Combining and Prioritising Dynamic Capabilities for Servitization in Small and Medium-sized Enterprises

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Abstract

UK manufacturers are facing unprecedented challenges, so must find new ways of developing competitive advantage, enhancing productivity, and building resilience. One option is to transition from selling products and basic services towards advanced services, where value is captured not only from making and moving products, but also during use. This requires a fundamental transformation of capabilities, known as servitization.

Manufacturers find this transformation difficult, sometimes launching new services without first developing appropriate capabilities for effective and efficient delivery. This can lead to failure, which can have severe consequences for SMEs. Challenges are exacerbated for SMEs by limited resources, meaning they cannot develop all the required capabilities simultaneously and need to prioritise. The cause of servitization failure has been attributed to low levels of dynamic capabilities, however, these are usually analysed in isolation, with no explanation regarding their measurement, combination, or sequencing.

This research identifies four key dynamic capabilities required for servitization, which form the theoretical framework, namely: vision innovation; service innovation; product innovation and organisational innovation. Two separate, but related multiple case studies reveal that SMEs do not require high intensities in all these dynamic capabilities to begin servitization. Companies can take one of two pathways, requiring different combinations of high and low intensities of the four dynamic capabilities depending on context. However, as servitization progresses all four will be required, which should be developed and applied in a particular sequence.

To enable the findings to be applied in practice, two practical application tools are developed. Firstly, a framework for SME practitioners to assess their organisational readiness to begin servitization. Secondly, a framework for alignment of activities and resources during servitization, with deployment sequence. These new tools will accelerate the adoption of advanced services within SMEs and help them navigate economic, societal and environmental challenges.

Key Words: Servitization, advanced services, product-service systems, integrated solutions, dynamic capabilities, Small and Medium-sized Enterprises, SMEs.

About the Author

Paul Jackson is the Founder/ Managing Director of UV Light Technology Limited and a Senior Industrial Fellow at Aston Business School. He is a recent MBA and graduate of the Goldman Sachs 10,000 Small Businesses Programme. Also, Paul is an Ambassador for Be the Business and Chairman of the Small Business Partnership within the Advanced Services Group.

Awards

Servitization Live Business Award 2021 - Outstanding contribution to the development and adoption of servitization

Spring Servitization Conference - Best Paper Award 2018 - For the category 'The Most Insightful Emerging Research'

The TRAN-SIP Programme Special Recognition Award 2018 - Chairman of SME partnership

Qualifications

2016   **Graziadio Business School, Pepperdine University, Malibu, California -** MBA exchange programme

2015-16   **Aston Business School, Aston University, Birmingham -** MBA (Distinction)

2013-15   **Aston and Oxford University -** Goldman Sachs 10,000 Small Businesses

1981-85   **Aston University, Birmingham** B.Sc. Metallurgy and Materials Technology (2.1)

Peer Reviewed Conference Papers

Jackson, P., Beltagui, A. and Andrews, D., 2019. Readiness for Servitization Towards Advanced Services: An SME Dynamic Capabilities Perspective. In: *Spring Servitization Conference*, *Linköping, Sweden.*

Jackson, P. and Beltagui, A., 2018. Readiness for Servitization: An SME Dynamic Capabilities Perspective. Received award for 'The Most Insightful Emerging Research'. In: *Spring Servitization Conference*, *Copenhagen Business School, Denmark.*

Invited Presentations

Baines, T., **Jackson, P**., Ziaee Bigdeli, A., Naik, P. and Glover, R. 2020. Manufacturing Competitiveness in Digitally Enabled Advanced Services. In: *Annual Conference of the Decision Sciences Institute, Virtual Event.*

Jackson, P., Bourne, A., Spiers, W., Bruch, P. and Andrews, D., 2020. Leadership and Compelling Stories for Services. In: *World Servitization Convention*, *Virtual Event.*

Jackson, P., Bruns, C., Butti, S. and Cassidy, L., 2020. The Services Transformation Journey. In: *World Servitization Convention*, *Virtual Event.*

Jackson, P. and Andrews, D., 2020. Selling through Storytelling. In: *Sales Educators Academy, Virtual Event.*

Baines, T., **Jackson, P**., Moffat, O. and Townshend, R., 2019. UK future Competitiveness in Digitally Enabled Advanced Services. In: *British Academy of Management*, *Aston University, Birmingham, UK.*

Acknowledgments and Academic Journey

After a gap of thirty years, I returned to Aston University in 2015 to undertake a full time MBA. This was triggered by my participation in the Goldman Sachs 10,000 Small Businesses Programme the previous year, during which I recognised the value of applying academic models and frameworks in practice. Mark Hart and Paula Whitehouse, supported by their team, guided the cohort through an intensive series of interactive modules. This had an immediate impact on my business, UV Light Technology Limited, by identifying barriers to progress and key factors for growth. Ian Brookes, my first mentor after 26 years of owner/management of small businesses, encouraged me to delineate leadership from management, which led to my step back from an operational role in the business to pursue a parallel path in the academic world.

Around the same time, I met Tim Baines and Iain McKechnie, who introduced me to servitization and the benefits of advanced services. Their passion for helping manufacturers innovate their business models through servitization to improve productivity, resilience and competitive advantage was inspirational. I joined as a founder member on their business support programme run by the Advanced Services Group (ASG). The aim of this programme was to help small and medium sized product-centric businesses transform their organisations to compete through services-led strategies.

The MBA and ASG programmes built on the Goldman Sachs business growth plan, leading to the creation of a transformation roadmap for UV Light Technology Limited. This highlighted the design and provision of advanced services as a key success factor. I also took the opportunity of studying at Graziadio Business School, Pepperdine University in California during the Autumn of 2016. Exposure to American principles of entrepreneurship was transformational, coupled with the privilege to attend the sales and sales force management course run by Jim Salas. He had transitioned his career from practitioner to academic and encouraged me to pursue a DBA. I often reflected on his words of wisdom, "you will have moments of imposter syndrome and frustration, but don't worry, stick with it and put your trust in the process."

On returning to the UK, I enrolled on the DBA programme with the help of Chris Owen and support of George Feiger. Throughout the doctoral process, I have been fortunate to be an integral part of the Advanced Services Group and greatly appreciate everyone's support. This community is an exemplar of how academics and practitioners can work together for mutual benefits. Jill Forrest organises the Spring Servitization Conference each year and I had the privilege of presenting on two occasions. This provided the opportunity to receive invaluable feedback on my emerging research from leading scholars in the servitization field, for which I am indebted. A

special mention must go to Dan Andrews, who inspired my interest in the application of storytelling techniques, attended all my focus groups and was always happy to discuss ideas.

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I appreciate the contributions of Aston Business School, Aston University and UV Light Technology Limited towards the funding of this research. Finally, it would not have been possible without the incredible support of my team at UV Light Technology Limited, especially Judith Weir, and crucially at home, Lisa Daymond-King.

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Glossary

Advanced Services Group (ASG)

The Advanced Services Group is a centre of excellence based at Aston Business School, Aston University in the UK. The group provide education, training, and research, whilst bringing together a global network of like-minded professionals to help accelerate the adoption of advanced services and servitization within product-centric organisations.

Be the Business

Be the Business is an independent, not for profit organisation, with the single goal of helping business owners and leaders improve the performance of their organisations.

EBITDA

An acronym that stands for "earnings before interest, tax, depreciation and amortisation". It provides information about the profitability of a company's activities.

Goldman Sachs 10,000 Small Businesses Programme

The *10,000 Small Businesses* programme is designed to unlock the growth potential of small businesses and social enterprises across the UK, through greater access to business education, mentors, networks, and financial capital.

Productivity

Productivity, in simple terms, is a measure of the amount of output that a business produces per unit input. Understanding the level of productivity is key to understanding business performance. This directly impacts on individual businesses, whilst also affecting the health and prosperity of a nation.

Small Business Partnership (ASG)

A cohort of small businesses who have completed or undertaking a programme with ASG aimed at accelerating the awareness and adoption of advanced services

SME

Small and Medium-sized Enterprises are defined as all business with between 0 and 249 employees. These firms account for approximately half of UK national output and create almost 60% of jobs.

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Chapter 1

Introduction

The UK is the birthplace of the industrial revolution and home to world leading industrial sectors, such as aerospace and defence. However, globalisation has lowered barriers to competition and manufacturers are facing unprecedented challenges. It is imperative they find new ways to develop competitive advantage, enhance productivity and build resilience (Baines and Lightfoot, 2013; Kowalkowski and Ulaga, 2017). One option is to transition from selling products and basic services towards advanced services, where value is captured not only from making and moving products, but also during their use (Baines and Lightfoot, 2014; Rabetino et al.,2018). This requires a fundamental transformation of capabilities, known as servitization (Baines et al.,2020).

Servitization challenges conventional thinking of manufacturers and requires dynamic capabilities (Fischer et al., 2010). Dynamic capabilities represent the capacity of an organisation to sustain competitive advantage by purposefully creating, extending, or modifying their resources and activities to build new capabilities in response to changing customer needs or market trends (Helfat, Finkelstein and Mitchell, 2010). However, Kindström, Kowalkowski and Sandberg (2013) caution that a major challenge associated with servitization is managing the essential dynamic capabilities of sensing, seizing and reconfiguring, at both strategic and operational levels.

UV Light Technology Limited (UVL) is an example of a Small and Medium-sized Enterprise (SME) with ambitions to differentiate through advanced services for increasing productivity and building resilience (section 2.5). The company has steadily adapted their capabilities over several years to successfully deliver a wide range of intermediate level services (section 3.1.3). However, the design and provision of advanced services will require a much more complex organisational transformation to build the necessary capabilities (Baines et al., 2020). This could be a risky strategy because fundamentally different capabilities are required, and managers need to understand which ones are key to success and how they should be prioritised.

1.1   Motivation for Research

The motivation for the research is to accelerate the adoption of advanced services within SMEs, in particular UV Light Technology Limited. The reasons behind the motivation for the research is covered in chapter 2. The aim is to contribute to knowledge in the domain of capabilities required for servitization. Application of this new knowledge in practice will enable SMEs to benchmark their capabilities in relation to those required for servitization, then prioritise their development and application. The research has taken on even greater importance in the wake of the Covid-19 pandemic, as companies look to build resilience by innovating their business models to mitigate risks of future disruption. This led to formulation of the research topic.

1.2 Formulation of Research Topic

Some servitizing manufacturers only partially transform and launch new services without first developing all the capabilities for their effective and efficient delivery (Kindström and Kowalkowski, 2014), often resulting in failure (Lutjen, Tietze and Schultz, 2017). Consequences of failure can be severe, particularly for Small and Medium-sized Enterprises (Neely, 2008; Benedettini, Swink and Neely, 2017). The cause of failing to sufficiently transform has been attributed to low levels of appropriate dynamic capabilities (Gebauer, Haldimann and Saul, 2017; Kindström, Kowalkowski and Sandberg, 2013), which prevents effective service innovation (Morelli, 2006); business model change (Kindström and Kowalkowski, 2014) or replicating for scale (Coreynen, Matthyssens and Van Bockhaven, 2017). However, literature is not clear on which dynamic capabilities are required, or the levels required and how they should be measured.

To assess and measure the levels of dynamic capabilities required for servitization, this research introduces the concept of intensity (section 3.3.3). Intensity is an important scientific concept, used to quantify for example, the strength of UV light required to produce a desired outcome. In the context of this research, intensity refers to the strength of dynamic capabilities required for servitization and differentiates from the descriptive, typographical levels proposed by Ambrosini, Bowman and Collier (2009).

In addition to which dynamic capabilities are required, and their intensity, Gebauer (2008) argues that it is not just about individual capabilities, but how they are combined which is often crucial. Also, interdependencies between capabilities can enable or inhibit a desired outcome (Black and Boal, 1994; Parida and Örtqvist, 2015). This illustrates the importance of resource orchestration (Sirmon et al., 2011), which argues that the strategic choices made by managers on alignment of resources and activities for development and application of capabilities, is at least as important as possession of resources. Despite the importance of how capabilities are combined, qualitative studies usually analyse capabilities in isolation (Sjödin, Parida and Kohtamäki, 2016), which implies all capabilities are equally important and fails to link strategic choices. Similarly, quantitative research commonly applies statistical methods that do not fully account for the combinational nature of capabilities (Eggert et al., 2014; Antioco et al., 2008). There are a few notable exceptions (Sjödin, Parida and Kohtamäki, 2016; Böhm, Eggert and Thiesbrummel, 2017), however, very little consideration has been given to which combinations of capabilities affect success or failure of servitization. A lack of configurational servitization research is noted by Forkmann et al. (2017), who calls for more research to better understand the interplay between factors driving successful servitization.

Research on capabilities for servitization largely draws on case studies of large multi-national organisations (Fliess and Lexutt, 2017). Although these studies are valuable, SMEs are not simply smaller version of larger companies (Möller et al., 2006) and have limited capacity for innovation. This means they cannot simultaneously develop all the capabilities required and will need to prioritise which capabilities to develop and apply (Böhm, Eggert and Thiesbrummel, 2017). How capabilities should be sequenced during servitization is therefore important.

Four strategic dynamic capabilities associated with servitization (section 3.2), along with twenty operational capabilities for their development and application (section 3.3.2) are identified from the literature. However, literature is unclear on how dynamic capabilities should be measured or the intensity required (section 3.4.1), along with how they should be combined (3.4.2), and sequenced (section 3.4.3) for servitization success, particularly in relation to SMEs. This led to three research questions:

Research Question 1 (section 3.4.1) - Do product-centric SMEs require high intensities in all four strategic dynamic capabilities to begin servitization?

Research Question 2 (section 3.4.2) - Which combinations of high and low intensities of the four strategic dynamic capabilities enable product-centric SMEs to begin servitization?

Research Question 3 (section 3.4.3) - How should product-centric SMEs sequence their development and application of the four strategic dynamic capabilities during early stage servitization?

The next section provides an overview of how the research design establishes a set of principles which shape a research programme to answer the three research questions.

1.3 Overview of the Research Programme

To answer the research questions a systematic research design is developed (section 4.2), involving a series of choices on: philosophy (section 4.2.1); approach to theory development (section 4.2.2); methodology (section 4.2.3); strategy (section 4.2.4); time horizon (section 4.2.5); methods and techniques (section 4.2.6). This establishes a set of principles (figure 18) on which to base the research programme (section 4.3), leading to the work been carried out in two phases for collection and analysis of data with both breadth and depth. It comprises of two separate, but related multiple case studies.

Phase 1 is a cross sectional study for generation of a broad data set (chapter 5) to determine the intensity (chapter 6) and combinations (chapter 7) of capabilities required by SMEs to begin servitization. It analyses 36 SMEs exploring servitization, some of whom began to servitize, whilst others failed to progress. A theoretical framework based on the four strategic dynamic capabilities and their operational dynamic capabilities previously identified from literature, is elaborated from empirical data to identify their indicators and a scoring criteria. This creates a data analysis instrument for assessing the intensity of the four strategic dynamic capabilities possessed by each company to answer research question 1. A subsequent qualitative comparative analysis (QCA) examines which combinations of high or low intensities of the four strategic dynamic capabilities enable the case companies to begin servitization and answers research question 2.

