | 0.706 |
| OS1: We found it difficult to shift our mindset from production-centric to customer-centric (e.g. our employees think we are still supplying core products with add-on services) | 0.819 | | |
| OS2: We found it difficult to communicate the concept of servitization to our customers and employees (e.g., misinterpreting the language used) | 0.779 | | |
| OS3: We found it difficult to retain service specialists (e.g. develop service capabilities through the recruitment of skilled service professionals) | 0.862 | | |
| OS4: We found it difficult to achieve synergy among service and production teams | 0.895 | | |
| Business model (BM) (1) Strongly disagree, (2) Moderately disagree, (3) Slightly disagree, (4) Neither agree nor disagree, (5) Slightly agree, (6) Moderately agree, (7) Strongly agree | | 0.896 | 0.590 |
| BM1: We found it difficult to tailor our business model to support the servitization strategy | 0.806 | | |
| BM2: We found it difficult to design services that best fit customer needs | 0.824 | | |
| BM3: We found it difficult to balance the resource utilisation between product and service teams | 0.748 | | |
| BM4: We found it difficult to cost the development and delivery processes of servitized offerings | 0.742 | | |
| BM5: We found it difficult to price servitized offerings | 0.625 | | |
| Development process (DP) (1) Strongly disagree, (2) Moderately disagree, (3) Slightly disagree, (4) Neither agree nor disagree, (5) Slightly agree, (6) Moderately agree, (7) Strongly agree | | 0.949 | 0.825 |
| DP1: We found it difficult to develop an integrated development process to support the development of servitized offerings | 0.964 | | |
| DP2: We found it difficult to apply appropriate tools & methodologies to support the development of servitized offerings | 0.953 | | |
| DP3: We found it difficult to measure the 'performance' of servitized offerings | 0.923 | | |
| DP4: We found it difficult to engage customers in our development process to gather feedback on the servitized offering | 0.780 | | |
| Customer management (CM) (1) Strongly disagree, (2) Moderately disagree, (3) Slightly disagree, (4) Neither agree nor disagree, (5) Slightly agree, (6) Moderately agree, (7) Strongly agree | | 0.876 | 0.589 |
| CM1: We found it difficult to market servitized offerings when customers do not accept that ownership of the core product is not transferred while only the performance/outcome of the product is delivered | 0.905 | | |
| CM2: We found it difficult to sell our servitized offerings before customers fully understood the benefits | 0.776 | | |
| CM3: We found it difficult to retain a long-term stable relationship with customers (e.g., the stability of the relationship relies on our performance, which must be excellent and consistent) | 0.629 | | |
| CM4: We found it difficult to collaborate with customers as they do not see our service personnel as a part of their team | 0.807 | | |
| CM5: We found it difficult to collaborate with customers as they do not want to share their data with us (e.g., new technology and core operational data) | 0.690 | | |
| Risk management (RM) (1) Strongly disagree, (2) Moderately disagree, (3) Slightly disagree, (4) Neither agree nor disagree, (5) Slightly agree, (6) Moderately agree, (7) Strongly agree | | 0.898 | 0.747 |
| RM1: We found it difficult to manage the financial risks of providing servitized offerings due to heavy upfront investments and increased operation costs | 0.816 | | |

| | | |
|--|-------|-------|
| RM2: We found it difficult to manage the operational risks of providing servitized offerings (e.g. all challenges shown above increase the level of internal risks within the company) | 0.898 | |
| RM3: We found it difficult to manage the external risks (e.g., dynamic market trend, fierce competition, regulation and technology innovation) | 0.877 | |
| Strategic Benefits (SB) (1) Strongly disagree, (2) Moderately disagree, (3) Slightly disagree, (4) Neither agree nor disagree, (5) Slightly agree, (6) Moderately agree, (7) Strongly agree | 0.894 | 0.632 |
| SB1: We want to increase the differentiation of our offering | 0.909 | |
| SB2: We want to create barriers to our competitors | 0.769 | |
| SB3: We want to reduce price-based competition on our core business product | 0.726 | |
| SB4: We want to gather feedback for further technical improvement/innovation (e.g., gathering operation data by monitoring on-site equipment and analysing data for future R&D) | 0.656 | |
| SB5: We want to retain competitive advantage in market competition | 0.886 | |
| Financial Benefits (FB) (1) Strongly disagree, (2) Moderately disagree, (3) Slightly disagree, (4) Neither agree nor disagree, (5) Slightly agree, (6) Moderately agree, (7) Strongly agree | 0.826 | 0.623 |
| FB1: We want to increase our revenues | 0.902 | |
| FB2: We want to increase declining sales on our core products | 0.536 | |
| FB3: We want to create new channels for our revenue growth | 0.876 | |
| Marketing Benefits (MB) (1) Strongly disagree, (2) Moderately disagree, (3) Slightly disagree, (4) Neither agree nor disagree, (5) Slightly agree, (6) Moderately agree, (7) Strongly agree | 0.914 | 0.728 |
| MB1: We want to respond to our customer needs (e.g., reducing their operation costs/risks, supporting their core business by taking over processes that were performed by the customers themselves) | 0.824 | |
| MB2: We want to increase our customer satisfaction | 0.862 | |
| MB3: We want to establish a cooperation brand image | 0.860 | |
| MB4: We want to retain our customers through long-term relationship building (e.g., through long-term service/solution contracts) | 0.866 | |
| Business Performance (BP) * (1) Almost never met the targets, (2) Usually not meet the set targets, (3) Rarely met the set targets, (4) Occasionally met the set targets, (5) Sometimes met the set targets, (6) Often met the set targets, (7) Almost always met the targets | 0.877 | 0.644 |
| BP1: Over the past five years, our net profit has:* | 0.857 | |
| BP2: Over the past five years, our revenue targets have* | 0.657 | |
| BP3: Over the past five years, our market share targets have* | 0.744 | |
| BP4: Over the past five years, our return on investment has* | 0.926 | |