Phase 2 is a longitudinal study comprising of 6 SMEs from phase 1 who began to servitize. Participants attend a series of focus groups over a period of 12 months. This generates in depth data to determine how the sequence in which capabilities are applied during the initial stages of servitization enables or inhibits progress and answers research question 3. Generation of rich data from privileged access to the case companies, used in combination with specialist research methods for conducting analysis (QCA and storytelling), culminates in findings which make significant contributions to both theory and practice. These contributions are summarised in the next section.

1.4   Summary of Research Contributions

The research identifies and defines the concepts of vision innovation, service innovation, product innovation and organisational innovation as core elements of a new theoretical perspective. This is based on the notion that servitization is facilitated by the intensity, combination, and sequencing of these four core elements. They are categorised as strategic dynamic capabilities, explaining that during servitization a company will sense opportunities for advanced services (vision innovation), then seize these opportunities (service innovation and product innovation) and reconfigure their capabilities as required (organisational innovation).

The principal theoretical contribution of this study specifies relationships between the core elements and causal mechanisms during servitization. In doing so, this extends the literature from its prior focus on examining capabilities in isolation. It shows that product-centric SMEs do not require high intensities in all four to begin servitization and can take one of two pathways, requiring different combinations of high and low intensities depending on context. However, all four strategic dynamic capabilities will eventually be required, and a particular sequence of development and application is identified which leads to success.

To enable the theoretical contributions to be applied in practice, the theoretical framework used throughout the research is translated into practical application tools. Firstly, a framework for SME practitioners to assess their organisational readiness to begin servitization (figure 10.4), and secondly, a framework for planning the alignment of activities and resources during servitization, with deployment sequence (figure 10.5). These new tools will accelerate the adoption of advanced services within SMEs by helping them navigate economic, societal and environmental challenges.

The practical application frameworks and the process of their development during the research has had an immediate impact on the adoption of advanced services by UV Light Technology Limited. At the start of the research programme, 25% of the company's annual revenue was derived from base and intermediate services, with the rest coming from product sales. During 2020, the first advanced service was successfully piloted and is now been replicated for scale. The latest quarterly figures reveal that for the first time in the company's 24 year history, 50% of revenue was generated from services. This has significantly increased productivity and is building resilience. Dissemination of this new knowledge will help other SMEs seeking to exploit the opportunities of servitization and policy makers to target their interventions to optimise impact. It will therefore contribute to accelerating the successful adoption of advanced services amongst product-centric SMEs, which ultimately is good for business, society and the environment. The next section provides an overview of the thesis, and each chapter is previewed below.

1.5 Thesis Structure

Chapter 2 - Industrial Context … Describes how four external macro-factors: economic; environmental; technological; and societal are driving interest in advanced services. This illustrates the relevance and value of advanced services and provides the background behind the motivation for the research.

Chapter 3 - Literature Review … Four key strategic dynamic capabilities for servitization and the operational capabilities required for their development and application are identified from literature to form a theoretical framework. However, questions remain concerning how these capabilities should be measured, or the strength required, along with how they should be combined, and sequenced for servitization success, particularly in relation to SMEs. This led to the development of the research questions.

Chapter 4 - Development of Research Programme … To answer the research questions the research design establishes a set of principles based on choices of philosophy, approach to theory development, methodology, strategy, methods and techniques for data collection and

analysis. These principles shape a two-phase research programme, which is based on multiple case studies to generate data with both breadth and depth.

Chapter 5 - Design and Execution of Multiple Case Studies - Phase 1 … Explains how cross-sectional data is generated by following a process for design and execution of multiple case studies adapted from a section of Eisenhardt's (1989) protocol for case study research. It comprises of a series of activities conducted in four stages, which are: design of case studies (section 5.1); selection of cases (section 5.2); data collection method (section 5.3) and measures to ensure rigour in data collection (section 5.4). This process culminates in a data set for subsequent analysis in chapters 6 and 7 to answer research questions 1 and 2.

Chapter 6 - Data Analysis and Findings - Intensity of Strategic Dynamic Capabilities Required to Begin Servitization … The theoretical framework developed from literature is elaborated using empirical data to identify indicators and scoring criteria for five operational capabilities for each of the four strategic dynamic capabilities. This creates a data analysis instrument, which is used to measure the operational capabilities of each company to assess the intensity of the four key strategic dynamic capabilities (section 3.2). Findings show that high intensity in all four strategic dynamic capabilities is not required to begin servitization. This prepares the ground for applying qualitative comparative analysis to determine which combinations of high and low intensities of the four strategic dynamic capabilities lead to servitization, or failure to progress beyond initial exploration.

Chapter 7 - Data Analysis and Findings - Combinations of Strategic Dynamic Capabilities Required to Begin Servitization … The qualitative comparative analysis determines two combinations of strategic dynamic capabilities which are sufficient to begin servitization by moving on to the engagement stage. These represent a company-led pathway and a customer-led pathway.

Chapter 8 - Design and Execution of Multiple Case Studies - Phase 2 … A longitudinal study of 6 SMEs who progressed to the engagement stage of servitization in phase 1. This generates in-depth data during their development and application of the four strategic dynamic capabilities for servitization. It follows a process for design and execution of multiple case studies adapted from a section of Eisenhardt's (1989) protocol for case study research.   It comprises of a series of activities conducted in four stages, which are: design of case studies (section 8.1); selection of cases (section 8.2); data collection method (section 8.3) and measures to ensure rigour in data collection (section 8.4).   This process culminates in a rich data set for subsequent analysis in chapter 9 to answer research questions 3.

Chapter 9 - Data Analysis and Findings - Sequence of Strategic Dynamic Capabilities Required During Servitization … Examines how the sequence in which the four strategic dynamic capabilities are developed and applied during the engagement stage of servitization enables or inhibits progress. This leads to the identification of a sequence leading to success and provides the answer to research question 3.

Chapter 10 - Discussion … Critical reflections on the answers to each of the research questions and their connection with relevant literature supports the move forward to research propositions. Finally, the set of research propositions are evaluated, along with two frameworks for their application in practice.

Chapter 11 - Conclusions … Describes the principal contributions of the research to theory and how these are translated into practical application frameworks for use by SME practitioners. In particular, the immediate value of the research to UV Light Technology Limited is showcased. This highlights how the adoption of advanced services has significantly increased productivity and is building resilience. Finally, limitations of the research are discussed, along with opportunities for future work.

An overview of the thesis structure is provided in figure 1.1. This is depicted as a sequential research programme, however, it was in fact a concurrent and iterative process, which required each stage to be regularly revisited to reflect on emergent ideas, inspiring numerous revisions.

Chapter 1 – Introduction
- Motivation for research
- Formulation of research topic
- Research overview and summary of contributions

Chapter 2 – Industrial Context
- Global perspectives
- UK national priorities
- Midlands region
- Small and Medium-sized Enterprises (SMEs)
- UV Light Technology Limited

Chapter 3 – Literature Review
- Servitization
- 4 key capabilities for servitization are identified
- Theoretical framework for research
- Boundaries of knowledge leading to research questions

Chapter 4 – Development of Research Programme
- Aim and research questions
- Research design
- Research programme

Chapter 5 – Design and Execution of Multiple Case Studies (Phase 1)
- Design of case studies, selection of cases, data collection method
- Measures taken to ensure rigour
- Data set

Chapter 6 – Data Analysis and Findings - Intensity of Capabilities
- Development of data analysis instrument
- Determining the intensity of 4 strategic dynamic capabilities to begin servitization
- Intensity of 4 strategic dynamic capabilities to begin servitization

Chapter 7 – Data Analysis and Findings - Combinations of Capabilities
- Qualitative Comparative Analysis
- Analysis of necessary conditions
- Analysis of sufficient conditions
- Combinations of 4 strategic dynamic capabilities to begin servitization

Chapter 8 – Design and Execution of Multiple Case Studies (Phase 2)
- Design of case studies, Selection of cases, data collection method
- Measures taken to ensure rigour
- Data set

Chapter 9 – Data Analysis and Findings - Sequences of Capabilities
- Within case analysis
- Cross case analysis
- Sequences of 4 strategic dynamic capabilities during servitization

Chapter 10 – Discussion
- Intensities of 4 strategic dynamic capabilities to begin servitization and RP1
- Combinations of 4 strategic dynamic capabilities to begin servitization and RP2
- Sequences of 4 strategic dynamic capabilities during servitization and RP3
- Evaluation of research propositions
- Development of practical application frameworks

Chapter 11 – Conclusions
- Contributions to theory
- Contributions to practice
- Limitations and future work

Figure 1.1 - Structure of the thesis

1.6 Summary

This chapter provides background information on the research topic, an overview of the research programme and a summary of contributions. It emphasises the important contributions to theory and how these can be applied in practice using practical application tools developed by translating the theoretical framework underpinning the research. These new tools will accelerate the adoption of advanced services within SMEs, and help them navigate economic, societal, and environmental challenges. This is evidenced by the immediate value to UV Light Technology Limited, highlighting how the accelerated adoption of advanced services significantly increased productivity and built resilience.

The next chapter explores the industrial context and the reasons behind the motivation for the research. It explores how four external macro-factors: economic; environmental; technological; and societal are driving interest in advanced services.

Chapter 2

Industrial Context

The previous chapter provided background information on the research topic, an overview of the research programme and a summary of contributions. It highlighted the important contributions to theory and how these can be applied in practice using practical application tools, developed by translating the theoretical framework underpinning the research. These new tools will accelerate the adoption of advanced services within SMEs by helping them navigate economic, environmental and societal challenges.

This chapter explores the industrial context and the background behind the motivation for the research. It examines how four external macro-factors: economic; environmental; technological; and societal are driving interest in advanced services. These factors are discussed in turn, first at global level, then from the perspective of UK national priorities, before considering the implications at regional level, with a focus on the Midlands. This provides the bigger picture, before drilling down further to examine the opportunities and benefits for Small and Medium-sized Enterprises (SMEs), in particular UV Light Technology Limited.

2.1 Global Perspective

Globally, four macro-factors are favouring the emergence and growth of advanced services, these are: economic; environmental; technological and societal. Each are discussed in turn within the international context.

Economic

High value products and services represent more than 20% of the European Union's total value added, providing approximately 35 million jobs (European Commission, 2021). However, manufacturers compete on a global stage, often in saturated and commoditised markets, with eroding profit margins for products. Asian Pacific companies are growing rapidly, offering not only attractive prices, but also quality and new technology. Therefore, European companies need to find new ways to differentiate for competitive advantage (McKinsey and Company, 2017). This is driving ambitions for services-led strategies to either protect existing business and customers or diversify into new areas offering greater volumes and bigger margins. The emphasis is on improving productivity, which not only impacts individual businesses, but also affects the health of a region and prosperity of a nation.

Now, in the wake of Covid-19, there are additional priorities during economic recovery. High on the agenda is building future resilience to deal with future global supply chain disruption, heightening the debate on local versus global (Bohn, 2020). Also, the pandemic has forced society in general to focus more on the fragility of the planet. The World Economic Forum (2020) advocates that companies across all sectors need to radically innovate current business models.

These complex challenges highlight opportunities for businesses to reconfigure their business models through servitization, which can embrace climate neutrality and digitalization to drive differentiation.

Environmental

Climate change is accelerating, as evidenced by recent events, such as widespread flooding in Europe and China, record temperatures in North America and forest fires around the world. These events have focussed minds on global warming and the collective action taken during this decade to reduce carbon dioxide levels will be crucial (Sun Institute, 2021). Society needs to reduce carbon dioxide emissions by 45% compared to 2010 levels by 2030 and reach net zero by 2050. This is considered essential for limiting global warming to 1.5 degrees centigrade in accordance with the Paris Agreement (EC 2030 Climate Target Plan, The White House, 2021). The manufacturing sector is a substantial driver of European emissions and material usage. Therefore, manufacturers urgently need to decarbonise and dematerialise to reach climate goals. However, existing policies provide little guidance on specific steps or mechanisms to support the necessary transition.

Advanced services represent a specific mechanism which can help companies to navigate the transforming industry landscape, whilst optimising economic value and minimising environmental impact. Advanced service business models can be circular in nature, differing from the traditional linear business models of production, consumption, and discard. They incentivise organisations to deliver outcomes, whilst using less materials and energy. Manufacturers take back their products at end of contract, often for recycling and refurbishment, which is conducive to dematerialisation. Contractual obligations mean that manufacturers should ensure optimum performance of their products, for as long as possible and at lower costs. This reduces consumption of resources and encourages less waste, providing a good fit with the principles of resource-efficient circular economy models and their synergies with carbon neutrality (Ellen MacArthur Foundation, 2015). It is estimated that circular systems and processes can lead to carbon savings of up to 45% (Ellen MacArthur Foundation, 2021). Critical enablers of circular advanced service business models are digitalisation and Industry 4.0 to transform operations.

Technological

New digitally enabled business models will change the way we produce and consume, by creating a circular economy to help reduce emissions, resource consumption and waste (Tukker, 2015). During the Covid-19 pandemic, the adoption of digital technologies has accelerated by up to seven years on previous forecasts. This is enabling companies to re-think their strategy, value chains, operations and customer engagement (McKinsey and Company, 2021). Digitalisation represents the catalyst for servitization towards circular business models, where companies can

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charge customers based on actual usage or product performance. It can be achieved for example by data analytics and machine learning, which predict and pre-empt failure. This contributes to improved performance, reduced emissions and less material waste (Antikainen, Uusitalo and Kivikytö-Reponen, 2018). These are key tools to build platforms for effective and efficient delivery of services, which increase product utilisation, whilst reducing overall resource consumption. This demonstrates return on investment by providing greater transparency on price and experience, which in turn drives customer expectations.

Societal

The Covid-19 global pandemic highlights the crucial role of technology for remote condition monitoring, prognostic support, and fixes. Companies are re-evaluating their priorities and society is more open minded to a paradigm shift towards an outcome-based economy, enabled by digital technology. Although the near term will be fraught with ambiguity and challenges, unpacking and re-framing opportunities will be key to economic recovery. Advanced services offer a response to the changing face of societal expectations and attitudes, enhancing their future relevance, along with associated value.

Advanced service business models encompass social benefits, since they democratise access to high quality products, strengthen regional employment and can even enhance health. Consumption is democratised by removing prohibitive upfront capital investments. Instead, costs are spread over the product life cycle and funded from operational budgets (Ellen MacArthur Foundation, 2015). Indeed, many procurement managers now view ownership of a product as a liability and prefer to focus on their organisational core competencies. This is a trend which is mirrored across society, where convenience, reliability and transparency are valued more than assets.

Advanced services require on-site work. To avoid emissions and save costs, field service teams along with support facilities are typically local. Repair or refurbishment activities are labour intensive and therefore contribute to regional employment (Circular Economy Initiative Deutschland, 2020). It is estimated that manufacturers implementing advanced services could create approximately 2 million new jobs across Europe by 2030 (Green Growth and Circular Economy, 2021). In addition, the International Resources Panel (2019) has shown that reducing environmental pressures through resource conservation has direct links to human health.

However, despite these four macro-factors combining to support the growth of advanced services, and many manufacturers recognising the compelling arguments for servitization, take up remains painfully slow. Service innovation still receives far less attention than product innovation, often focussing on internal processes for productivity improvement. It is usually evolutionary,

incremental and exploratory (Baines and Ziaee Bigdeli, 2020). Therefore, manufacturers seeking to adopt servitization strategies will need to raise the bar for service innovation within their organisations. This will depend critically on reconfiguring resources, such as people and processes to build the required capabilities (Neu and Brown, 2005). Development of these socio-technical service systems represent a complex and challenging change process, which will benefit from policy maker support at both national and regional levels.

2.2   UK National Priorities

Globally, four macro-factors are favouring the emergence and growth of advanced services, these are: economic; environmental; technological and societal. Each are discussed in turn within the context of UK national priorities.

Economic

The manufacturing sector contributes £192 billion to UK Gross Domestic Product (GDP), representing 47% of exports and 66% of research and development investment. Crucially, it employed around 2.7m people during 2019-20 and will play a major role in driving the post Covid economic recovery. Although essential, manufacturing has been declining in the UK for some time, largely due to production activities migrating from western to eastern economies offering the advantage of lower costs. This is reflected by the UKs current global ranking of 9th largest manufacturing output, which is down from 6th in 2008.

Over the last 20 years (figure 2.1) the proportion of UK GDP generated from manufacturing and selling products has contracted, a trend which is replicated in every developed economy across the world (World Bank open data).
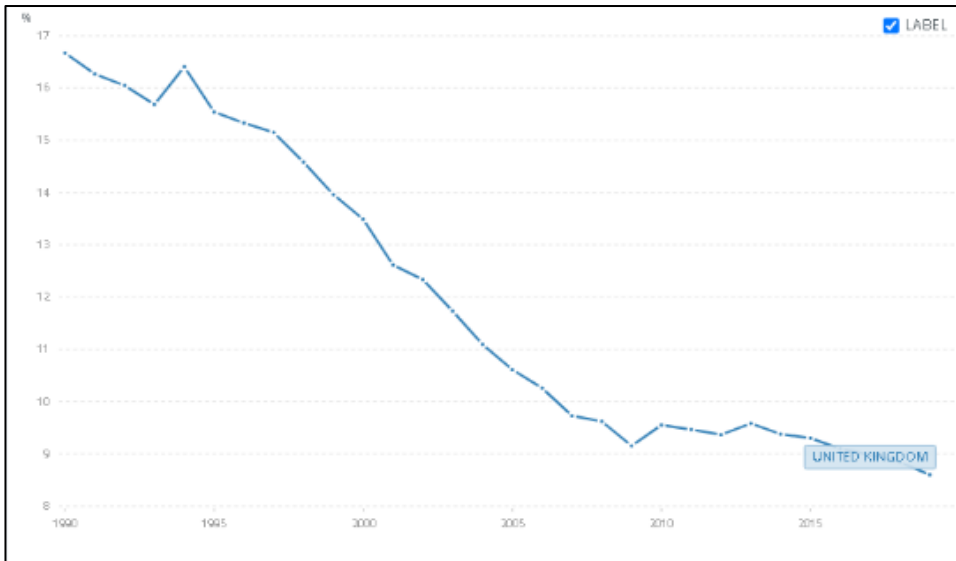
Figure 2.1 - Value added by UK manufacturing as a percentage of GDP between 1990 and 2019 (World Bank open data)

By comparison, the proportion of UK GDP generated from services has grown by 30% over the last 20 years (figure 2.2). The UK economy is now predominantly services-based, representing 80% of GDP.
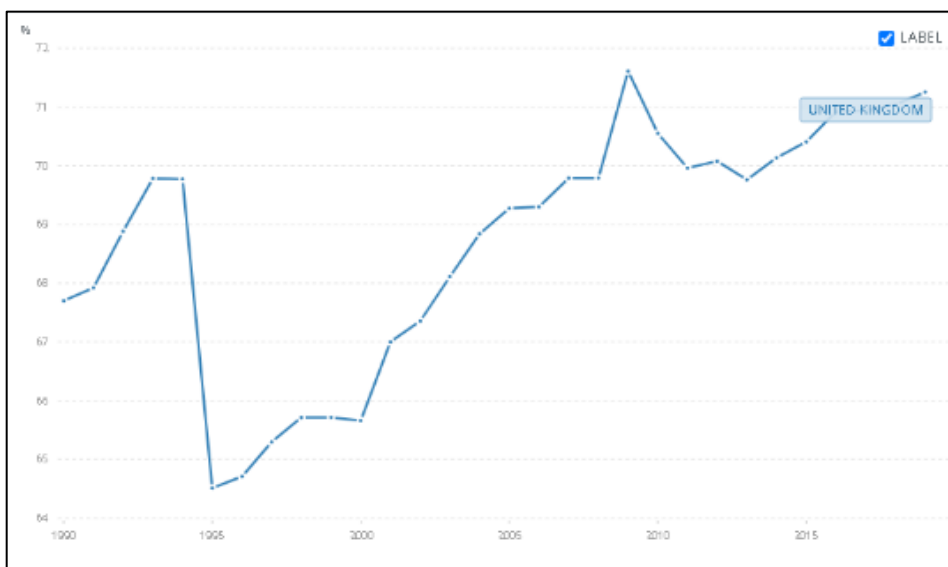
Figure 2.2 - Value added by UK services as a percentage of GDP between 1990 and 2019 (World Bank open data)

UK industrial strategy has attempted to address this issue by predominantly focussing on interventions to help companies improve their productivity. Emphasis has been placed on incentives to accelerate the adoption of lean techniques for reducing costs, whilst improving quality and speed by embracing new technology. Yet, despite considerable attention, UK

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productivity still lags other G8 economies and is now around a fifth lower than Germany, France and the US (BEIS, 2021).

Understanding and increasing the level of productivity within UK businesses is key to the nation's health and prosperity. Increased productivity enables a business to produce more products and offer greater services. This in turn, can support higher wages, hold back inflation and increase tax revenues, enabling greater spending on public services. During 2021, the UK has seen rising inflation, excessive wage demands and increased costs of living. This has pushed productivity improvements back to the top of the economic policy agenda, however, persistently low UK productivity levels demonstrate the need for new ways of addressing this problem. Improving the efficiency of inputs (e.g., time and costs) is important, but focus on enhancing outputs by increasing customer value created is more likely to accelerate productivity improvements (Advanced Services Group, 2019).

Environmental

The UK has set a world leading net zero target of ending contributions to greenhouse gas emissions by 2050. In 2008, the UK pledged to reduce greenhouse gas emissions by 80% against 1990 levels before 2050, setting carbon budgets and establishing the Committee on Climate Change. In 2019, the UK became the first nation to make net zero by 2050 a legally binding commitment. However, this target is unlikely to be reached (Committee on Climate Change, 2019) and the response of UK industry has been slow in comparison to other leading world economies (Institute of Engineering and Technology, 2017). Recently, the Industrial Decarbonisation Strategy (HM Government, 2021) advocated accelerating the transition towards a circular economy model and increasing reuse, repair and re-manufacturing of products.

Technological

Innovation of low carbon technologies is essential to meet the carbon net zero target and represents the predominant focus of UK Innovation Strategy (BEIS, 2021). This will be followed by further strategy documents on artificial intelligence and digital, which can be expected to advocate their use to help facilitate the transition towards a circular economy model through servitization.

Societal

Advanced services require local facilities and personnel to provide efficient and effective on-site service. Repair or refurbishment activities are labour intensive and therefore contribute to regional employment (Circular Economy Initiative Deutschland, 2020) and the Government's levelling up agenda. It was highlighted earlier (section 2.1) that implementing advanced services could create approximately 2 million new jobs across Europe by 2030 (Green Growth and Circular

Economy, 2021). In addition, the International Resources Panel (2019) has shown that reducing environmental pressures through resource conservation has direct links to improved human health.

2.3   Midlands Region

The Midlands region, once the engine room of the 19th century industrial revolution, is home to many well known brands, both large multi-nationals, such as Jaguar Land Rover and small family businesses, who export their products and services worldwide.   It is the UK's most active advanced engineering and manufacturing region, accounting for 14% of the country's advanced engineering work force. The region boasts twice the national average of manufacturing businesses and outstrips most of the UK for Gross Value Added (GVA), demonstrating the ability to transform alongside evolving technology and market trends. This is evident by a proliferation of new electronic and digital technology businesses, which have replaced the decimated heavy engineering sector across the West Midlands.

The Midlands region is well aligned with international and national policies through regional policies. A good example is The West Midlands Combined Authority pledge to make the region carbon net zero by 2041.   The aim is for region to become the UK's green industrial revolution hub and a pioneer in remanufacturing and industrial symbiosis. It is already home to circular economy research centres (e.g., Aston University), enabling networks (e.g. ASG, WM5G), early adopters (e.g. Rolls Royce and Koolmill Limited) and demonstrators (e.g. National Brownfield Institute).   The policy to Repower the Black Country, developed by the Local Enterprise Partnership is another good example. This sets out an ambitious plan to deliver the world's first zero carbon industrial cluster, enabling clean GVA growth of £16 billion by 2030, whilst creating or safeguarding at least 20,000 jobs. The West Midlands is well positioned regarding 5G, having led the way to accelerate deployment in the UK.   This connectivity will help to enable the innovations necessary to meet the ambitions of the region.

2.4   Small and Medium-sized Enterprises (SMEs)

The benefits and opportunities of advanced services are now beginning to cascade down tiers of the value chain to reach SMEs. A good example is AE Aerospace Limited (Baines et al., 2019), a leading high precision component manufacturer. The company was the first SME in the UK to deploy a private 5G network (Business and Innovation Magazine, 2021). This enabled the implementation of their advanced service, known as Machine Time Servitization. It involves data collection and analysis across CNC machines to understand utilisation and production flow. The

aim is to sell machine time by the hour, which is directly allocated by customers. This is a good example of embracing digital technology to enable business model innovation.

AE Aerospace represents an exemplar of the bustling entrepreneurial spirit amongst SMEs in the Midlands, which continues to underpin the regions enviable heritage of resilience and innovation. These are vital ingredients required for exploration and subsequent implementation of new business models such as advanced services, which offer new ways to create, delivery and capture value. This is essential for many of the regions SMEs to reduce reliance on narrow supply chains, such as automotive diesel engine technology, now seeing rapid decline due to factors such as electric vehicle technology and society's changing views on mobility. An example of another West Midlands based SME innovating their business model towards advanced services is UV Light Technology Limited.

2.5   UV Light Technology Limited

UV Light Technology Limited (UVL) is an ambitious and innovative company, founded by the author in 1997. It began life as a distributor for a German organisation, but quickly moved on to begin developing and manufacturing its own range of ultra-violet light equipment for industrial and medical applications. During the first 10 years, the business achieved several periods of high growth, comparing favourably with 250,000 other start-ups during the same period and positioning the company in the top 1% (Anyadike-Danes et al., 2009). High growth is defined in this case by increasing sales revenue greater than 20% for three consecutive years.

However, sustaining growth proved elusive, which has since been attributed to difficulties in building customer life-time value and establishing regular recurring income streams. Competitive strategy was built on the sale of best-in-class products, with only a relatively small percentage of revenue generated from repairs and spare parts. The company's lack of recurring income and subsequent reliance on constantly winning new customers was severely exposed by the global financial crisis in 2008. This was devasting for the business and resulted in annual revenue plummeting by 50%. Also, around this time, competitors offering disruptive LED technology from lower cost economies were starting to commoditize a previously specialist and niche market for the company's High Intensity Discharge Lamp technology. This represented a crucial tipping point, and the company needed to find solutions or risk going out of business.

In response to similar situations, other manufacturers have invested in becoming leaner and more flexible to remain competitive by improving their productivity, quality, and speed. This was considered important, but it was also recognised that benchmarking and outsourcing means that best practices can be emulated, resulting in all companies competing within a particular sector

adopting similar activities. This rapid diffusion of best practice often leads to frustration, where operational improvements fail to translate into sustainable profitability. UVL was already fully committed to product quality and performance, which was seen as an order qualifier rather than order winner (Hill, 2000). Operational efficiencies were therefore recognised as necessary, but not sufficient to significantly improve productivity, or provide long term competitive advantage. The world was becoming more and more efficient and cutting costs and optimising processes would only take the company so far.

UVL wanted to go beyond operational effectiveness to improve productivity and differentiate from competitors.   This created an imperative to find new ways of creating value for customers, by performing different activities than competitors. The company chose to do this by transitioning towards a more services-led strategy. They have steadily adapted their capabilities to enable the design and provision of intermediate level services. This led to the development of the company's trademark OptiMinUV®. It stands for optimising the customers process, whilst minimising their risks, which is achieved by guaranteeing product performance and safety compliance.   This provides a competitive advantage which sets the company apart from its competitors, as shown in figure 2.3.
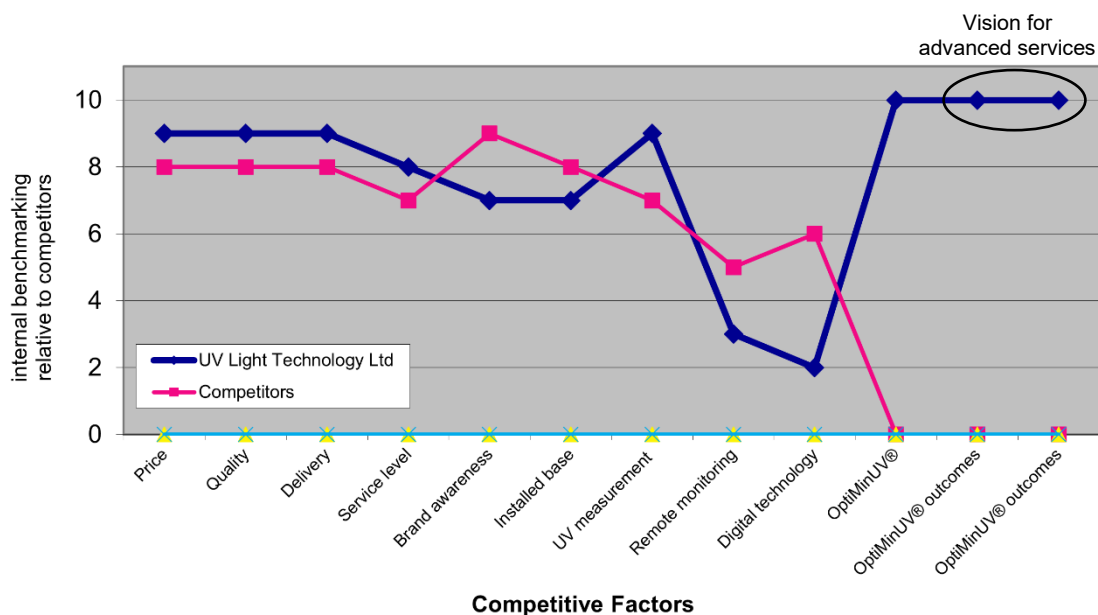
Figure 2.3 - UV Light Technology Limited - competitive factors benchmarked against competitors. Adapted from Kim and Mauborgne (2015)

Encouraged by the positive impact on the business, managers have a vision to develop advanced services by further servitization, which is also shown in figure 2.3 and represented by the arrow in figure 2.4. However, this will require a more complex organisational transformation (Baines et al., 2020), involving significant business model innovation and risk to compete through outcomes delivered by their products (Baines and Lightfoot, 2014; Rabetino et al., 2018). The idea is that provision of advanced services will address customer pains during use of a product. Customer