Appendix 10

Loading and cross loadings in the final research model 1

| | BM | BP | CM | DP | FB | MB | OS | RM | SB |
|------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| BM1 | 0.813 | 0.272 | 0.440 | 0.354 | 0.086 | 0.321 | 0.342 | 0.567 | 0.203 |
| BM2 | 0.827 | 0.222 | 0.306 | 0.564 | 0.126 | 0.328 | 0.521 | 0.312 | 0.208 |
| BM3 | 0.757 | 0.210 | 0.599 | 0.391 | 0.234 | 0.399 | 0.557 | 0.529 | 0.287 |
| BM4 | 0.705 | 0.162 | 0.549 | 0.237 | 0.305 | 0.228 | 0.412 | 0.378 | 0.321 |
| BP1 | 0.190 | 0.904 | 0.184 | 0.298 | 0.299 | 0.349 | 0.234 | 0.203 | 0.446 |
| BP3 | 0.215 | 0.677 | 0.122 | 0.190 | -0.034 | 0.118 | 0.102 | 0.190 | 0.142 |
| BP4 | 0.364 | 0.920 | 0.361 | 0.531 | 0.092 | 0.311 | 0.385 | 0.375 | 0.330 |
| CM1 | 0.466 | 0.248 | 0.916 | 0.306 | 0.092 | 0.327 | 0.379 | 0.309 | 0.208 |
| CM2 | 0.345 | 0.195 | 0.860 | 0.552 | 0.194 | 0.302 | 0.315 | 0.503 | 0.300 |
| CM4 | 0.318 | 0.300 | 0.750 | 0.513 | 0.036 | 0.193 | 0.565 | 0.338 | 0.115 |
| DP1 | 0.578 | 0.469 | 0.324 | 0.964 | -0.035 | 0.228 | 0.379 | 0.465 | 0.148 |
| DP2 | 0.581 | 0.401 | 0.350 | 0.953 | -0.083 | 0.251 | 0.350 | 0.407 | 0.108 |
| DP3 | 0.476 | 0.383 | 0.548 | 0.922 | -0.111 | 0.160 | 0.539 | 0.276 | 0.104 |
| DP4 | 0.419 | 0.172 | 0.593 | 0.785 | -0.192 | 0.059 | 0.402 | 0.315 | -0.036 |
| FB1 | 0.236 | 0.247 | 0.125 | -0.114 | 0.939 | 0.423 | 0.129 | 0.254 | 0.463 |
| FB3 | 0.281 | 0.121 | 0.147 | -0.069 | 0.953 | 0.540 | 0.251 | 0.272 | 0.598 |
| MB1 | 0.338 | 0.290 | 0.180 | 0.106 | 0.320 | 0.851 | 0.226 | 0.252 | 0.405 |
| MB2 | 0.449 | 0.233 | 0.400 | 0.292 | 0.370 | 0.844 | 0.503 | 0.321 | 0.508 |
| MB3 | 0.510 | 0.377 | 0.409 | 0.362 | 0.254 | 0.829 | 0.430 | 0.309 | 0.566 |
| MB4 | 0.293 | 0.260 | 0.197 | 0.017 | 0.489 | 0.892 | 0.290 | 0.127 | 0.529 |
| OS1 | 0.479 | 0.208 | 0.568 | 0.345 | 0.034 | 0.264 | 0.815 | 0.384 | 0.212 |
| OS2 | 0.499 | 0.248 | 0.588 | 0.353 | -0.020 | 0.243 | 0.772 | 0.403 | 0.249 |
| OS3 | 0.434 | 0.221 | 0.311 | 0.501 | 0.178 | 0.370 | 0.863 | 0.594 | 0.198 |
| OS4 | 0.401 | 0.328 | 0.379 | 0.487 | 0.347 | 0.439 | 0.901 | 0.541 | 0.255 |
| RM1 | 0.323 | 0.242 | 0.560 | 0.332 | 0.171 | 0.150 | 0.647 | 0.824 | 0.122 |
| RM2 | 0.483 | 0.282 | 0.395 | 0.519 | 0.178 | 0.299 | 0.586 | 0.902 | 0.217 |
| RM3 | 0.339 | 0.261 | 0.488 | 0.232 | 0.337 | 0.261 | 0.372 | 0.870 | 0.192 |
| SB1 | 0.270 | 0.398 | 0.238 | 0.167 | 0.468 | 0.432 | 0.304 | 0.092 | 0.933 |
| SB2 | 0.216 | 0.288 | 0.209 | -0.006 | 0.386 | 0.525 | 0.098 | 0.121 | 0.838 |
| SB3 | 0.369 | 0.160 | 0.208 | -0.034 | 0.420 | 0.576 | 0.229 | 0.305 | 0.839 |
| SB5 | 0.345 | 0.522 | 0.260 | 0.219 | 0.377 | 0.512 | 0.272 | 0.207 | 0.852 |

Loading and cross loadings in the final research model 2

| | BM | BP | CM | DP | FB | MB | OS | RM | SB |
|------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| BM1 | 0.814 | 0.273 | 0.440 | 0.355 | 0.087 | 0.330 | 0.342 | 0.567 | 0.200 |
| BM2 | 0.829 | 0.222 | 0.306 | 0.564 | 0.127 | 0.339 | 0.521 | 0.312 | 0.208 |
| BM3 | 0.756 | 0.211 | 0.599 | 0.390 | 0.233 | 0.401 | 0.557 | 0.529 | 0.287 |
| BM4 | 0.704 | 0.162 | 0.549 | 0.238 | 0.304 | 0.228 | 0.412 | 0.377 | 0.323 |
| BP1 | 0.190 | 0.903 | 0.184 | 0.297 | 0.297 | 0.348 | 0.234 | 0.202 | 0.441 |
| BP3 | 0.215 | 0.677 | 0.122 | 0.190 | -0.034 | 0.118 | 0.102 | 0.189 | 0.136 |
| BP4 | 0.364 | 0.920 | 0.361 | 0.530 | 0.091 | 0.315 | 0.385 | 0.375 | 0.323 |
| CM1 | 0.466 | 0.248 | 0.916 | 0.307 | 0.092 | 0.333 | 0.679 | 0.310 | 0.206 |
| CM2 | 0.346 | 0.196 | 0.860 | 0.552 | 0.194 | 0.310 | 0.615 | 0.504 | 0.300 |
| CM4 | 0.317 | 0.300 | 0.749 | 0.513 | 0.036 | 0.197 | 0.565 | 0.338 | 0.113 |
| DP1 | 0.579 | 0.470 | 0.324 | 0.963 | -0.034 | 0.240 | 0.379 | 0.466 | 0.144 |
| DP2 | 0.582 | 0.402 | 0.350 | 0.953 | -0.082 | 0.263 | 0.350 | 0.408 | 0.103 |
| DP3 | 0.476 | 0.384 | 0.548 | 0.921 | -0.112 | 0.169 | 0.539 | 0.277 | 0.100 |
| DP4 | 0.420 | 0.172 | 0.593 | 0.787 | -0.191 | 0.069 | 0.402 | 0.316 | -0.040 |
| FB1 | 0.235 | 0.247 | 0.125 | -0.115 | 0.936 | 0.424 | 0.129 | 0.253 | 0.469 |
| FB3 | 0.281 | 0.121 | 0.147 | -0.070 | 0.955 | 0.537 | 0.251 | 0.271 | 0.604 |
| MB1 | 0.338 | 0.290 | 0.180 | 0.105 | 0.321 | 0.857 | 0.226 | 0.252 | 0.704 |
| MB2 | 0.449 | 0.233 | 0.400 | 0.292 | 0.371 | 0.856 | 0.503 | 0.322 | 0.503 |
| MB3 | 0.511 | 0.378 | 0.409 | 0.362 | 0.255 | 0.828 | 0.430 | 0.309 | 0.560 |
| MB4 | 0.293 | 0.260 | 0.197 | 0.016 | 0.490 | 0.876 | 0.290 | 0.127 | 0.525 |
| OS1 | 0.480 | 0.209 | 0.568 | 0.345 | 0.035 | 0.270 | 0.815 | 0.385 | 0.210 |
| OS2 | 0.499 | 0.249 | 0.588 | 0.353 | -0.018 | 0.246 | 0.772 | 0.404 | 0.247 |
| OS3 | 0.434 | 0.221 | 0.311 | 0.501 | 0.179 | 0.375 | 0.862 | 0.595 | 0.197 |
| OS4 | 0.401 | 0.328 | 0.379 | 0.486 | 0.347 | 0.446 | 0.901 | 0.541 | 0.254 |
| RM1 | 0.323 | 0.243 | 0.560 | 0.332 | 0.171 | 0.161 | 0.647 | 0.825 | 0.124 |
| RM2 | 0.483 | 0.283 | 0.395 | 0.519 | 0.178 | 0.308 | 0.586 | 0.903 | 0.218 |
| RM3 | 0.339 | 0.261 | 0.488 | 0.232 | 0.337 | 0.268 | 0.372 | 0.868 | 0.194 |
| SB1 | 0.270 | 0.398 | 0.238 | 0.166 | 0.470 | 0.424 | 0.304 | 0.092 | 0.932 |
| SB2 | 0.216 | 0.288 | 0.209 | -0.006 | 0.386 | 0.514 | 0.098 | 0.121 | 0.841 |
| SB3 | 0.368 | 0.160 | 0.208 | -0.035 | 0.421 | 0.566 | 0.229 | 0.304 | 0.847 |
| SB5 | 0.345 | 0.522 | 0.260 | 0.218 | 0.378 | 0.500 | 0.272 | 0.206 | 0.843 |