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pains identified are performance validation and process control, whilst also ensuring regulatory safety compliance. An advanced service to address these needs would go beyond the current OptiMinUV® strategy and be known as OptiMinUV® Outcomes, aimed at building trust and long-term loyalty.
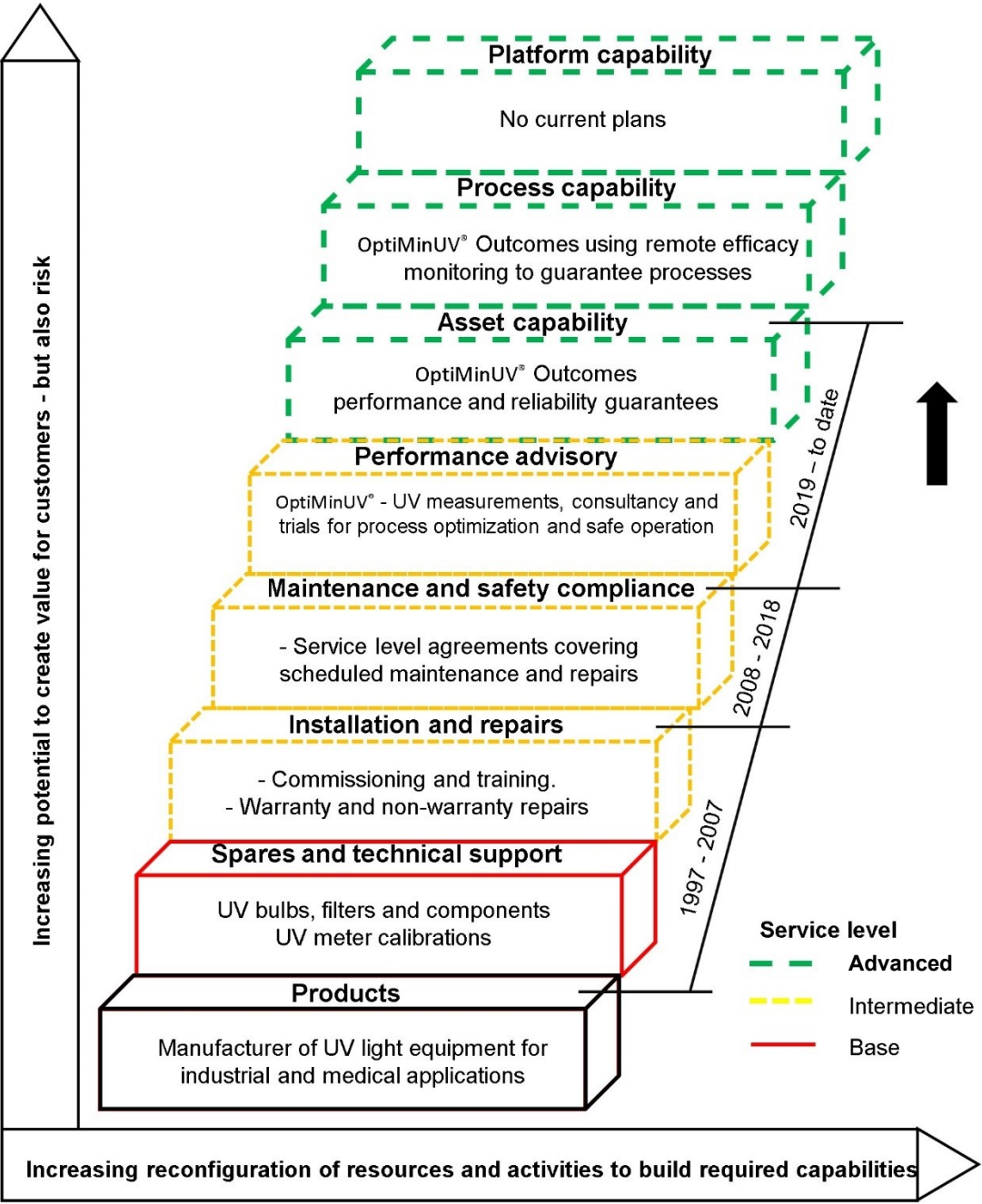
Figure 2.4 - Service Level Staircase for UV Light Technology Limited. Adapted from Baines et al., (2019)

2.6 Summary

This chapter explains how four external macro-factors: economic; environmental; technological and societal are combining to create an environment which is driving interest in advanced services. These factors are discussed firstly at global level, secondly, from the perspective of UK national priorities and thirdly, their implications within the Midlands region. The market dynamics created by the combination of the four macro-factors demonstrate that advanced services are high in future relevance and value. This offers reassurance that UV Light Technology Limited's ambitions for advanced services align well with both the latest industrial thinking, the desires of potential customers and environmental policies. In summary, this chapter clearly demonstrates that advanced services are not only good for business, but also good for the environment and good for society.

The next chapter reviews the state of the art in the servitization literature to first understand the principles and definitions of servitization, before exploring which capabilities are required for the design and provision of advanced services.

Chapter 3

Literature Review

The previous chapter explained how four external macro-factors: economic; environmental; technological and societal are combining to create an environment which is driving interest in advanced services. It explained how the market dynamics created by the combination of these factors, demonstrate that advanced services are high in future relevance and value. This highlights the changing face of business and provides compelling reasons for manufacturers to servitize. However, servitization can be a risky strategy due to the need for fundamental changes in capabilities, which does not come naturally to most manufacturers.

This chapter seeks to understand which capabilities are required for servitization towards advanced services, by thematically reviewing the literature in a four-step process. The first step (section 3.1) reviews the extant knowledge on servitization across four major research streams, namely: general management; marketing; operations and service management. This establishes the key definitions, assumptions, and constructs. The second step draws together knowledge to identify four key capabilities for servitization, namely: vision innovation; service innovation; product innovation and organisational innovation (section 3.2). The third step (section 3.3) views these capabilities through the lens of dynamic capability theory. This defines them as strategic dynamic capabilities and then identifies the operational capabilities for their development and application, leading to the formation of a theoretical framework. The fourth and final step (section 3.4) drew together the insights from sections 3.1 to 3.3 to establish the boundaries of knowledge. This highlights that the extant literature is unclear on how the four strategic dynamic capabilities identified (section 3.3) should be measured or the strength required, along with how they should be combined and sequenced for servitization success.   The chapter concludes with three research questions to address these issues (figure 3.8).

3.1   Servitization

Since first appearing in the research literature (Vandermerwe and Rada, 1988), servitization has established solid conceptual foundations. Interest is accelerating amongst both academics and practitioners, demonstrated by the number of academic papers published each year, which has grown from single digits in 2007 to around forty five today (Raddats et al., 2019). Baines and Lightfoot (2013) identify five research communities who make valuable contributions to this knowledge base. These are provided in table 3.1, which summarises their main areas of interest and key contributions, illustrating the multi-disciplinary interest in the broad topic of servitization. The differing areas of interest within these research streams provides a rich diversity of insights, however, it has led to variances in vocabulary and constructs amongst scholars discussing the same topic. This can be confusing, and some examples are provided in the next section.

Research Community	Main areas of interest	Key contributions
Service marketing	Service-Dominant Logic, which considers products to be a distribution mechanism for services, where value is co-created during use through ecosystems.	Vargo and Lusch, 2004 Grönroos, 1994 Vandermerwe and Rada, 1998
Service management	Adaptations to resources and activities to enable a manufacturer to build capabilities for design and provision of services	Chase and Garvin, 1989 Neu and Brown, 2005 Ulaga and Reinartz, 2011
Service operations management	The servitization transformation process (also referred to as service infusion), during which organisations adapt their resources and activities to build the required capabilities for design and provision of services. Advanced services (also referred to as integrated solutions and hybrid offerings) which combine products and services are a key opportunity for manufacturers to build new revenue streams and greater profits.	Baines et al., 2009 Baines et al., 2020 Lutjen et al., 2019 Martinez et al., 2017 Wise and Baumgartner, 1999 Oliva and Kallenberg, 2003 Baines and Lightfoot, 2013 Parida et al., 2014
Product - service systems	Emphasise the potential of product - service systems to minimise environmental impacts of both production and consumption, with positive social implications through job creation. Established the classifications of Services Supporting Products (SSP) and Services Supporting Customers (SSC).	Tukker, 2004 Mont, 2000 Mathieu, 2001
Service science	An approach which studies the co-ordination amongst individuals, groups and technology to understand the business impact of service ecosystems.	Spohrer et al., 2007

Table 3.1 - Servitization research communities, their main areas of interest and key contributions. Adapted from Baines and Lightfoot (2013)

3.1.1 Terminology and definitions

The most common and highly cited definitions for servitization describe a transformation process, whereby manufacturers innovate their business model to compete through services in addition to products (Baines and Lightfoot, 2014; Rabetino et al., 2018). During servitization, manufacturers must adapt resources and activities to reconfigure their capabilities for the design and provision of services. The aim is that products become a platform for provision of services, which deliver performance outcomes and improves a customer's business process. Shifting competitive strategy in this way, from best products or lowest price towards total solutions (Treacy and Wiersema, 1997), represents a transition from goods-dominant to service-dominant logic (Vargo and Lusch, 2004). Service-dominant logic is not new, what is new is that manufacturers are now applying it to innovate their business models.

Servitization is also known as service infusion by some authors. Raddats et al., (2019), attempt to distinguish between the two terms. They argue that servitization requires significant business model innovation (section 3.1.5), whereas service infusion merely represents an increase in the relative importance of services within an organisation. However, they also acknowledge that in practice it is difficult to identify these different approaches and that the terms are often used interchangeably (Eloranta and Turunen, 2015). Marketing literature tends to prefer service infusion, whilst operational literature favours servitization, but in essence both terms can be taken to mean the same thing. This is evidenced by Zeithaml et al. (2014) who describe a service infusion continuum incorporating five dimensions of change (5C's), which aligns well with the service level continuum (figure 3.2). Evolution of servitization literature within the different research communities has also resulted in different nomenclature concerning the types of services which manufacturers can combine with their products. Different nomenclature includes: product - service systems; advanced services; hybrid offerings and integrated solutions.

The body of knowledge on servitization has evolved from topics covering service offerings, motivation and performance towards capabilities required for strategy implementation. This seems a logical progression as the topic matures and more manufacturers adopt services-led strategies, with those progressing to the deployment stages driving research in this area. Research is often theoretically underpinned by the resource-based view and dynamic capabilities, (Kindström, Kowalkowski and Sandberg, 2013). In recent years the emerging topic of digitally enabled advanced services has increasingly driven research momentum, particularly within the themes of service development, sales and delivery.

Across the research streams, empirical work predominantly comprises of case studies involving large multi-national organisations. These are usually exploratory and qualitative in nature, with generalisations notoriously difficult. There is also a need for more replicable studies, to learn general lessons which can be widely applied in practice. There is also an urgent need for more research in relation to SMEs, because the benefits of servitization are now beginning to cascade down supply chains to Tier 1 and Tier 2 levels (Ambroise et al., 2018, Mennens et al., 2018). This will create opportunities for research studies within smaller organisation. The extant servitization literature, particularly within the marketing field tends to focus on the opportunities and benefits of manufacturers becoming more service orientated. To provide a more balanced view, the next section considers both the rewards and risks.

3.1.2 Rewards and risks

Wise and Baumgartner (1999) highlight the value of manufacturers going down stream to build new revenue from services. They argue that services can represent a core differentiator for competitive advantage, enabling value-based pricing models demonstrating that competitor's lower product prices can lead to higher total cost of ownership. There are two main approaches. Firstly, and most popular, is based around manufacturers competing in the much larger after markets for their products. In this case manufacturers look to exploit their design authority to demonstrate return on investment by reducing total costs of ownership during the product life cycle. Secondly, and less popular due to the complexities involved are advanced services, which guarantee outcomes and capture mutual value during use of a product. For example, it's about customers buying mobility rather than a car. These are potentially the most lucrative, but companies offering these services are relatively rare (Baines and Lightfoot, 2013). Advanced services usually exploit digital innovations to drive effectiveness and efficiencies of people and processes for service delivery which help to make customers more competitive in their markets.

Product-centric companies who successfully apply the principles of servitization will develop closer relationships with their customers, which in turn builds trust and loyalty (Baines and Lightfoot, 2013). This is achieved through alignment of motivations, particularly during co-production of service offerings. It represents a shift in competitive strategy, which changes seller-buyer conversations from price to value. However, manufacturers will only capture true value by ensuring the primary benefactor of their services is the customer or even customers further down the supply chain.

Services are associated with higher gross margins compared to sale of products. Companies who build new and significant revenue streams with higher gross margins should also expect positive impact on their bottom-line net profit. However, this will depend on efficient and effective delivery of services. A study across five industrial sectors (Henkel et al., 2004) highlights how profit margins for services can be between two and five times greater than those for product sales (table 3.2). In addition, long service contacts with regular payments can enhance a company's valuation (Fang, Palmatier and Steenkamp, 2008). This is because guaranteed future business, which is often difficult for competitors to replicate, for example, the handling and environmental monitoring service offered by Nicklin Transit Packaging (Baines et al., 2019), will increase the EBITDA multiple used for valuation.

Industry sector	Product profit margin	Service profit margin	Profit margin leverage (service margin/product margin)
Machine Tools	1-12%	5-15%	2
Metallurgy Equipment	-3-6%	15-20%	4
Paper Machines	1-3%	10-15%	5
Power Equipment	2-5%	15-20%	4
Rail Vehicles	3-6%	8-10%	2

Table 3.2 - Profit margin comparison for product and service business. Adapted from Henkel et al., 2004

Many companies struggle to carry out this transformation successfully (Lütjen, Tietze and Schultz, 2017) (section 3.1.4), because fundamentally different capabilities are required compared to those for manufacturing or selling products (section 3.1.6). Neu and Brown (2005) cautioned that creating a service business within a product-centric organisation requires a complex organisational transformation, the extent of which will depend on the type of product-service system. This is necessary for the effective and efficient provision of new services, involving adaptation of resources and activities. Companies failing to adapt can lack the capabilities required for service delivery in accordance with their contractual obligations and run the risk of failing to translate gross profit into net profit (Benedettini, Swink and Neely, 2017; Gebauer, Fleisch and Friedli, 2005; Brax, 2005). This is illustrated by the inflection points in figure 3.1. In addition, short term financial sacrifice may be necessary to gain long term future rewards, or the expected benefits can be elusive, leading to financial and reputational loses, the so-called service paradox (Gebauer, Fleisch and Friedli, 2005).
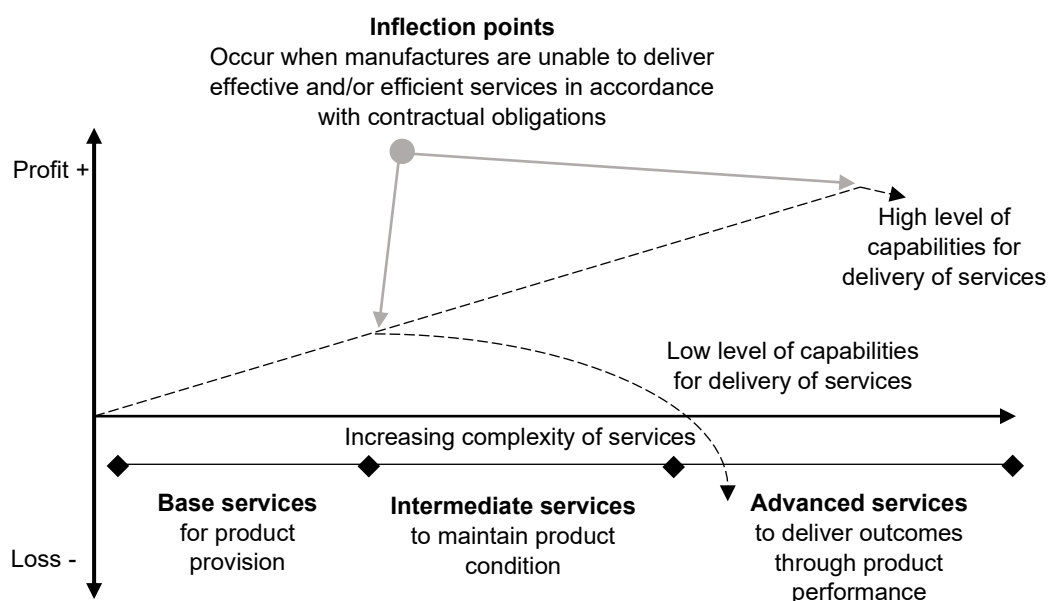
Figure 3.1 - Profit and loss scenarios for manufacturers offering advanced services. Adapted from Baines and Lightfoot (2013)

Failed servitization attempts are usually attributed to companies not fully carrying out the servitization transformation to build the appropriate capabilities. This is often because servitizing companies prioritise the development of new service offerings without considering adaptations required to their resources and activities across the organisation (Kindström and Kowalkowski, 2014). Intel Corporation for instance, spent $150 million to launch data centres designed to host web sites, which lasted three years before they announced closure, to re-focus on their core microprocessor business (Sawhney, Balasubramanian and Krishnan, 2005; Kowalkowski and Ulaga, 2017). The cause of servitization failure has been attributed to low levels of appropriate dynamic capabilities (Gebauer, Haldimann and Saul, 2017; Kindström, Kowalkowski and Sandberg, 2013), preventing for example: effective service innovation (Morelli, 2006); business model innovation or replication for scale (Coreynen et al., 2017). Dynamic capabilities are required (section 3.3) to manage the necessary changes by sensing and seizing opportunities for services, and reconfiguring resources (Kindström, Kowalkowski and Sandberg, 2013).