Loading and cross loadings in the final research model 3

| | BM | BP | CM | DP | FB | MB | OS | RM | SB |
|------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| BM1 | 0.813 | 0.272 | 0.440 | 0.354 | 0.084 | 0.316 | 0.342 | 0.566 | 0.207 |
| BM2 | 0.827 | 0.222 | 0.406 | 0.563 | 0.125 | 0.324 | 0.521 | 0.312 | 0.207 |
| BM3 | 0.757 | 0.211 | 0.400 | 0.391 | 0.234 | 0.396 | 0.557 | 0.529 | 0.281 |
| BM4 | 0.705 | 0.161 | 0.549 | 0.238 | 0.306 | 0.229 | 0.412 | 0.378 | 0.311 |
| BP1 | 0.190 | 0.902 | 0.184 | 0.298 | 0.301 | 0.350 | 0.234 | 0.203 | 0.461 |
| BP3 | 0.215 | 0.681 | 0.123 | 0.190 | -0.034 | 0.113 | 0.102 | 0.190 | 0.157 |
| BP4 | 0.364 | 0.919 | 0.362 | 0.531 | 0.093 | 0.307 | 0.385 | 0.374 | 0.351 |
| CM1 | 0.466 | 0.247 | 0.917 | 0.306 | 0.092 | 0.324 | 0.379 | 0.309 | 0.212 |
| CM2 | 0.345 | 0.195 | 0.859 | 0.551 | 0.194 | 0.299 | 0.315 | 0.503 | 0.297 |
| CM4 | 0.318 | 0.300 | 0.751 | 0.513 | 0.035 | 0.190 | 0.564 | 0.338 | 0.121 |
| DP1 | 0.579 | 0.468 | 0.324 | 0.964 | -0.036 | 0.226 | 0.379 | 0.465 | 0.160 |
| DP2 | 0.581 | 0.401 | 0.350 | 0.953 | -0.084 | 0.247 | 0.351 | 0.407 | 0.123 |
| DP3 | 0.476 | 0.383 | 0.548 | 0.922 | -0.111 | 0.158 | 0.539 | 0.276 | 0.116 |
| DP4 | 0.419 | 0.171 | 0.593 | 0.484 | -0.193 | 0.054 | 0.402 | 0.315 | -0.020 |
| FB1 | 0.236 | 0.246 | 0.125 | -0.114 | 0.941 | 0.430 | 0.129 | 0.254 | 0.441 |
| FB3 | 0.281 | 0.121 | 0.147 | -0.069 | 0.951 | 0.545 | 0.251 | 0.272 | 0.575 |
| MB1 | 0.338 | 0.289 | 0.180 | 0.107 | 0.319 | 0.859 | 0.226 | 0.252 | 0.405 |
| MB2 | 0.449 | 0.232 | 0.400 | 0.292 | 0.369 | 0.847 | 0.503 | 0.321 | 0.520 |
| MB3 | 0.510 | 0.377 | 0.409 | 0.362 | 0.252 | 0.820 | 0.430 | 0.309 | 0.579 |
| MB4 | 0.293 | 0.259 | 0.197 | 0.017 | 0.487 | 0.890 | 0.290 | 0.127 | 0.538 |
| OS1 | 0.479 | 0.207 | 0.568 | 0.345 | 0.032 | 0.261 | 0.816 | 0.384 | 0.217 |
| OS2 | 0.499 | 0.248 | 0.587 | 0.352 | -0.023 | 0.239 | 0.773 | 0.402 | 0.253 |
| OS3 | 0.434 | 0.221 | 0.312 | 0.501 | 0.178 | 0.368 | 0.862 | 0.594 | 0.196 |
| OS4 | 0.401 | 0.327 | 0.379 | 0.487 | 0.346 | 0.438 | 0.900 | 0.541 | 0.254 |
| RM1 | 0.323 | 0.241 | 0.560 | 0.332 | 0.171 | 0.151 | 0.647 | 0.823 | 0.114 |
| RM2 | 0.483 | 0.281 | 0.395 | 0.519 | 0.177 | 0.297 | 0.586 | 0.902 | 0.211 |
| RM3 | 0.339 | 0.262 | 0.488 | 0.232 | 0.338 | 0.262 | 0.372 | 0.870 | 0.181 |
| SB1 | 0.270 | 0.398 | 0.238 | 0.167 | 0.465 | 0.434 | 0.304 | 0.092 | 0.940 |
| SB2 | 0.216 | 0.287 | 0.208 | -0.006 | 0.386 | 0.526 | 0.098 | 0.121 | 0.833 |
| SB3 | 0.368 | 0.160 | 0.207 | -0.034 | 0.419 | 0.578 | 0.229 | 0.305 | 0.809 |
| SB5 | 0.345 | 0.522 | 0.260 | 0.219 | 0.375 | 0.509 | 0.272 | 0.207 | 0.871 |

Appendix 11

A brief summative evidence for cross-case analysis

| | IS Providers | PS Suppliers | Comparison |
|-------------------------------|---|---|--|
| Servitization benefits | | | |
| Strategic benefits | <ul style="list-style-type: none"> • Providing servitized offerings to business customers helps the company secure a leading position in the market • Engaging business customers as value co-creators enhances the overall operational efficiency through effective communication and monitoring the equipment | <ul style="list-style-type: none"> • Providing servitized offerings to business customers helps the company secure a leading position in the market | Both cases have perceived that providing servitized offerings secures a leading position of the company in the market competition. However, IS providers claim an additional benefit as providing integrated solutions increases the overall operational efficiency due to monitoring the equipment and ensuring effective communication with customers. |
| Financial benefits | <ul style="list-style-type: none"> • Supplying integrated solutions creates an additional channel of revenue generation in addition to product sales • Delivering integrated solutions through long-term contracts enhance the financial stability of the company | <ul style="list-style-type: none"> • Supplying servitized offerings creates an additional channel of revenue generation in addition to product sales • Regular service demands and long-term service contracts constantly contribute to the overall financial growth | Both cases perceived the financial benefits at a similar level, as they mutually claim that providing servitized offerings establishes a new channel for generating stable revenues. |
| Marketing benefits | <ul style="list-style-type: none"> • The IS provides a comprehensive solution to address customer needs by directly responding to their operational challenges • Delivering solution-oriented contracts allows the provider to engage the business customers on a long-term basis • The provider working closely with customers enables a better understanding of customer needs and to plan for future business • Providing IS enables the provider to build a connection with end-users and obtain an instant feedback on the user experience | <ul style="list-style-type: none"> • Supporting product life cycle and functionalities through various service offerings satisfy customer needs • Delivering service contracts (e.g. service subscription and warranty programme) allows the supplier to engage business customers on a long-term basis • The supplier working closely with customers enables a better understanding of customer needs and to plan for future business | <p>The marketing benefits exhibit at a similar level in both cases, as they acknowledged that shifting towards servitization allows them to respond effectively to the market demand and build close relationships with customers.</p> <p>However, IS providers enjoy more benefits as they seek to engage customers as a value co-creator, where they could work with customers side by side to enhance trust in the relationship and share resources to support the IS delivery.</p> |

| | IS Providers | PS Suppliers | Comparison |
|---------------------------------|---|--|--|
| Servitization challenges | | | |
| OS | <ul style="list-style-type: none"> Managing the product and service team separately ('silo management') prevents inter-departmental collaboration The stakeholder's lack of a clear understanding on the servitization concept and strategy prevents the shift of the business culture from product-centric to solution-centric | <ul style="list-style-type: none"> The employee's resistance to the change of BM and operation process prevents the shift in business culture Internal competition among the service and product team inhibits the internal-departmental collaboration | <p>The OS challenges appear to be similar in the two groups, but they are manifested in different ways:</p> <ul style="list-style-type: none"> Inter-departmental collaboration in IS providers is inhibited by the silo management in which product and service teams are managed separately. In PS suppliers, the teams focus on competing with each other on financial performance causing a loss of focus on achieving mutual strategic goals The shift of business culture is ineffective in IS providers, as the stakeholders need ongoing education to understand servitization. In PS suppliers, the culture change is prevented by the employees' resistant to the changes that are associated with the adoption of servitization |
| BM | <ul style="list-style-type: none"> Modifying the entire BM to support the solution business is a critical challenge, as the company needs to make changes in different areas of the business and ensure the BM is aligned with the customer's business needs Designing a value proposition to suit customer's needs is challenging as there is a mismatch between the provider and customer in terms of value perception Planning and managing internal resources is a challenge, given that the solution delivery may experience a 'peak time' when the provider requires more human resources to support the solution delivery | <ul style="list-style-type: none"> The PS supplier needs to develop a separate service sales channel as selling services requires different skillsets and business mentalities | <ul style="list-style-type: none"> The BM challenges are reflected more obviously in IS providers, as they encounter extensive challenges in modifying the overall BM, designing the value proposition and utilising the internal resources In the PS supplier, the challenge appears less significant as the company only faces a challenge in redeveloping a service sales channel |
| DP | <ul style="list-style-type: none"> Creating an integrated DP to support the development of an integrated solution is prevented by the silo management of the product and service business The complex nature of IS makes it difficult to measure the overall performance of the offering The applicable toolkit for supporting the solution development is lacking and underdeveloped | <ul style="list-style-type: none"> Insufficient customer engagement in the service DP causes the PS supplier to have a lack of customer understanding | <p>The DP challenges are exhibited differently in the two groups.</p> <ul style="list-style-type: none"> The IS provider encounters more challenges in this area, including the issues regarding the development of an integrated process, design of performance assessment metrics and the application of a relevant toolkit The PS supplier faces only one significant challenge that relates to the insufficient customer engagement in the DP |