There is conflicting evidence in the literature, which shows that servitization can promote or impede business growth (Neely, 2008; Visnjic, Wiengarten and Neely, 2016; Kohtamäki et al., 2015). The readiness of a company to begin the servitization transformation and ultimately success or failure, will depend on whether they possess the right type and level of dynamic capabilities.

3.1.3 Service typologies

There are different types of services. Baines and Lightfoot (2013) describe clusters of service types, from base level product orientated (e.g., warranty entitlements), through intermediate level (e.g., maintenance, training, advisory) to more customised and outcome orientated advanced services. The latter are the most complex and potentially disruptive, representing a combination of products and services which seek to enhance productivity by going beyond the internal manufacturing environment to find new ways of creating value for customers. The principle is to provide solutions which improve the usage and performance of products, to the extent that customers see a positive effect on their bottom line. This enables buyers to outsource capability provision to manufacturers, meaning they can buy the output enabled by a product, for example a machines availability, reliability and performance.

A good example of the imperative of guaranteeing output through availability is Toyota Materials Handling, whose retail customers are shipping to their customers 24/7, driven by changing consumer behaviour. Incentives for uptime and penalties for downtime emphasise the critical nature of remote condition monitoring to predict and prevent breakdowns. This is nicely illustrated in figure 3.2, which compares traditional and advanced service contracts to illustrate how revenue

is affected as a function of time to conduct a repair. Success will ultimately increase revenues and profits, particularly as economies of scale further reduce initial costs.
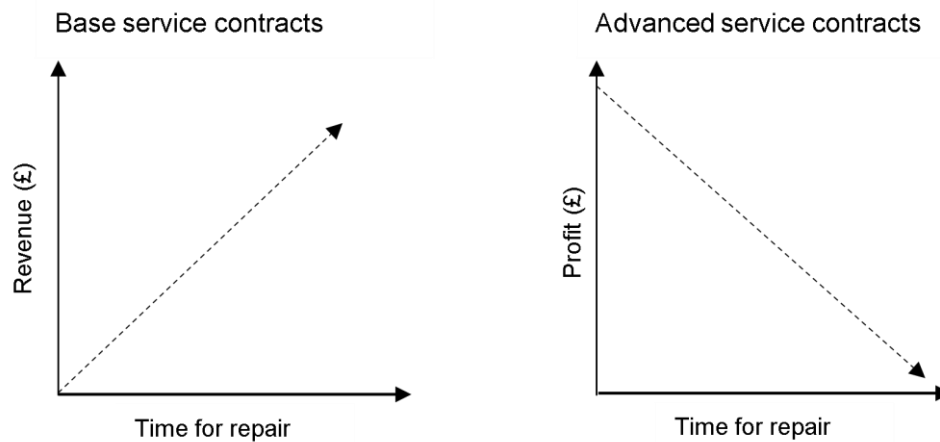
Figure 3.2 - Comparison of base service and advanced service contracts showing the revenue implications as a function of time to conduct a repair.
Adapted from Baines and Lightfoot (2013)

Base level services and most intermediate services can be considered as services supporting products (SSP), whereas advanced services are process orientated and services supporting customers (SSC). Similarly, Ulaga and Reinartz (2011) derived a two-dimensional framework to classify product-service systems, which they refer to as hybrid offerings. One dimension aligns well with the SSP-SSC classification (Mathieu, 2001) and the other depends on whether the service is based on performing a deed (input) or performance achieved (output). Relating this back to Baines and Lightfoot (2013), their base and intermediate services would be classified as input based and advanced services as output based. Irrespective of which classification scheme is adopted, the scope of service provision is wide ranging and can be considered to exist on a product-service continuum between SSPs and SSCs. This is illustrated by figure 3.3, which shows base, intermediate and advanced services as a continuum between these dichotomies. The service examples provided within each cluster are for illustrative purposes and not intended to be exhaustive. Therefore, classifications should be considered as convenient distinctions, rather than boundaries.
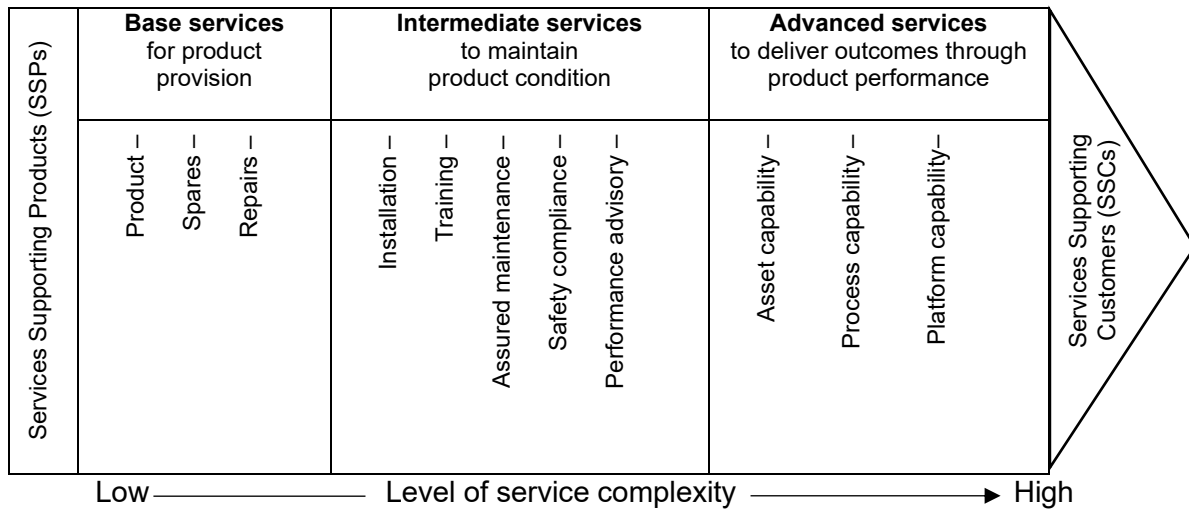
Figure 3.3 - Service level continuum from SSP to SSC. Adapted from Baines and Lightfoot (2013), Oliva and Kallenberg (2003) and Mathieu (2001)

This research adopts the classification clusters proposed by Baines and Lightfoot (2013). Moving from base services, through intermediate to advanced services increases the complexity of the product-service system necessary for design and provision of services. Raddats and Kowalkowski (2019) point out that companies often provide a wide range of services across the continuum and therefore occupy different positions simultaneously. This is the case with UV Light Technology Limited, who steadily built a portfolio of services by transitioning from left to right. Each step builds on and retains existing services to support products, whilst moving towards advanced services which support the customers business. Raddats and Kowalkowski (2019) also emphasise that managers should pursue strategies reflecting their customer needs and organisational capabilities, rather than simply looking to move towards more advanced services.

Product-centric companies exploring the benefits of competing through a portfolio of integrated products and services can visualise their new value propositions as a positional shift along this continuum from left to right (Oliva and Kallenberg, 2003). Viewing a company's vision for new services as a shift in position on the product-service continuum is the first step to developing the customer value proposition. The level of complexity of the product-service system will depend on the extent of the positional shift on the product-service continuum. The vision previously described for UV Light Technology Limited (section 2.5), represents a transition from intermediate (performance advisory) to advanced services (asset capability). This requires fundamental changes to the company's resources and activities to reconfigure their capabilities.

Gebauer, Paiola and Edvardsson (2012) describe three strategic pathways for service business development, which represent a way of defining a positional shift on the product-service continuum. These are categorised as: enhancing relational value with existing customers (free services); adding financial value from existing and new customers and a radical leap towards new

value further down the supply value chain. They argue that progress along these pathways requires co-evolution of ordinary capabilities and dynamic capabilities and provide a framework which highlights those required for each one. The pathways align well with the development of base, intermediate and advanced services respectively. The next section explores knowledge on how companies transform from a product focus to a product-service focus.

3.1.4 Transformation process

The previous section covered types of services and their different levels of complexity. Higher levels of complexity require not only greater service and product innovation, but also organisational innovation (Pawar, Beltagui and Riedel, 2009). This section explores how the transformation proceeds and the enablers and barriers linked to different stages. Understanding and managing this transformation process is perhaps the biggest challenge for both practitioners and academics (Baines et al., 2020). This is not surprising, since it involves fundamental cross functional changes to resources and activities for building the required capabilities (Ulaga and Reinartz, 2011; Neu and Brown, 2005). It affects individuals, teams and the organisation itself from top to bottom. The underlying dynamics of the cultural changes necessary can create conflicts and resistance, which must be addressed at individual level (Lenka et al., 2018).

To help practitioners understand, communicate, and manage servitization, several researchers have proposed models to rationalise and explain the process. For example, Lütjen et al. (2019) describe a three-stage transformation model from the perspective of innovation management and the resource-based view, consisting of: service initiation; service anchoring and service extension. In contrast, Martinez et al. (2017) identified 36 steps, which were originally clustered into 12 themes, before finally evolving into their seven-stage service strategy model. The study concludes that journeys do not follow a single path or share the same departure point. It demonstrates that servitization is a continuous incremental process, which is neither logical or structured, but emergent and intuitive with back and forth sequences.

Alternatively, Baines et al. (2020) frame the transformation process within their Servitization Progression Model, which represents how organisational changes unfold. This model comprises of four stages: - exploration; engagement; expansion and exploitation. A servitizing company will need to transition through and between these stages, during which they will encounter contextual forces which either enable or impede success. These forces will determine the rate of progression through each stage and relate to: market; technology; value networks; organisational readiness and commitment. Many companies fail to navigate a particular stage and progress from one stage to another represents an important tipping point, requiring a decision to move forward.

During the initial exploration stage, the principles of servitization are introduced, opportunities for services evaluated and threats considered before formulating a vision. Once an opportunity is established, organisations choosing to proceed beyond exploration should produce a roadmap for planning and implementation of the next stages. Establishing this roadmap will be essential for the rest of the journey, therefore the exploration stage is a crucial pre-requisite for successful navigation of subsequent stages. This can be particularly challenging for SMEs with limited resources and capabilities to research markets and competitors. Companies who proceed to the engagement stage, will start to design and evaluate new services by interaction with carefully selected customers. Again, scarcity of resources within SMEs may limit the extent of pilot studies. A successful outcome can lead to scaling up in the expansion stage and ultimately roll out across the organisation during exploitation.

The exploration, engagement and expansion stages proposed by Baines et al. (2020) align well with the service initiation, service anchoring and service extension steps of Lutjen, Tietze and Schultz (2017). The additional exploitation step in the Servitization Progression Model emphasises the need for broader cultural changes as the product-service system is integrated throughout the entire organisation. The analysis of both these studies is conducted at higher levels of aggregation than Martinez et al. (2017). This enables rationalisation of the servitization process as a manageable concept, therefore these models are perhaps more likely to find practical application.

Viewing servitization through a transformation model lens should help practitioners to understand that fundamental changes are required to their capabilities for design and provision of new services. To understand which capabilities and the cross functional nature of the transformation requires a more holistic business model perspective. The next section explains how business model innovation can be used as a lens to visualise how service opportunities are brought to life to create, deliver and capture new value.

3.1.5 Business model innovation

The previous section explained how the servitization transformation comprises of several stages and can take different pathways. This section explains that the transformation process can be considered as innovation of a company's business model, the extent of which will depend on the complexity of the product-service offering. A business model starts with the value proposition and then illustrates how resources and activities should be combined for delivery and capture of value (Spring and Araujo, 2009). They enable the visualisation of how an organisation delivers a value proposition in a profitable way, using certain key resources and processes (Johnson, Christensen and Kagermann, 2008). Similarly, Zott, Amit and Massa (2011) argue that a business

model comprises of three major elements, which are: the value proposition; value delivery and value capture. This is summarised by Musson, Baines and Ziaee Bigdeli, (2019), who emphasise the interdependencies of value proposition, value creation and value capture to protect competitive advantage. Viewing the servitization transformation through a business model lens highlights the adaptations required to resources and activities to build the appropriate capabilities (Raja et al., 2018).

Traditional product-centric business models are based on production, consumption and disposal. These are transactional and unidirectional in nature, usually emphasising cost, quality and delivery of products. In comparison, product-service systems require business models where products and services exist interdependently and in the case of advanced services illustrate provision of capabilities to capture mutual value in use (Gaiardelli, Martinez and Cavalieri, 2015). This requires visualisation of resources and activities which will provide capabilities to establish close customer relationships, emphasising the back and forth nature leading to co-production of value propositions and co-creation of value (Vargo and Lusch, 2004). Therefore, product-centric companies exploring the potential benefits of servitizing need to evaluate their organisational readiness to innovate their existing business model for design and provision of services.

Creating a service business within a product-centric organisation is challenging and requires fundamentally different capabilities compared to those for manufacturing or selling products (Neu and Brown, 2005). Parida et al. (2014) categorised different product-service offerings based on the logic of their underlying business model to evaluate the value of product-service offerings. Their study shows that bolting on additional services to an existing business model was negatively associated with financial performance. Instead, their statistical analysis suggests that servitizing companies need to undertake a comprehensive organisational transformation to generate significant financial value. Manufacturers, unlike pure service providers are in an enviable position to wrap services around their products, but must reconfigure their unique resources to build the necessary capabilities (Ulaga and Reinartz, 2011).