| | | | |
|----|--|---|--|
| CM | <ul style="list-style-type: none"> • There is a gap between the provider and customer in the way of perceiving the value of servitized offerings, thus the provider finds it difficult to demonstrate how the offering matches the customer's needs and expectations • The lack of commitment from the customer's side in the co-creation prevents the effective delivery of solutions, such as the customer being reluctant to share operational data with the provider | <ul style="list-style-type: none"> • Understanding customers' needs and setting clear expectations are hard to achieve due to the lack of customer engagement in the DP • The lack of effective communication causes some misunderstandings of the value created by services on the customer's side • The supplier and business customer may compete in the same market (e.g. service capability and access to the end user), which causes some tensions in the relationship | <p>The IS provider and PS supplier show a similar level of CM challenges, in which both of them highlight that ineffective communication and lack of understanding of customer needs and expectations are critical challenges in managing the relationship.</p> <p>In addition, they face some different challenges. IS providers highlight that the customer is lacking in commitment to the relational process which could prevent the value co-creation in the solution delivery. In contrast, PS suppliers are aware that they may face potential competition from their business customers, and this could cause some tensions in the relationship.</p> |
| RM | <ul style="list-style-type: none"> • The four servitization challenges identified above increase the level of operational risks in the business • The provider needs to share some risks with the customer to realise the value of servitized offerings and this could increase the level of operational risks • The level of financial risks is increased due to heavy upfront investments and potential financial penalties involved in the IS contract | <ul style="list-style-type: none"> • The four servitization challenges identified above increase the level of operational risks in the business | <ul style="list-style-type: none"> • The RM challenges are strongly perceived by the IS provider, as both operational and financial risks are evident in the case • The RM challenges are less evident in the PS supplier as they do not encounter obvious financial risks or share operational risks with their customers |

Appendix 12

Descriptive analysis of survey results (Mean, Std, Deviation & Correlations Matrix)

Organisational structure challenges

Descriptive Statistics

| | Mean | Std. Deviation | N |
|-----|--------|----------------|----|
| OS1 | 4.5313 | 1.96792 | 96 |
| OS2 | 4.5521 | 1.67878 | 96 |
| OS3 | 3.6458 | 1.57600 | 96 |
| OS4 | 3.9167 | 1.68377 | 96 |

Correlations

| | | OS1 | OS2 | OS3 | OS4 |
|-----|---------------------|--------|--------|--------|--------|
| OS1 | Pearson Correlation | 1 | .844** | .516** | .585** |
| | Sig. (2-tailed) | | .000 | .000 | .000 |
| | N | 96 | 96 | 96 | 96 |
| OS2 | Pearson Correlation | .844** | 1 | .504** | .497** |
| | Sig. (2-tailed) | .000 | | .000 | .000 |
| | N | 96 | 96 | 96 | 96 |
| OS3 | Pearson Correlation | .516** | .504** | 1 | .766** |
| | Sig. (2-tailed) | .000 | .000 | | .000 |
| | N | 96 | 96 | 96 | 96 |
| OS4 | Pearson Correlation | .585** | .497** | .766** | 1 |
| | Sig. (2-tailed) | .000 | .000 | .000 | |
| | N | 96 | 96 | 96 | 96 |

** . Correlation is significant at the 0.01 level (2-tailed).

Business Model Challenges

Descriptive Statistics

| | Mean | Std. Deviation | N |
|-----|--------|----------------|----|
| BM1 | 3.9479 | 1.67564 | 96 |
| BM2 | 3.6250 | 1.73053 | 96 |
| BM3 | 4.0729 | 1.68113 | 96 |
| BM4 | 3.9375 | 1.64677 | 96 |
| BM5 | 3.7083 | 1.66649 | 96 |

Correlations

| | | BM1 | BM2 | BM3 | BM4 | BM5 |
|-----|---------------------|--------|--------|--------|--------|--------|
| BM1 | Pearson Correlation | 1 | .828** | .502** | .460** | .341** |
| | Sig. (2-tailed) | | .000 | .000 | .000 | .001 |
| | N | 96 | 96 | 96 | 96 | 96 |
| BM2 | Pearson Correlation | .828** | 1 | .418** | .483** | .381** |
| | Sig. (2-tailed) | .000 | | .000 | .000 | .000 |
| | N | 96 | 96 | 96 | 96 | 96 |
| BM3 | Pearson Correlation | .502** | .418** | 1 | .397** | .395** |
| | Sig. (2-tailed) | .000 | .000 | | .000 | .000 |
| | N | 96 | 96 | 96 | 96 | 96 |
| BM4 | Pearson Correlation | .460** | .483** | .397** | 1 | .768** |
| | Sig. (2-tailed) | .000 | .000 | .000 | | .000 |
| | N | 96 | 96 | 96 | 96 | 96 |
| BM5 | Pearson Correlation | .341** | .381** | .395** | .768** | 1 |
| | Sig. (2-tailed) | .001 | .000 | .000 | .000 | |
| | N | 96 | 96 | 96 | 96 | 96 |

** . Correlation is significant at the 0.01 level (2-tailed).

Development Process Challenges

Descriptive Statistics

| | Mean | Std. Deviation | N |
|-----|--------|----------------|----|
| DP1 | 4.3333 | 1.60700 | 96 |
| DP2 | 4.3646 | 1.60342 | 96 |
| DP3 | 4.4583 | 1.83485 | 96 |
| DP4 | 3.9167 | 1.70860 | 96 |

Correlations

| | | DP1 | DP2 | DP3 | DP4 |
|-----|---------------------|--------|--------|--------|--------|
| DP1 | Pearson Correlation | 1 | .892** | .872** | .681** |
| | Sig. (2-tailed) | | .000 | .000 | .000 |
| | N | 96 | 96 | 96 | 96 |
| DP2 | Pearson Correlation | .892** | 1 | .801** | .726** |
| | Sig. (2-tailed) | .000 | | .000 | .000 |
| | N | 96 | 96 | 96 | 96 |
| DP3 | Pearson Correlation | .872** | .801** | 1 | .660** |
| | Sig. (2-tailed) | .000 | .000 | | .000 |
| | N | 96 | 96 | 96 | 96 |
| DP4 | Pearson Correlation | .681** | .726** | .660** | 1 |
| | Sig. (2-tailed) | .000 | .000 | .000 | |
| | N | 96 | 96 | 96 | 96 |

** . Correlation is significant at the 0.01 level (2-tailed).

Customer Management Challenges

Descriptive Statistics

| | Mean | Std. Deviation | N |
|-----|--------|----------------|----|
| CM1 | 4.0000 | 1.62221 | 96 |
| CM2 | 4.6979 | 1.77183 | 96 |
| CM3 | 3.1042 | 1.57266 | 96 |
| CM4 | 3.6250 | 1.71219 | 96 |
| CM5 | 4.0208 | 1.56258 | 96 |

Correlations

| | | CM1 | CM2 | CM3 | CM4 | CM5 |
|-----|---------------------|--------|--------|--------|--------|--------|
| CM1 | Pearson Correlation | 1 | .626** | .590** | .739** | .494** |
| | Sig. (2-tailed) | | .000 | .000 | .000 | .000 |
| | N | 96 | 96 | 96 | 96 | 96 |
| CM2 | Pearson Correlation | .626** | 1 | .321** | .389** | .272** |
| | Sig. (2-tailed) | .000 | | .001 | .000 | .007 |
| | N | 96 | 96 | 96 | 96 | 96 |
| CM3 | Pearson Correlation | .590** | .321** | 1 | .652** | .380** |
| | Sig. (2-tailed) | .000 | .001 | | .000 | .000 |
| | N | 96 | 96 | 96 | 96 | 96 |
| CM4 | Pearson Correlation | .739** | .389** | .652** | 1 | .597** |
| | Sig. (2-tailed) | .000 | .000 | .000 | | .000 |
| | N | 96 | 96 | 96 | 96 | 96 |
| CM5 | Pearson Correlation | .494** | .272** | .380** | .597** | 1 |
| | Sig. (2-tailed) | .000 | .007 | .000 | .000 | |
| | N | 96 | 96 | 96 | 96 | 96 |

** . Correlation is significant at the 0.01 level (2-tailed).

Risk Management Challenges

Descriptive Statistics

| | Mean | Std. Deviation | N |
|-----|--------|----------------|----|
| RM1 | 3.7396 | 1.90426 | 96 |
| RM2 | 3.7708 | 1.84949 | 96 |
| RM3 | 4.3750 | 1.81949 | 96 |

Correlations

| | | RM1 | RM2 | RM3 |
|-----|---------------------|--------|--------|--------|
| RM1 | Pearson Correlation | 1 | .748** | .533** |
| | Sig. (2-tailed) | | .000 | .000 |
| | N | 96 | 96 | 96 |
| RM2 | Pearson Correlation | .748** | 1 | .620** |
| | Sig. (2-tailed) | .000 | | .000 |
| | N | 96 | 96 | 96 |
| RM3 | Pearson Correlation | .533** | .620** | 1 |
| | Sig. (2-tailed) | .000 | .000 | |
| | N | 96 | 96 | 96 |

** . Correlation is significant at the 0.01 level (2-tailed).

Strategic Benefits

Descriptive Statistics

| | Mean | Std. Deviation | N |
|-----|--------|----------------|----|
| SB1 | 6.3333 | 1.16679 | 96 |
| SB2 | 5.7292 | 1.63178 | 96 |
| SB3 | 5.4583 | 1.54181 | 96 |
| SB4 | 5.7292 | 1.41778 | 96 |
| SB5 | 6.2604 | 1.14473 | 96 |

Correlations

| | | SB1 | SB2 | SB3 | SB4 | SB5 |
|-----|---------------------|--------|--------|--------|--------|--------|
| SB1 | Pearson Correlation | 1 | .767** | .681** | .411** | .778** |
| | Sig. (2-tailed) | | .000 | .000 | .000 | .000 |
| | N | 96 | 96 | 96 | 96 | 96 |
| SB2 | Pearson Correlation | .767** | 1 | .669** | .259* | .545** |
| | Sig. (2-tailed) | .000 | | .000 | .011 | .000 |
| | N | 96 | 96 | 96 | 96 | 96 |
| SB3 | Pearson Correlation | .681** | .669** | 1 | .197 | .564** |
| | Sig. (2-tailed) | .000 | .000 | | .054 | .000 |
| | N | 96 | 96 | 96 | 96 | 96 |
| SB4 | Pearson Correlation | .411** | .259* | .197 | 1 | .511** |
| | Sig. (2-tailed) | .000 | .011 | .054 | | .000 |
| | N | 96 | 96 | 96 | 96 | 96 |
| SB5 | Pearson Correlation | .778** | .545** | .564** | .511** | 1 |
| | Sig. (2-tailed) | .000 | .000 | .000 | .000 | |
| | N | 96 | 96 | 96 | 96 | 96 |

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

Financial Benefits

Descriptive Statistics

| | Mean | Std. Deviation | N |
|-----|--------|----------------|----|
| FB1 | 5.8229 | 1.74111 | 96 |
| FB2 | 3.7708 | 1.92206 | 96 |
| FB3 | 5.7708 | 1.59920 | 96 |

Correlations

| | | FB1 | FB2 | FB3 |
|-----|---------------------|--------|-------|--------|
| FB1 | Pearson Correlation | 1 | .246* | .791** |
| | Sig. (2-tailed) | | .016 | .000 |
| | N | 96 | 96 | 96 |
| FB2 | Pearson Correlation | .246* | 1 | .161 |
| | Sig. (2-tailed) | .016 | | .118 |
| | N | 96 | 96 | 96 |
| FB3 | Pearson Correlation | .791** | .161 | 1 |
| | Sig. (2-tailed) | .000 | .118 | |
| | N | 96 | 96 | 96 |

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Marketing Benefits

Descriptive Statistics

| | Mean | Std. Deviation | N |
|-----|--------|----------------|----|
| MB1 | 6.1667 | 1.24534 | 96 |
| MB2 | 6.2396 | 1.14013 | 96 |
| MB3 | 5.5104 | 1.61568 | 96 |
| MB4 | 6.3542 | 1.16961 | 96 |

Correlations

| | | MB1 | MB2 | MB3 | MB4 |
|-----|---------------------|--------|--------|--------|--------|
| MB1 | Pearson Correlation | 1 | .668** | .554** | .682** |
| | Sig. (2-tailed) | | .000 | .000 | .000 |
| | N | 96 | 96 | 96 | 96 |
| MB2 | Pearson Correlation | .668** | 1 | .619** | .654** |
| | Sig. (2-tailed) | .000 | | .000 | .000 |
| | N | 96 | 96 | 96 | 96 |
| MB3 | Pearson Correlation | .554** | .619** | 1 | .666** |
| | Sig. (2-tailed) | .000 | .000 | | .000 |
| | N | 96 | 96 | 96 | 96 |
| MB4 | Pearson Correlation | .682** | .654** | .666** | 1 |
| | Sig. (2-tailed) | .000 | .000 | .000 | |
| | N | 96 | 96 | 96 | 96 |

** . Correlation is significant at the 0.01 level (2-tailed).

Business Performance

Descriptive Statistics

| | Mean | Std. Deviation | N |
|-----|--------|----------------|----|
| BP1 | 6.1458 | .89418 | 96 |
| BP2 | 5.7083 | 1.42841 | 96 |
| BP3 | 5.6146 | 1.33274 | 96 |
| BP4 | 5.8750 | .92053 | 96 |

Correlations

| | | BP1 | BP2 | BP3 | BP4 |
|-----|---------------------|--------|--------|--------|--------|
| BP1 | Pearson Correlation | 1 | .388** | .401** | .700** |
| | Sig. (2-tailed) | | .000 | .000 | .000 |
| | N | 96 | 96 | 96 | 96 |
| BP2 | Pearson Correlation | .388** | 1 | .632** | .548** |
| | Sig. (2-tailed) | .000 | | .000 | .000 |
| | N | 96 | 96 | 96 | 96 |
| BP3 | Pearson Correlation | .401** | .632** | 1 | .638** |
| | Sig. (2-tailed) | .000 | .000 | | .000 |
| | N | 96 | 96 | 96 | 96 |
| BP4 | Pearson Correlation | .700** | .548** | .638** | 1 |
| | Sig. (2-tailed) | .000 | .000 | .000 | |
| | N | 96 | 96 | 96 | 96 |

** . Correlation is significant at the 0.01 level (2-tailed).

Group difference (IS provider VS. PS supplier)
(Mean, Std, Deviation & Correlations Matrix)

Group 1 – IS provider (N=48)

Organisational structure challenges

Descriptive Statistics

| | Mean | Std. Deviation | N |
|-----|--------|----------------|----|
| OS1 | 4.3958 | 2.08071 | 48 |
| OS2 | 4.2708 | 1.74721 | 48 |
| OS3 | 3.5625 | 1.60989 | 48 |
| OS4 | 3.9792 | 1.70718 | 48 |