Teece (2018) highlights the interdependencies of strategy, business model innovation and dynamic capabilities (section 3.3). He argues high levels of dynamic capabilities enable the creation and implementation of new business models to deploy strategy. Emphasis is placed on translating business model innovation into organisational transformation, which adapts ordinary capabilities to build the required operational capabilities. The next section discusses the resources and activities which will be required to provide the capabilities for effective and efficient provision of advanced services.

3.1.6 Adapting capabilities for services

Research on manufacturers adapting their capabilities for design and provision of services usually adopt theories around the resource-based view and dynamic capabilities (Eloranta and Turunen, 2015). Resources are the productive assets owned by a business, whether tangible, intangible or human. Capabilities represent the ability of a business to apply their assets, therefore, resources alone will not enable competitive advantage. Assets must be combined with appropriate activities to operationalise capabilities for delivery of a desired outcome. Organisations therefore strive to gain competitive advantage by developing their capabilities, made up of combinations of resources and activities, which aim to provide a differentiated offering or lower costs compared with competitors (Peteraf, 1993; Helfat and Lieberman, 2002).

Baines and Lightfoot (2013) advocate that provision of successful services is ultimately dependent on the interplay between two essential capabilities: ability to respond cost effectively and ability to improve cost effectiveness. These capabilities are likely to represent a significant divergence from the environment for which a manufacturer's resources and activities were originally developed. Future business performance will therefore depend on effectively managing the adaptation of an organisations resources and activities to build the necessary capabilities to suit a services-led strategy. The extent of the transformation required will depend on the complexity of the service aspect of the product-service system. Ulaga and Reinartz (2011) identify four critical resource areas unique to manufacturers, which can be reconfigured to build five distinctive capabilities for the design and provision of product-service systems (referred to as hybrid offerings). These five capabilities can subsequently be applied to provide competitive advantage based on differentiation or lower cost. This is summarised in figure 3.4.
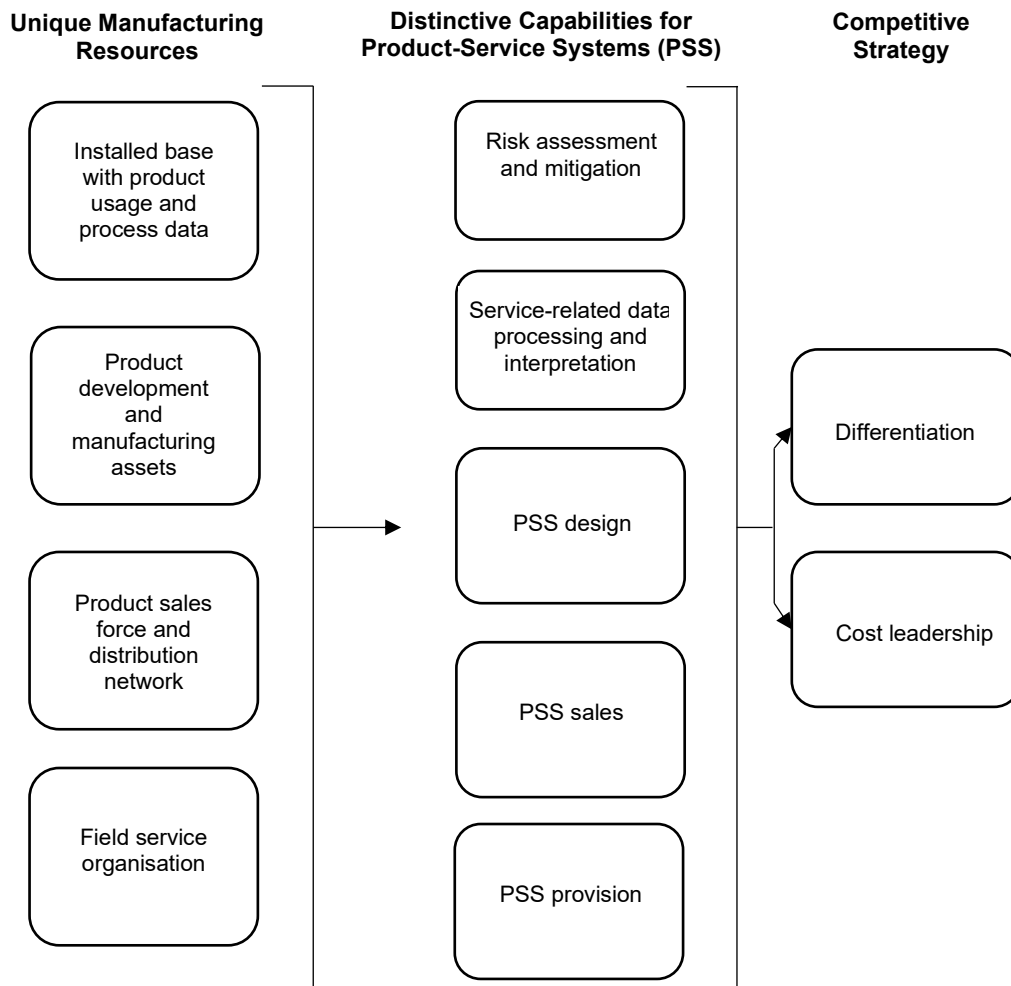
Figure 3.4 - Reconfiguring manufacturing resources to build capabilities for the design and provision of product-service systems. Adapted from Ulaga and Reinartz (2011)

Ultimately, success depends on matching the competitive strategy of a company to their customer's value drivers and ensuring the right resources and activities are in place to enable execution. (Galbraith, 1973; Mintzberg, 1979). This is supported by Neu and Brown (2005), who show that formation of successful business to business services within product-centric companies requires alignment of a services-led strategy with the external environment (customer value drivers) and reconfiguration of organisational factors (resources and activities) to develop the capabilities required for execution (performance). This is depicted in figure 3.5. However, Leonard-Barton (1992) cautions that although existing resources can potentially be reconfigured to facilitate capability fit with a new strategic direction, internal rigidities could inhibit the development of new critical capabilities.
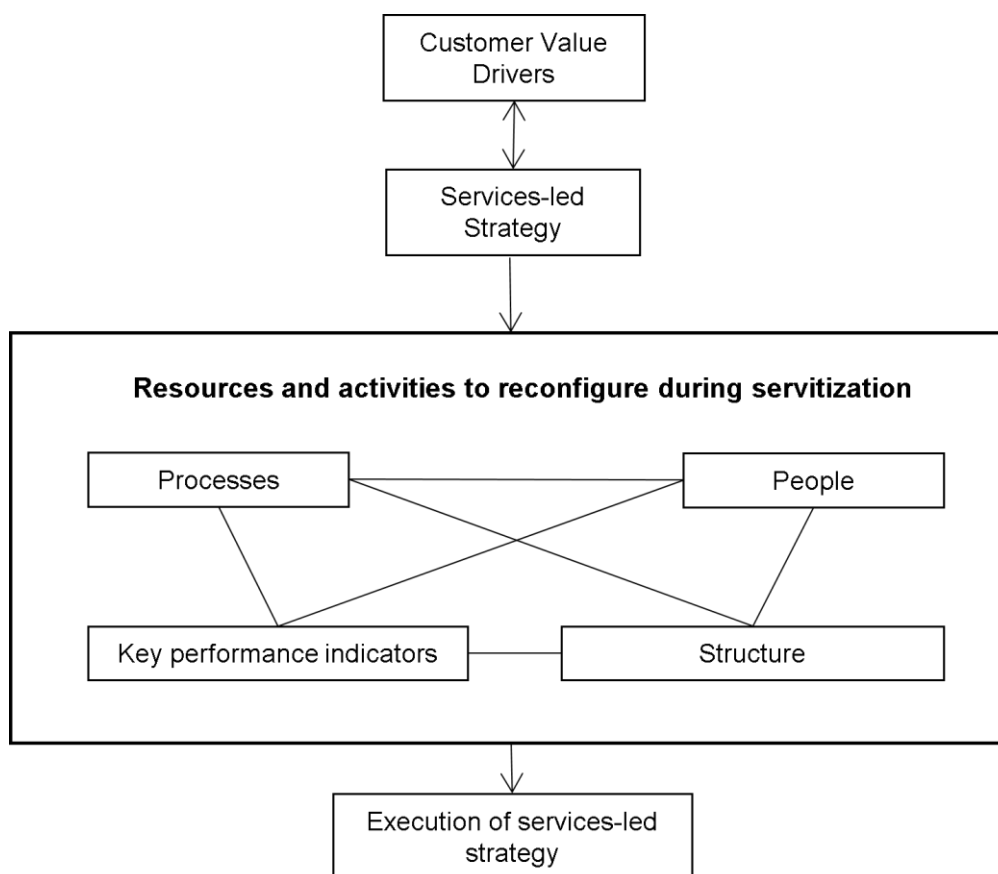
Figure 3.5 - Aligning services-led strategy with customer value drivers, then reconfiguring resources and activities for execution. Adapted from Neu and Brown (2005)

Neu and Brown (2005) focus their research on understanding how companies reconfigure their resources and activities within five specific areas, relating to: strategy; structure; people; processes and key performance indicators (including rewards). Their findings are discussed below for four of these areas, with inclusions from other authors where appropriate.

People

The personal characteristics required for the necessary structure, processes and key performance indicators to achieve alignment between services-led strategy and customer value drivers place high demands on a team. Recruitment and training should support the personal characteristics required and financial incentives based on both behavioural and outcome controls (Johnston and Marshall, 2013). Managers should first adapt customer facing roles and invest in further developing and retaining people who possess the appropriate personal traits to become trusted advisors, understand customer processes and communicate cross functionally.

A study by Huikkola, Kohtamäki and Rabetino (2016) explores how manufacturers modify their capabilities during servitization by creation of new resources, leveraging existing resources in new ways and releasing resources no longer required. They emphasise the need to leverage

existing resources, for example the installed base, while simultaneously building new resources. This study focuses on reconfiguring resources and activities by hiring people who act from a service mindset, in particularly leaders and salespeople, who in most cases form a separate business unit. This is supported by Alghisi and Saccani (2015), who also highlight the importance of commitment from senior management. In addition, Santamaría, Nieto and Miles (2011) argue that the right training and motivation of salespeople is essential to develop their ability to act as a conduit for customer information. This is closely linked to the need to change organisational culture (Sjödin, Parida and Kohtamäki, 2016), which is essential to avoid resistance leading to insufficient transformation and ultimately failure.

Processes

In the Neu and Brown study (2005), managers relied on four inter-related knowledge transfer processes, namely: acquiring external and internal information; inter and intra-company information flow; conceptualisation for analysis and utilization of information. The study focusses on processes to co-produce value propositions which would alleviate customer pains and should therefore align with their value drivers. Their emphasis on conceptual understanding for effective communication amongst stakeholders supports the earlier discussions in section 3.1 on business models, transformation models and road mapping.

Parida et al. (2014) identify four distinctive capabilities associated with servitization success and highlight key learning activities for their development, these are: business model design; network management; integrated development and service delivery network management. Taking these in order, key processes will need to be developed for each, which include: risk and value based revenue sharing; developing partner understanding; integrating product usage data within product development and support for delivery partners.

Structure

Both integrated and separate business units were established by participants in the study (Neu and Brown, 2005), but in both scenarios the following key structural factors emerge: intra and inter-company collaboration and decentralised decision-making authority. Pawar, Beltagui and Riedel (2009) argue that designing the new structure of an organisation should be undertaken simultaneously with product and service innovation. This is conceptualised by their PSO triangle and linked with a practical framework to help guide the development of product-service-organisation systems. The framework comprises a three-stage process, including: defining mutual value; designing the product-service system and organisation and delivering value. The emphasis of this work in relation to organisational change is on a front and back office approach (Foote et al., 2021; Davies, Brady and Hobday, 2006; Raja et al., 2018). In alignment with Cova

and Salle (2008), it also advocates networking with strategic partners to deliver the capabilities which are required but not possessed by a servitizing organisation.

Key Performance Indicators

In the Neu and Brown study (2005), key performance indicators (KPIs) focus on outcomes aligned to customer value drivers, such as, product life cycle costs, product availability and product reliability. This is an essential perspective, however KPIs should also represent the integration of financial and non-financial measures (Thakkar, Kanda and Deshmukh, 2009), with long and short term perspectives, using leading and lagging indicators (Kurien and Qureshi, 2011).

The balanced scorecard (Kaplan and Norton, 1992) provides an integrated performance measurement framework. This can be customised around four measurement perspectives: financials; operations; customers and innovation. Together these provide a comprehensive, multi-dimensional assessment of diverse performance objectives (Kaplan and Norton, 1996). It balances internal and external views to enable understanding of an organisation and its ability to respond to opportunities and threats within their business environment. It also balances leading and lagging indicators to monitor progress against long term strategic objectives, whilst not losing sight of immediate day to day imperatives. The balanced scorecard approach has been used as a framework to structure and build KPIs for advanced services (Ziaee Bigdeli et al., 2018), who identify a diverse set of service-related measures across the four perspectives.

The Neu and Brown (2005) study, by grouping resources into five key focus areas relating to strategy, people, processes, structure and key performance indicators, provides an ideal lens through which to view the required activity characteristics. This builds on the resource-capability framework proposed by Ulaga and Reinartz (2011), which is constructed at a higher level of aggregation. Both these studies are still the most highly cited in this area of research and align well with the framework proposed by Baines et al. (2009). This is designed to help manufacturers configure their production and support operations for effective and efficient delivery of product-service systems. It compares the operations, structures and processes for product-service systems against those which deliver products only or services only. Combining the studies of Neu and Brown (2005) and Baines et al. (2009) led to the formation of the organisational innovation section of figure 3.6, which emphasises the need for the characteristics of activities to transition from transactional to relational in nature during servitization.

3.2   Four Key Capabilities for Servitization

Drawing together the insights from section 3.1 led to the construction of figure 3.6.   This synthesises and adapts the service level continuum (figure 3.3), four areas where manufacturers should reconfigure their resources and activities during servitization (figure 3.5) and the transition of activity characteristics required by product-centric organisations to design and deliver services (Baines et al., 2009; Baines and Lightfoot, 2013).   Figure 3.6 comprises of four blocks of knowledge, described as: vision innovation; service innovation; product innovation and organisational innovation (highlighted in blue), representing four key capabilities required by product-centric organisations to servitize.

Three of the key capabilities identified, namely, service innovation; product innovation and organisational innovation align directly with research by Pawar, Beltagui and Riedel (2009).   They posit that servitization requires the simultaneous innovation of product, service and organisation, described as the PSO triangle.   Adding vision innovation as a fourth element builds on their model by focussing the definition of service innovation (section 3.2.1) on co-production and evaluation of the service offering with customers.

Figure 3.6 establishes the notion of combination and alignment between four key capabilities to facilitate servitization at a conceptual level. This represents the foundational premise of the research.   On a practical level figure 3.6 enables visualisation of the changes required to resources and activities (organisational innovation) to reconfigure capabilities for design and provision of advanced services (product and service innovation), which are positioned further to the right than existing offerings (vision innovation).   It emphasises that moving from base services, through intermediate to advanced services will impact the characteristics of capabilities required, which must be transitioned to become less transactional and more relational in nature.   This is contextualised for UV Light Technology Limited by the arrow above service innovation in figure 3.6. This represents the company vision to move beyond performance advisory services towards asset capability (section 2.5).   The next section provides definitions for the four key capabilities within the context of the research.

Services Supporting Products ... **Services Supporting Customers**

Product dominant	Vision innovation	Service dominant
Base services for product provision	**Intermediate services** to maintain product condition	**Advanced services** to deliver outcomes through product usage with shared risks and rewards

Service innovation →

- Product
- Spares
- Repairs
- Installation
- Training
- Assured Maintenance
- Safety compliance
- Performance advisory
- Asset capability
- Process capability
- Platform capability

Product performance	Product innovation	Assured product performance
Design, development, production	Sensors and data analytics	Remote monitoring, upgrading, re-manufacturing, disposal

Transactional activities	Organisational innovation	Relational activities

People and Partnerships

| Technical and analytical product knowledge skills. | Culture – individuals, teams and units. | Technical and relationship building skills, good understanding of customer processes and ability to communicate cross functionally. |
| Based on individual outcomes. | Recruitment, training and incentives. | Based on service orientated team behaviour. |

Processes and Technology

Run in isolation within functions.	Project management.	Cross-functional and inter-company collaboration.
Reactive after-sales support.	Field services.	Digitally enabled predictive and pre-emptive systems to avoid or contain failures and recover rapidly.
Revenue from asset sales.	Payment systems, legal and financial contracts.	Subscription payments often based on customer usage data
Engineering contacts.	Customer segmentation and relationship management.	C-suite level, engineering and financial contacts.
Continuous improvements to reduce product and warranty period costs.	Engineering design and development.	Design for services to keep products working better for longer and at lower costs.
Narrow scope within functions.	Information and communications.	Cross functional and inter-company with wider scope.

Structure and Facilities

| Centralised facilities and decision making to exploit economies of scale. | Integration between front and back offices or separate business units. | Centralised production with decentralised field facilities, close to customers. |

Key Performance Indicators

| Focus on cost, quality and delivery of products. | Demonstration of value. | Focus on customer satisfaction - product life cycle costs, availability and response. |

Figure 3.6 - Four key capabilities for servitization. Identified by drawing together and adapting Oliva and Kallenberg (2003); Baines and Lightfoot (2013); Mathieu (2001); Neu and Brown (2005) and Baines et al. (2009)

3.2.1 Defining the four key capabilities for servitization

This research is specifically concerned with the capabilities required to explore the opportunities and benefits of advanced services, then design and evaluate new service offerings with target customers. This represents the exploration and engagement stages of servitization, according to Baines et al., 2020.

Vision innovation

A vision is an image of a desirable future for an organisation (Reichard, 2016), which in this case illustrates or describes a new business model for the design and provision of advanced services. It should articulate a clear purpose and reasons for servitization. This is essential to help people fight their natural instincts to resist change (Sinek, 2011). It must therefore be meaningful and important, providing an irresistible invitation to come along by demonstrating value for all stakeholders.

A vision should recognise opportunities and benefits for new services, which are highlighted by specific knowledge of the present and future needs of key customers. These should be based on specific customer segments, market research, competitor intelligence and environmental trends (Story et al., 2017; Kindström, Kowalkowski and Sandberg, 2013). A vision will be most powerful when it communicates opportunities which are understood cross-functionally, including external stakeholders (Kotter, 1995). This will enable rapid flow of information and decision making. A quote which is usually accredited to Thomas Edison … "vision without execution is hallucination", serves to emphasise the need for a clear implementation plan or roadmap. This will require a champion to provide direction and motivation, along with setting targets, milestones and risk assessment (Cohen and Levinthal, 1990; Bartkus, Glassman and McAfee, 2000).

Vision innovation is defined within the context of this study as: *The capability to reconfigure the vision of a company, with a roadmap for implementation of advanced services.*

Service innovation

Manufacturing companies looking to execute their vision by moving from left to right on figure 3.6 need to design and evaluate new service offerings. This requires close working relationships with customers to understand how new services could add value to their business (Grönroos, 2011). New service offerings should be co-produced with customers (Vargo and Lusch, 2004). However, a balance must be struck between customisation to provide value as perceived by the customer and modularity to ensure profitable scaling is possible (Davies, Brady and Hobday, 2006). The question should not be based on how to innovate services, but instead centred around how to help customers address problems and add value to their business (Gallouj, 2002).

To enable focus on customer perceived value, this research takes a narrower view of service innovation, compared to Kindström, Kowalkowski and Sandberg (2013). Service innovation focusses on developing, evaluating, and validating new service offerings with customers. Other aspects such as service delivery and value capture are covered within organisational innovation capabilities.

Service innovation is defined within the context of this study as: *The capability to reconfigure a company's service portfolio by design, evaluation, and validation of advanced services.*

Product innovation

Successful and reliable products are a pre-requisite to provide a stable platform for delivering outcome based services. (Chase and Garvin, 1989; Parida et al., 2014). It is therefore essential that service innovation is accompanied by product innovation, such that products are designed for service (Beltagui, 2018), rather than services being bolted on later (Oliva and Kallenberg, 2003). The aim is to keep products working better, for longer and at lower costs. Digital technology such as remote condition monitoring builds understanding on product condition, operation and service activities required (Bustinza, Parry and Vendrell-Herrero, 2013). This feedback will enable design updates, allowing full exploitation of a manufacturers design authority (Burton et al., 2017). This process can often lead to recognition of new business opportunities aligned with the usage needs of customers (Ulaga and Reinartz, 2011). This demands effective cross functional project management because most new customers will represent a new project (Davies and Brady, 2000).

Product innovation is defined within the context of this study as: *The capability to reconfigure a company's product portfolio by creating or adapting products to facilitate delivery of advanced services.*

Organisational innovation

Reconfiguring unique manufacturing resources to build the required capabilities for design and provision of an integrated product-service solution is critical to carry out the servitization transformation (Ulaga and Reinartz, 2011). This is supported by Neu and Brown (2005), who focus on building the necessary capabilities in the following areas: strategy; people; processes; structure and key performance indicators (including rewards). The changes required in these areas are discussed earlier in this chapter and summarised in figure 3.6.

Organisational innovation is defined within the context of this study as: *The capability to reconfigure a company's resources and activities for the design and provision of advanced services.*

The imperative of innovation and transformation inherent within the four key capabilities identified in figure 3.6 and defined above highlight the enabling role of dynamic capabilities. These represent the skills and processes to sense and seize opportunities for services and reconfigure resources and activities for delivery. The next section develops the theoretical framework for the research with the four key capabilities for servitization as central tenets.

3.3   Theoretical Framework for Research

The previous sections identified and defined four key capabilities for servitization. This developed the foundational premise for the research, by establishing the notion that the combination and sequencing of these capabilities is essential to facilitate successful servitization. This section views the four key capabilities through the theoretical lens of dynamic capabilities and subsequently categorises them as strategic dynamic capabilities (section 3.3.2). These require operational dynamic capabilities, known as micro-foundations for their development and application (section 3.3.3). Dynamic capability theory explains that servitizing companies must sense opportunities for advanced services (vision innovation), then seize them (service innovation and product innovation) and reconfigure their capabilities as required (organisational innovation) for their design and provision. Finally, the strategic and operational capabilities identified are drawn together into a theoretical framework. This evolved through use during the research to enable operationalisation of these theoretical terms by transforming them into empirical terms, enabling their measurement and assessment. This section culminates by considering different intensities of dynamic capabilities and their measurement.

3.3.1 Dynamic capabilities

The dynamic capability concept is viewed by many as a further development of the resource-based view of the firm (Penrose, 2013), by adding a dynamic component to the notion that competitive advantage is gained or lost by differences in bundles of resources owned or controlled by companies. Barney (1991) and Peteraf (1993) argue that resources which are valuable, rare, difficult to copy and non-substitutable will enable sustainable competitive advantage.

Crook et al. (2008) argue that resource-based theory is overly focussed on the actual resources, rather than how they are deployed to create competitive advantage. They argue that possession of resources will not guarantee competitive advantage and what a company does with them is at least as important. In addition, to sustain competitive advantage companies must adapt their resources to build new capabilities which meet the evolving needs of customers (Danneels, 2002). This requires dynamic capabilities, which will enable innovation of resources, whilst how they are combined with activities in a timely manner by the strategic choices of manager's is known as

resource orchestration. The term resource orchestration was originally coined by Sirmon et al. (2011), who combined Sirmon, Hitt and Ireland's (2007) resource management framework with Helfat, Finkelstein and Mitchell's (2010) asset orchestration framework. The latter was derived from research on dynamic capabilities (Adner and Helfat, 2003), which like the resource management framework has also been linked to resource-based theory (Helfat and Peteraf, 2003).

Dynamic capabilities represent the capacity of an organisation to sustain competitive advantage by purposefully creating, extending, or modifying resources to reconfigure their capabilities in response to changing customer needs or market trends (Helfat, Finkelstein and Mitchell, 2010). This innovation of resources is essential to survive and prosper, particularly in times of rapid change. It is important to clearly delineate dynamic capabilities and ordinary capabilities (Teece, 2014; Winter, 2003). The literature makes a conceptual distinction as follows:

> *Ordinary capabilities* enable an organisation to perform business as usual activities to get tasks done and earn a living in the present. They can only have positive values, depending on varying degrees of efficiency and effectiveness. Performance is evaluated in relation to existing products and service and without consideration of customer relevance or competitive advantage.

> *Dynamic capabilities* impact the rate of change (innovation) of ordinary capabilities when an organisation senses and seizes opportunities. These can be negatively rated where a business fails to spot or respond to the need for innovation and transformation in fast moving business environments. To qualify as a dynamic capability, it must not only be able to change the resource base, but also be embedded in a firm's managerial and organisational processes to enable repeatability. Dynamic capabilities are therefore included in the resource base and can also be created, extended or modified (Helfat and Peteraf, 2003).

The focus on innovation, inherent within the dynamic capabilities concept, makes it particularly relevant to manufacturers undertaking servitization. This is supported by Fischer et al. (2010), who argues that servitization challenges conventional manufacturing thinking and requires dynamic capabilities. Kindström, Kowalkowski and Sandberg (2013) caution that a major challenge associated with servitization is managing the essential dynamic capabilities of sensing, seizing and reconfiguring, at both strategic and operational levels (micro-foundations).

3.3.2 Strategic dynamic capabilities

The four key capabilities for servitization can be classified as strategic dynamic capabilities according to Teece's (2007) framework. This consists of three inter-related activities (1) sensing opportunities and threats (vision innovation), (2) seizing opportunities (service and product innovation) and (3) transforming an organisation by reconfiguring resources and activities (organisational innovation). In summary, the focus of Teece's framework is to help practitioners formulate and deploy strategy, based on reconfiguring their resources and activities as they sense and seize opportunities. It is a transformation process which must be undertaken whilst also effectively managing competitive threats. These strategic level activities are expanded below for the four key capability definitions (3.2.1) within the context of this study.

Sensing (vision innovation)

Sensing refers to the capabilities of managers to sense and evaluate opportunities for combining services and products in a way which will add value for customers. This must be communicated in the form of a reconfigured vision for the company's future, along with a roadmap for timely execution. The strategic level sensing of potential opportunities for provision of integrated product-service solutions is only the first step. Realising the potential by seizing these opportunities is the next step, often in combination with reconfiguring resources and activities to provide the required capabilities.

Seizing (service and product innovation)

Seizing the opportunities sensed for product-service combinations means planning and managing the service and product innovations required to create an integrated product-service solution which will add value for customers.

Reconfiguring (organisational innovation)

Design and provision of integrated product-service solutions will require capabilities with different characteristics compared to those for manufacturing and selling products. Therefore, in addition to sensing opportunities for services, it is also necessary to reconfigure capabilities to enable the design and provision of advanced services. This will form an integral part of the vision and roadmap, which emphasises the inter-related nature of dynamic capabilities (sensing, seizing, and reconfiguring).

These strategic dynamic capabilities of sensing, seizing and reconfiguring are developed and applied by operational dynamic capabilities, known as micro-foundations. Eisenhardt and Martin (2000) provided the following examples of micro-foundations: cross functional research and development teams; new product development routines; effective knowledge transfer and key

performance indicators. These must be embedded throughout an organisation and include: people (skills); structures; processes; decision rules and discipline. However, like most authors in this field, they neglected the service aspect by their bias towards products and technology. The next section extends Eisenhardt and Martin's (2000) micro-foundations (operational dynamic capabilities) for services.

3.3.3 Operational dynamic capabilities

The four key capabilities for servitization (figure 3.6) have been classified as strategic dynamic capabilities (section 3.3.2), These require operational dynamic capabilities (micro-foundations) for their application or development. These are resources and activities which will enable an organisation to adapt their ordinary capabilities (resources and activities), in this case for the design and provision of advanced services. Kindström, Kowalkowski and Sandberg (2013) extended the Eisenhardt and Martin (2000) examples of micro-foundations to achieve a better fit for servitization by specifically considering the service aspect. The focus of their research led to a non-exhaustive list of activities, which will enable a company to sense and seize opportunities for services and reconfigure their resources. Kindström, Kowalkowski and Sandberg (2013) adopted a broad view of service innovation, by not only considering the service offering within their definition, but also other areas of business model innovation, such as service delivery and revenue model. Their findings, along with other relevant studies are viewed below through the lens of each of the four strategic dynamic capabilities in turn. This led to the identification of five operational capabilities for each one and formation of the theoretical framework for conducting the research (table 3.3).

Vision innovation

Strategic dynamic capabilities to sense the opportunities and benefits of offering new advanced services requires market analysis, competitor intelligence, and customer data. This can be complex, particularly gathering customer insights, because the real potential value will most likely be deeply embedded within their processes. It is therefore necessary to go beyond traditional market research techniques by interaction with customers (Kindström and Kowalkowski, 2009; Vargo and Lusch 2008; Edvardsson et al., 2006). Kindström, Kowalkowski and Sandberg (2013) advocate involving other actors, such as field service personnel, distributors and network partners. This is essential to ensure that a new service offering will provide solutions to problems which are recognised by customers. They also highlight the likely need for additional competences and resources to undertake these activities. New organisational roles, systems and processes will need to be created, with feedback loops to continuously capture the evolving needs of customers.

Service innovation

Kindström, Kowalkowski and Sandberg (2013) re-emphasise their earlier points about customer interactions by advocating co-production of new service offerings with potentially receptive customers. This should be followed by pilot testing, validation and include the development of new revenue models. Continuous improvements to the service portfolio by enhancing the structure and management of the service delivery process is highlighted as the best way to build trust and loyalty, leading to future business. Organisational routines will be required, involving iterative interactions with customers to create new knowledge which will enhance dynamic capabilities (Eisenhardt and Martin, 2000).

A study by Saul and Gebauer (2018) identifies key micro-foundations enabling manufacturers to provide advanced services during their market development phase. Amongst their findings, three insights are particularly interesting. Firstly, they found that a servitizing company should focus simultaneously on customization to meet specific customer needs, and standardisation of delivery through modularity. This is important and is generally overlooked in the literature, which tends to emphasise revenue generation, rather than cost efficiencies for profitable scaling. Secondly, they suggest an evolutionary perspective of tentative steps of trial and error, whilst looking to understand and satisfy simple customer needs first to get some quick wins. This will simultaneously build manufacturer and customer confidence, leading to future solutions for more complex needs. Thirdly, by viewing technology exploration from the perspective of reconfiguration, rather than sensing (Kindström, Kowalkowski and Sandberg, 2013), their findings suggest that self-service and remote monitoring technologies can play a vital role in reconfiguring solutions.