Correlations

| | | OS1 | OS2 | OS3 | OS4 |
|-----|---------------------|--------|--------|--------|--------|
| OS1 | Pearson Correlation | 1 | .883** | .618** | .691** |
| | Sig. (2-tailed) | | .000 | .000 | .000 |
| | N | 48 | 48 | 48 | 48 |
| OS2 | Pearson Correlation | .883** | 1 | .618** | .601** |
| | Sig. (2-tailed) | .000 | | .000 | .000 |
| | N | 48 | 48 | 48 | 48 |
| OS3 | Pearson Correlation | .618** | .618** | 1 | .748** |
| | Sig. (2-tailed) | .000 | .000 | | .000 |
| | N | 48 | 48 | 48 | 48 |
| OS4 | Pearson Correlation | .691** | .601** | .748** | 1 |
| | Sig. (2-tailed) | .000 | .000 | .000 | |
| | N | 48 | 48 | 48 | 48 |

** . Correlation is significant at the 0.01 level (2-tailed).

Business Model Challenges

Descriptive Statistics

| | Mean | Std. Deviation | N |
|-----|--------|----------------|----|
| BM1 | 3.9583 | 1.68798 | 48 |
| BM2 | 3.5417 | 1.78598 | 48 |
| BM3 | 4.1042 | 1.62742 | 48 |
| BM4 | 4.0625 | 1.58995 | 48 |
| BM5 | 3.9167 | 1.56876 | 48 |

Correlations

| | | BM1 | BM2 | BM3 | BM4 | BM5 |
|-----|---------------------|--------|--------|--------|--------|--------|
| BM1 | Pearson Correlation | 1 | .876** | .513** | .405** | .360* |
| | Sig. (2-tailed) | | .000 | .000 | .004 | .012 |
| | N | 48 | 48 | 48 | 48 | 48 |
| BM2 | Pearson Correlation | .876** | 1 | .427** | .445** | .396** |
| | Sig. (2-tailed) | .000 | | .002 | .002 | .005 |
| | N | 48 | 48 | 48 | 48 | 48 |
| BM3 | Pearson Correlation | .513** | .427** | 1 | .351* | .303* |
| | Sig. (2-tailed) | .000 | .002 | | .014 | .036 |
| | N | 48 | 48 | 48 | 48 | 48 |
| BM4 | Pearson Correlation | .405** | .445** | .351* | 1 | .838** |
| | Sig. (2-tailed) | .004 | .002 | .014 | | .000 |
| | N | 48 | 48 | 48 | 48 | 48 |
| BM5 | Pearson Correlation | .360* | .396** | .303* | .838** | 1 |
| | Sig. (2-tailed) | .012 | .005 | .036 | .000 | |
| | N | 48 | 48 | 48 | 48 | 48 |

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

Development Process Challenges

Descriptive Statistics

| | Mean | Std. Deviation | N |
|-----|--------|----------------|----|
| DP1 | 4.2500 | 1.69480 | 48 |
| DP2 | 4.2292 | 1.67890 | 48 |
| DP3 | 4.3333 | 1.96060 | 48 |
| DP4 | 3.9583 | 1.79785 | 48 |

Correlations

| | | DP1 | DP2 | DP3 | DP4 |
|-----|---------------------|--------|--------|--------|--------|
| DP1 | Pearson Correlation | 1 | .974** | .877** | .800** |
| | Sig. (2-tailed) | | .000 | .000 | .000 |
| | N | 48 | 48 | 48 | 48 |
| DP2 | Pearson Correlation | .974** | 1 | .881** | .814** |
| | Sig. (2-tailed) | .000 | | .000 | .000 |
| | N | 48 | 48 | 48 | 48 |
| DP3 | Pearson Correlation | .877** | .881** | 1 | .783** |
| | Sig. (2-tailed) | .000 | .000 | | .000 |
| | N | 48 | 48 | 48 | 48 |
| DP4 | Pearson Correlation | .800** | .814** | .783** | 1 |
| | Sig. (2-tailed) | .000 | .000 | .000 | |
| | N | 48 | 48 | 48 | 48 |

** . Correlation is significant at the 0.01 level (2-tailed).

Customer Management Challenges

Descriptive Statistics

| | Mean | Std. Deviation | N |
|-----|--------|----------------|----|
| CM1 | 4.1250 | 1.61936 | 48 |
| CM2 | 4.6667 | 1.81405 | 48 |
| CM3 | 3.1667 | 1.65457 | 48 |
| CM4 | 3.8125 | 1.73397 | 48 |
| CM5 | 4.1458 | 1.52970 | 48 |

Correlations

| | | CM1 | CM2 | CM3 | CM4 | CM5 |
|-----|---------------------|--------|--------|--------|--------|--------|
| CM1 | Pearson Correlation | 1 | .579** | .635** | .744** | .405** |
| | Sig. (2-tailed) | | .000 | .000 | .000 | .004 |
| | N | 48 | 48 | 48 | 48 | 48 |
| CM2 | Pearson Correlation | .579** | 1 | .302* | .386** | .187 |
| | Sig. (2-tailed) | .000 | | .037 | .007 | .204 |
| | N | 48 | 48 | 48 | 48 | 48 |
| CM3 | Pearson Correlation | .635** | .302* | 1 | .656** | .360* |
| | Sig. (2-tailed) | .000 | .037 | | .000 | .012 |
| | N | 48 | 48 | 48 | 48 | 48 |
| CM4 | Pearson Correlation | .744** | .386** | .656** | 1 | .516** |
| | Sig. (2-tailed) | .000 | .007 | .000 | | .000 |
| | N | 48 | 48 | 48 | 48 | 48 |
| CM5 | Pearson Correlation | .405** | .187 | .360* | .516** | 1 |
| | Sig. (2-tailed) | .004 | .204 | .012 | .000 | |
| | N | 48 | 48 | 48 | 48 | 48 |

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

Risk Management Challenges

Descriptive Statistics

| | Mean | Std. Deviation | N |
|-----------------|--------|----------------|----|
| Risk Management | 3.6042 | 1.97581 | 48 |
| RM2 | 3.5833 | 1.92225 | 48 |
| RM3 | 4.4792 | 1.95687 | 48 |

Correlations

| | | Risk Management | RM2 | RM3 |
|-----------------|---------------------|-----------------|--------|--------|
| Risk Management | Pearson Correlation | 1 | .740** | .386** |
| | Sig. (2-tailed) | | .000 | .007 |
| | N | 48 | 48 | 48 |
| RM2 | Pearson Correlation | .740** | 1 | .535** |
| | Sig. (2-tailed) | .000 | | .000 |
| | N | 48 | 48 | 48 |
| RM3 | Pearson Correlation | .386** | .535** | 1 |
| | Sig. (2-tailed) | .007 | .000 | |
| | N | 48 | 48 | 48 |

** . Correlation is significant at the 0.01 level (2-tailed).

Strategic Benefits

Descriptive Statistics

| | Mean | Std. Deviation | N |
|-----|--------|----------------|----|
| SB1 | 6.3750 | 1.21384 | 48 |
| SB2 | 5.8125 | 1.61977 | 48 |
| SB3 | 5.5000 | 1.50177 | 48 |
| SB4 | 5.6667 | 1.43413 | 48 |
| SB5 | 6.2708 | 1.12495 | 48 |

Correlations

| | | SB1 | SB2 | SB3 | SB4 | SB5 |
|-----|---------------------|--------|--------|--------|--------|--------|
| SB1 | Pearson Correlation | 1 | .783** | .700** | .342* | .765** |
| | Sig. (2-tailed) | | .000 | .000 | .017 | .000 |
| | N | 48 | 48 | 48 | 48 | 48 |
| SB2 | Pearson Correlation | .783** | 1 | .660** | .229 | .496** |
| | Sig. (2-tailed) | .000 | | .000 | .117 | .000 |
| | N | 48 | 48 | 48 | 48 | 48 |
| SB3 | Pearson Correlation | .700** | .660** | 1 | .217 | .623** |
| | Sig. (2-tailed) | .000 | .000 | | .138 | .000 |
| | N | 48 | 48 | 48 | 48 | 48 |
| SB4 | Pearson Correlation | .342* | .229 | .217 | 1 | .426** |
| | Sig. (2-tailed) | .017 | .117 | .138 | | .003 |
| | N | 48 | 48 | 48 | 48 | 48 |
| SB5 | Pearson Correlation | .765** | .496** | .623** | .426** | 1 |
| | Sig. (2-tailed) | .000 | .000 | .000 | .003 | |
| | N | 48 | 48 | 48 | 48 | 48 |

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

Financial Benefits

Descriptive Statistics

| | Mean | Std. Deviation | N |
|-----|--------|----------------|----|
| FB1 | 6.1667 | 1.53447 | 48 |
| FB2 | 3.8125 | 2.03853 | 48 |
| FB3 | 5.9167 | 1.52753 | 48 |

Correlations

| | | FB1 | FB2 | FB3 |
|-----|---------------------|--------|------|--------|
| FB1 | Pearson Correlation | 1 | .133 | .868** |
| | Sig. (2-tailed) | | .369 | .000 |
| | N | 48 | 48 | 48 |
| FB2 | Pearson Correlation | .133 | 1 | .152 |
| | Sig. (2-tailed) | .369 | | .302 |
| | N | 48 | 48 | 48 |
| FB3 | Pearson Correlation | .868** | .152 | 1 |
| | Sig. (2-tailed) | .000 | .302 | |
| | N | 48 | 48 | 48 |

** . Correlation is significant at the 0.01 level (2-tailed).

Marketing Benefits

Descriptive Statistics

| | Mean | Std. Deviation | N |
|-----|--------|----------------|----|
| MB1 | 6.2083 | 1.16616 | 48 |
| MB2 | 6.2292 | 1.13437 | 48 |
| MB3 | 5.5208 | 1.55727 | 48 |
| MB4 | 6.4167 | 1.10768 | 48 |

Correlations

| | | MB1 | MB2 | MB3 | MB4 |
|-----|---------------------|--------|--------|--------|--------|
| MB1 | Pearson Correlation | 1 | .574** | .607** | .706** |
| | Sig. (2-tailed) | | .000 | .000 | .000 |
| | N | 48 | 48 | 48 | 48 |
| MB2 | Pearson Correlation | .574** | 1 | .545** | .600** |
| | Sig. (2-tailed) | .000 | | .000 | .000 |
| | N | 48 | 48 | 48 | 48 |
| MB3 | Pearson Correlation | .607** | .545** | 1 | .673** |
| | Sig. (2-tailed) | .000 | .000 | | .000 |
| | N | 48 | 48 | 48 | 48 |
| MB4 | Pearson Correlation | .706** | .600** | .673** | 1 |
| | Sig. (2-tailed) | .000 | .000 | .000 | |
| | N | 48 | 48 | 48 | 48 |

** . Correlation is significant at the 0.01 level (2-tailed).

Business Performance

Descriptive Statistics

| | Mean | Std. Deviation | N |
|-----|--------|----------------|----|
| BP1 | 6.1458 | .65199 | 48 |
| BP2 | 5.7083 | 1.39845 | 48 |
| BP3 | 5.5625 | 1.35122 | 48 |
| BP4 | 5.9167 | .67896 | 48 |

Correlations

| | | BP1 | BP2 | BP3 | BP4 |
|-----|---------------------|--------|--------|--------|--------|
| BP1 | Pearson Correlation | 1 | .211 | .219 | .509** |
| | Sig. (2-tailed) | | .150 | .135 | .000 |
| | N | 48 | 48 | 48 | 48 |
| BP2 | Pearson Correlation | .211 | 1 | .393** | .288* |
| | Sig. (2-tailed) | .150 | | .006 | .047 |
| | N | 48 | 48 | 48 | 48 |
| BP3 | Pearson Correlation | .219 | .393** | 1 | .400** |
| | Sig. (2-tailed) | .135 | .006 | | .005 |
| | N | 48 | 48 | 48 | 48 |
| BP4 | Pearson Correlation | .509** | .288* | .400** | 1 |
| | Sig. (2-tailed) | .000 | .047 | .005 | |
| | N | 48 | 48 | 48 | 48 |

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

Group 2 – PS Supplier (N=48)

Organisational structure challenges

Descriptive Statistics

| | Mean | Std. Deviation | N |
|-----|--------|----------------|----|
| OS1 | 4.6667 | 1.86037 | 48 |
| OS2 | 4.8333 | 1.57552 | 48 |
| OS3 | 3.7292 | 1.55385 | 48 |
| OS4 | 3.8542 | 1.67573 | 48 |

Correlations

| | | OS1 | OS2 | OS3 | OS4 |
|-----|---------------------|--------|--------|--------|--------|
| OS1 | Pearson Correlation | 1 | .801** | .395** | .475** |
| | Sig. (2-tailed) | | .000 | .005 | .001 |
| | N | 48 | 48 | 48 | 48 |
| OS2 | Pearson Correlation | .801** | 1 | .372** | .410** |
| | Sig. (2-tailed) | .000 | | .009 | .004 |
| | N | 48 | 48 | 48 | 48 |
| OS3 | Pearson Correlation | .395** | .372** | 1 | .793** |
| | Sig. (2-tailed) | .005 | .009 | | .000 |
| | N | 48 | 48 | 48 | 48 |
| OS4 | Pearson Correlation | .475** | .410** | .793** | 1 |
| | Sig. (2-tailed) | .001 | .004 | .000 | |
| | N | 48 | 48 | 48 | 48 |

** . Correlation is significant at the 0.01 level (2-tailed).

Business Model Challenges

Descriptive Statistics

| | Mean | Std. Deviation | N |
|-----|--------|----------------|----|
| BM1 | 3.9375 | 1.68101 | 48 |
| BM2 | 3.7083 | 1.68798 | 48 |
| BM3 | 4.0417 | 1.74987 | 48 |
| BM4 | 3.8125 | 1.70925 | 48 |
| BM5 | 3.5000 | 1.75038 | 48 |

Correlations

| | | BM1 | BM2 | BM3 | BM4 | BM5 |
|-----|---------------------|--------|--------|--------|--------|--------|
| BM1 | Pearson Correlation | 1 | .781** | .493** | .514** | .329* |
| | Sig. (2-tailed) | | .000 | .000 | .000 | .022 |
| | N | 48 | 48 | 48 | 48 | 48 |
| BM2 | Pearson Correlation | .781** | 1 | .415** | .534** | .389** |
| | Sig. (2-tailed) | .000 | | .003 | .000 | .006 |
| | N | 48 | 48 | 48 | 48 | 48 |
| BM3 | Pearson Correlation | .493** | .415** | 1 | .437** | .472** |
| | Sig. (2-tailed) | .000 | .003 | | .002 | .001 |
| | N | 48 | 48 | 48 | 48 | 48 |
| BM4 | Pearson Correlation | .514** | .534** | .437** | 1 | .708** |
| | Sig. (2-tailed) | .000 | .000 | .002 | | .000 |
| | N | 48 | 48 | 48 | 48 | 48 |
| BM5 | Pearson Correlation | .329* | .389** | .472** | .708** | 1 |
| | Sig. (2-tailed) | .022 | .006 | .001 | .000 | |
| | N | 48 | 48 | 48 | 48 | 48 |

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

Development Process Challenges

Descriptive Statistics

| | Mean | Std. Deviation | N |
|-----|--------|----------------|----|
| DP1 | 4.4167 | 1.52753 | 48 |
| DP2 | 4.5000 | 1.52984 | 48 |
| DP3 | 4.5833 | 1.71145 | 48 |
| DP4 | 3.8750 | 1.63245 | 48 |

Correlations

| | | DP1 | DP2 | DP3 | DP4 |
|-----|---------------------|--------|--------|--------|--------|
| DP1 | Pearson Correlation | 1 | .792** | .865** | .542** |
| | Sig. (2-tailed) | | .000 | .000 | .000 |
| | N | 48 | 48 | 48 | 48 |
| DP2 | Pearson Correlation | .792** | 1 | .699** | .630** |
| | Sig. (2-tailed) | .000 | | .000 | .000 |
| | N | 48 | 48 | 48 | 48 |
| DP3 | Pearson Correlation | .865** | .699** | 1 | .514** |
| | Sig. (2-tailed) | .000 | .000 | | .000 |
| | N | 48 | 48 | 48 | 48 |
| DP4 | Pearson Correlation | .542** | .630** | .514** | 1 |
| | Sig. (2-tailed) | .000 | .000 | .000 | |
| | N | 48 | 48 | 48 | 48 |

** . Correlation is significant at the 0.01 level (2-tailed).

Customer Management Challenges

Descriptive Statistics

| | Mean | Std. Deviation | N |
|-----|--------|----------------|----|
| CM1 | 3.8750 | 1.63245 | 48 |
| CM2 | 4.7292 | 1.74721 | 48 |
| CM3 | 3.0417 | 1.50118 | 48 |
| CM4 | 3.4375 | 1.68733 | 48 |
| CM5 | 3.8958 | 1.60106 | 48 |

Correlations

| | | CM1 | CM2 | CM3 | CM4 | CM5 |
|-----|---------------------|--------|--------|--------|--------|--------|
| CM1 | Pearson Correlation | 1 | .682** | .540** | .731** | .573** |
| | Sig. (2-tailed) | | .000 | .000 | .000 | .000 |
| | N | 48 | 48 | 48 | 48 | 48 |
| CM2 | Pearson Correlation | .682** | 1 | .345* | .402** | .362* |
| | Sig. (2-tailed) | .000 | | .016 | .005 | .011 |
| | N | 48 | 48 | 48 | 48 | 48 |
| CM3 | Pearson Correlation | .540** | .345* | 1 | .648** | .400** |
| | Sig. (2-tailed) | .000 | .016 | | .000 | .005 |
| | N | 48 | 48 | 48 | 48 | 48 |
| CM4 | Pearson Correlation | .731** | .402** | .648** | 1 | .671** |
| | Sig. (2-tailed) | .000 | .005 | .000 | | .000 |
| | N | 48 | 48 | 48 | 48 | 48 |
| CM5 | Pearson Correlation | .573** | .362* | .400** | .671** | 1 |
| | Sig. (2-tailed) | .000 | .011 | .005 | .000 | |
| | N | 48 | 48 | 48 | 48 | 48 |

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

Risk Management Challenges

Descriptive Statistics

| | Mean | Std. Deviation | N |
|-----|--------|----------------|----|
| RM1 | 3.8750 | 1.84073 | 48 |
| RM2 | 3.9583 | 1.77402 | 48 |
| RM3 | 4.2708 | 1.68522 | 48 |

Correlations

| | | RM | RM2 | RM3 |
|-----|---------------------|--------|--------|--------|
| RM1 | Pearson Correlation | 1 | .754** | .731** |
| | Sig. (2-tailed) | | .000 | .000 |
| | N | 48 | 48 | 48 |
| RM2 | Pearson Correlation | .754** | 1 | .751** |
| | Sig. (2-tailed) | .000 | | .000 |
| | N | 48 | 48 | 48 |
| RM3 | Pearson Correlation | .731** | .751** | 1 |
| | Sig. (2-tailed) | .000 | .000 | |
| | N | 48 | 48 | 48 |

** . Correlation is significant at the 0.01 level (2-tailed).

Strategic Benefits

Descriptive Statistics

| | Mean | Std. Deviation | N |
|-----|--------|----------------|----|
| SB1 | 6.2917 | 1.12908 | 48 |
| SB2 | 5.6458 | 1.65657 | 48 |
| SB3 | 5.4167 | 1.59565 | 48 |
| SB4 | 5.7917 | 1.41359 | 48 |
| SB5 | 6.2500 | 1.17600 | 48 |

Correlations

| | | SB1 | SB2 | SB3 | SB4 | SB5 |
|-----|---------------------|--------|--------|--------|--------|--------|
| SB1 | Pearson Correlation | 1 | .750** | .663** | .492** | .793** |
| | Sig. (2-tailed) | | .000 | .000 | .000 | .000 |
| | N | 48 | 48 | 48 | 48 | 48 |
| SB2 | Pearson Correlation | .750** | 1 | .677** | .295* | .592** |
| | Sig. (2-tailed) | .000 | | .000 | .042 | .000 |
| | N | 48 | 48 | 48 | 48 | 48 |
| SB3 | Pearson Correlation | .663** | .677** | 1 | .181 | .510** |
| | Sig. (2-tailed) | .000 | .000 | | .219 | .000 |
| | N | 48 | 48 | 48 | 48 | 48 |
| SB4 | Pearson Correlation | .492** | .295* | .181 | 1 | .595** |
| | Sig. (2-tailed) | .000 | .042 | .219 | | .000 |
| | N | 48 | 48 | 48 | 48 | 48 |
| SB5 | Pearson Correlation | .793** | .592** | .510** | .595** | 1 |
| | Sig. (2-tailed) | .000 | .000 | .000 | .000 | |
| | N | 48 | 48 | 48 | 48 | 48 |

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

Financial Benefits

Descriptive Statistics

| | Mean | Std. Deviation | N |
|-----|--------|----------------|----|
| FB1 | 5.4792 | 1.87922 | 48 |
| FB2 | 3.7292 | 1.81881 | 48 |
| FB3 | 5.6250 | 1.67109 | 48 |

Correlations

| | | FB1 | FB2 | FB3 |
|-----|---------------------|--------|-------|--------|
| FB1 | Pearson Correlation | 1 | .356* | .736** |
| | Sig. (2-tailed) | | .013 | .000 |
| | N | 48 | 48 | 48 |
| FB2 | Pearson Correlation | .356* | 1 | .169 |
| | Sig. (2-tailed) | .013 | | .251 |
| | N | 48 | 48 | 48 |
| FB3 | Pearson Correlation | .736** | .169 | 1 |
| | Sig. (2-tailed) | .000 | .251 | |
| | N | 48 | 48 | 48 |

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Marketing Benefits

Descriptive Statistics

| | Mean | Std. Deviation | N |
|-----|--------|----------------|----|
| MB1 | 6.1250 | 1.33089 | 48 |
| MB2 | 6.2500 | 1.15777 | 48 |
| MB3 | 5.5000 | 1.68851 | 48 |
| MB4 | 6.2917 | 1.23699 | 48 |

Correlations

| | | MB1 | MB2 | MB3 | MB4 |
|-----|---------------------|--------|--------|--------|--------|
| MB1 | Pearson Correlation | 1 | .753** | .511** | .662** |
| | Sig. (2-tailed) | | .000 | .000 | .000 |
| | N | 48 | 48 | 48 | 48 |
| MB2 | Pearson Correlation | .753** | 1 | .686** | .706** |
| | Sig. (2-tailed) | .000 | | .000 | .000 |
| | N | 48 | 48 | 48 | 48 |
| MB3 | Pearson Correlation | .511** | .686** | 1 | .662** |
| | Sig. (2-tailed) | .000 | .000 | | .000 |
| | N | 48 | 48 | 48 | 48 |
| MB4 | Pearson Correlation | .662** | .706** | .662** | 1 |
| | Sig. (2-tailed) | .000 | .000 | .000 | |
| | N | 48 | 48 | 48 | 48 |

** . Correlation is significant at the 0.01 level (2-tailed).

Business Performance

Descriptive Statistics

| | Mean | Std. Deviation | N |
|-----|--------|----------------|----|
| BP1 | 6.1458 | 1.09135 | 48 |
| BP2 | 5.7083 | 1.47256 | 48 |
| BP3 | 5.6667 | 1.32622 | 48 |
| BP4 | 5.8333 | 1.11724 | 48 |

Correlations

| | | BP1 | BP2 | BP3 | BP4 |
|-----|---------------------|--------|--------|--------|--------|
| BP1 | Pearson Correlation | 1 | .504** | .534** | .771** |
| | Sig. (2-tailed) | | .000 | .000 | .000 |
| | N | 48 | 48 | 48 | 48 |
| BP2 | Pearson Correlation | .504** | 1 | .864** | .720** |
| | Sig. (2-tailed) | .000 | | .000 | .000 |
| | N | 48 | 48 | 48 | 48 |
| BP3 | Pearson Correlation | .534** | .864** | 1 | .823** |
| | Sig. (2-tailed) | .000 | .000 | | .000 |
| | N | 48 | 48 | 48 | 48 |
| BP4 | Pearson Correlation | .771** | .720** | .823** | 1 |
| | Sig. (2-tailed) | .000 | .000 | .000 | |
| | N | 48 | 48 | 48 | 48 |

** . Correlation is significant at the 0.01 level (2-tailed).