Product innovation

Coreynen et al. (2020) highlight the importance of micro-foundations for the purpose of strategic change in general but focus on the digital aspects of servitization. They emphasise the importance of sensor technologies and processes to improve efficiencies, whilst also experimenting with new ideas. They argue for example, that manufacturers should consider which processes would benefit most from digitalisation and explore how they could support customers by moving into new services. Ultimately, activities which lead to digital servitization, for example, adding sensors to products for remote condition monitoring, will enable data driven services. This will also be important for the efficient and effective delivery of services (Baines and Lightfoot, 2013). Coreynen, Matthyssens and van Bockhaven (2017) examined how digitalisation can drive servitization for manufacturers, for example, how digital tools can help to integrate front and back offices to facilitate standardisation, transaction cost reductions and scalability.

Organisational innovation

Organisational innovation requires the ability to adapt resources and activities to reconfigure capabilities during servitization. Neu and Brown (2005) focus on activities which will reconfigure capabilities in the following areas: strategy; people, processes, structure and key performance indicators (figure 3.5). Storbacka (2011) argues that this should include fundamental changes to marketing and production capabilities. The changes required in these areas are discussed in section 3.1.6 and summarised in figure 3.6, highlighting the necessary transition from transactional to relational characteristics for design and provision of advanced services.

Kindström, Kowalkowski and Sandberg (2013), consider one of the most important and complex areas to address is orchestration of the service system, which must be both effective and efficient (Baines and Lightfoot, 2013). In addition, they highlight the importance and challenges of product and service innovation, in particular, building a company wide service-orientated culture. Kanninen et al. (2017) in their study exploring dynamic capabilities within the process industry sector found that major challenges were not in creating services, but rather their visibility, communicating the value, business models and pricing. This is a reflection on transactional capabilities falling short where relational skills and processes are required, further reinforcing the emphasise of this aspect in figure 3.6. Kindström (2010) highlights that any resources which are adapted for services must be integrated cross functionally. Lütjen et al. (2019) add that external networks and ecosystems should also be integrated where appropriate.

Combining the insights of sections 3.3.1 to 3.3.3 led to the formation of the theoretical framework for the research, which is shown in table 3.3. This shows the four key capabilities for servitization (figure 3.6), classified as strategic dynamic capabilities (section 3.3.2). These require operational dynamic capabilities (section 3.3.3) for their application or development. Five operational dynamic capabilities (resources and activities) are identified for each strategic dynamic capability, which will enable an organisation to reconfigure their ordinary capabilities (resources and activities) for the design and provision of advanced services. At the more abstract level of strategic dynamic capabilities, each is either a sensing, seizing or reconfiguring activity. At operational dynamic capability level, to develop or apply each of four strategic capabilities requires all three activities of sensing, seizing and reconfiguring. The three constructs (sensing, seizing, reconfiguring) at the core of dynamic capability theory are closely related to the exploration and exploitation dichotomy (Lisboa, Skarmeas and Lages, 2011) and the entrepreneurial process model incorporating recognition, innovation and execution (McGuirk, Lenihan and Hart, 2015). This demonstrates the relevance of the concept and why it was chosen to form the foundations of the theoretical framework for conducting the research.

Strategic dynamic capability	Operational dynamic capability (micro-foundational activity or resource)	Supporting references
Vision Innovation (Sense)	**Sense** opportunities for advanced service	Kindström, Kowalkowski and Sandberg, 2013 Kindström and Kowalkowski, 2009 Edvardsson et al., 2006; Vargo and Lusch, 2008 Ulaga and Reinartz, 2011
	Customer, market, and competitor data	Kindström, Kowalkowski and Sandberg, 2013 Parida et al., 2014; Story et al., 2017
	Seize by evaluating opportunities and developing a new vision	Reichard, 2016 Treacy and Wiersema, 1997
	Influential champion to gain stakeholder support	Kotter, 1995
	Reconfigure existing vision and create a roadmap for implementation	Bartkus, Glassman and McAfee, 2000 Cohen and Levinthall, 1990
Service Innovation (Seize)	**Sense** potentially receptive customers for advanced service	Grönroos, 2011
	Customer relationship management system to segment and target based on needs	Kindström, Kowalkowski and Sandberg, 2013 Smith, Maull and Ng, 2014
	Seize by collaborating with customers to explore problems and design advanced service	Davies, Brady and Hobday, 2006 Kindström, Kowalkowski and Sandberg, 2013 Kindström and Kowalkowski, 2009 Edvardsson et al., 2006; Vargo and Lusch, 2008
	Devices to collect and analyse data on problems solved to demonstrate the value of advanced service	Baines and Lightfoot, 2013; Eggert et al., 2014 Kanninen et al., 2017
	Reconfigure product-service offerings to include advanced service	Osterwalder et al., 2014 Saul and Gebauer, 2018

Strategic dynamic capability	Operational dynamic capability (micro-foundational activity or resource)	Supporting references
Product Innovation (Seize)	**Sense** product development required to enable advanced service	Beltagui, 2018; Eisenhardt and Martin, 2000 Oliva and Kallenberg, 2003 Parida et al., 2014
	Cross functional systems to understand product usage, customer problems and needs	Bustinza, Parry and Vendrell-Herrero, 2013 Ulaga and Reinartz, 2011
	Seize by designing new or adapted products	Baines and Lightfoot, 2013; Burton et al., 2017
	Research and development facilities	Coreynen et al., 2020 Coreynen, Matthyssens and van Bockhaven, 2017 Bustinza, Parry, Vendrell-Herrero, 2013 Kindström, Kowalkowski and Sandberg, 2013
	Reconfigure product range to combine with advanced service	Burton et al., 2017; Davies and Brady, 2000 Wilkinson et al., 2009
Organisational Innovation (Reconfigure)	**Sense** changes required to resources and activities for design and provision of advanced service	Bartkus, Glassman and McAfee, 2000 Cohen and Levinthall, 1990
	Recruitment, training and incentives	Kindström, Kowalkowski and Sandberg, 2013 Lütjen et al., 2019; Parida et al., 2014 Story et al., 2017: Cova and Salle, 2008
	Seize by adapting resources and activities to build the required capabilities	Gaiardelli, Martinez and Cavalieri, 2015 Neu and Brown, 2005; Storbacka, 2011 Ulaga and Loveland, 2014 Ulaga and Reinartz, 2011
	Finance to fund investments	Neely, 2008
	Reconfigure by integrating the adapted resources and activities	Alghisi and Saccani, 2015 Eisenhardt and Martin, 2000 Gebauer and Friedli, 2005

Table 3.3 - Theoretical framework, comprising of four strategic dynamic capabilities and the operational dynamic capabilities for their development and application, with supporting references

Dynamic capabilities research has evolved primarily to explain sources of competitive advantage. Companies with high levels of dynamic capabilities display the capacity to learn and adjust, enabling them to continuously upgrade, protect and keep relevant their resource base in line with changing customer demands and market trends over time (Teece, 2007). This is essential to carry out the servitization transformation required for design and provision of services. Manufacturers who only partially transform and launch new services without first developing all the capabilities for their effective and efficient delivery are prone to failure (Lutjen, Tietze and Schultz, 2017). The cause of failing to sufficiently transform has been attributed to low levels of appropriate dynamic capabilities (Gebauer, Haldimann and Saul, 2017; Kindström, Kowalkowski and Sandberg, 2013). Therefore, it is important to understand how to measure and assess the level of the four strategic dynamic capabilities (section 3.3.2) to determine organisational readiness to begin. This is the topic of the next section.

3.3.4 Measurement and assessment of dynamic capabilities

Ambrosini, Bowman and Collier (2009) propose three distinct levels of dynamic capabilities, from low to high these are known as incremental, renewing, and regenerative dynamic capabilities. Their impact on the resource base varies from minor changes (incremental) in stable market conditions to major changes (renewing and regenerative) often in turbulent markets. They are defined as follows: -.

> *Incremental dynamic capabilities* represent minor adjustments and adaptations to existing products, services, and processes. These are simple, iterative changes for continuous improvement.

> *Renewing dynamic capabilities* are deployed to create or introduce new resources or combine existing ones in new ways. Examples include introduction of new products or adapting existing products for new markets.

> *Regenerative dynamic capabilities* represent the capacity to embed new or to improve existing incremental and renewing dynamic capabilities. They are required to embed new dynamic capabilities into a firm and will have an indirect impact on the resource base. An example is mergers and acquisitions.

A more accurate description for the levels proposed by Ambrosini, Bowman and Collier (2009) would be typologies. To assess and measure the levels of dynamic capabilities required for servitization, this research introduces the concept of intensity. Intensity is an important scientific concept, used to quantify for example, the strength of UV light required to produce a desired outcome. In the context of this research, intensity refers to the strength of dynamic capabilities

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required for servitization and differentiates from the descriptive levels proposed by Ambrosini, Bowman and Collier (2009).

To assess high or low intensity of dynamic capabilities it is necessary to understand how they can be measured. Dynamic capabilities create, modify or extend ordinary capabilities and cannot be measured directly. Operationalisation is therefore required to observe changes in ordinary activities and resources which are being created, modified or extended (Zahra, Sapienza and Davidsson, 2006). To understand operationalisation for observing changes in ordinary capabilities, Laaksonen and Peltoniemi (2018) undertook a systematic review of empirical dynamic capabilities studies to examine how they were measured. They found that four types of operationalizations are used: manager's evaluations; financial data; company's experience, actions and performance; and manager's or employee's experience, actions and performance. Based on their analysis, they provide eight recommendations for researchers. These are shown in figure 3.7 below, which emphasises the need to delineate ordinary and dynamic capabilities, avoid common method bias, take into account the quality and fitness rather than quantity and the use of longitudinal data.
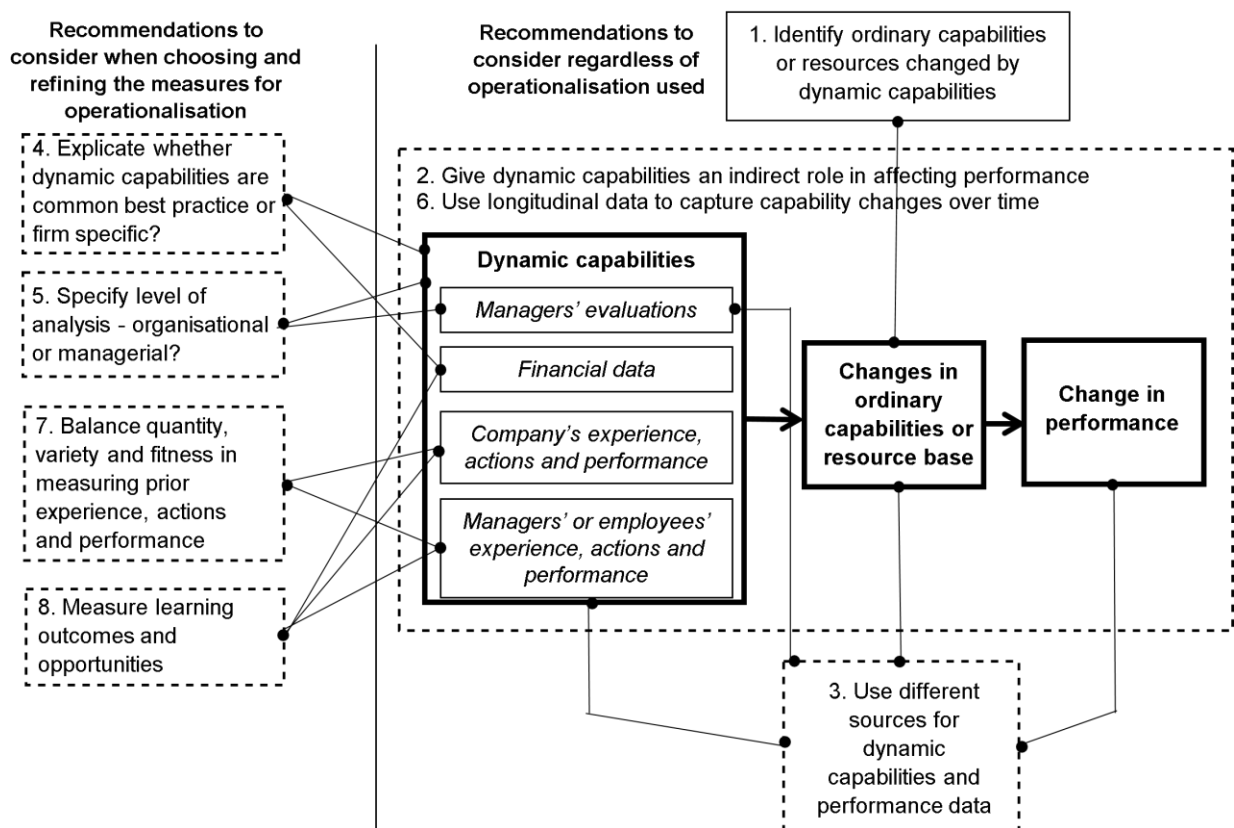
Figure 3.7 - Assessment criteria for measurement of dynamic capabilities. Adapted from Laaksonen and Peltoniemi (2018)

3.4   Boundaries of Knowledge Leading to Research Questions

This chapter has emphasised that manufacturers seeking to create new integrated product-service offerings need to innovate their business models through servitization. This will involve fundamental changes to resources and activities for building the required capabilities, which many companies fail to achieve. Failure can have severe consequences for SMEs and has been attributed to low levels of appropriate dynamic capabilities (Gebauer, Haldimann and Saul, 2017; Kindström, Kowalkowski and Sandberg, 2013), which prevents for example, effective service innovation (Morelli, 2006), business model innovation or replication for scale (Coreynen et al., 2017). However, literature is unclear on which dynamic capabilities are required, how they should be measured or the level necessary.

A common mistake is that servitizing companies tend to prioritise the development of new services, then rush to market without first considering the organisational wide changes required to enable their effective and efficient delivery (Kindström and Kowalkowski, 2014). This is a recurring problem, which is effectively replicated in the literature by recognition that servitization requires an organisation wide transformation, but then focussing on function-specific operational capabilities, usually in isolation and failing to link to strategic choices. How dynamic capabilities are combined is important (Gebauer, 2008), therefore there is a need for new knowledge, along with practice-orientated tools, which not only help managers understand the capabilities required, but also how they should be combined and sequenced to prioritise their development.

Four strategic dynamic capabilities associated with servitization, along with their operational dynamic capabilities (micro-foundations) have been identified from literature. However, questions remain relating to the levels required, along with how they should be measured, combined, and sequenced. These issues are explored in more detail in sections 3.4.1 to 3.4.3, which serve to highlight the boundaries of knowledge in the literature and lead to three research questions. Addressing these deficiencies in the existing knowledge base will make valuable contributions to theory and practice.

3.4.1 Intensity of dynamic capabilities to begin servitization

The cause of organisations failing to sufficiently transform during servitization has been attributed to low levels of appropriate dynamic capabilities (Gebauer, Haldimann and Saul, 2017; Kindström, Kowalkowski and Sandberg, 2013). This prevents for example: effective service innovation (Morelli, 2006); business model change (Kindström and Kowalkowski, 2014) or replicating for scale (Coreynen et al., 2017). However, literature is not clear on the levels required and how they should be measured. To measure the levels of the four key strategic dynamic capabilities

associated with servitization, this research introduces the concept of intensity (section 3.3.3). However, to determine organisational readiness to begin servitization it is necessary to understand if high levels of intensity are required in all four.

This led to the first research question.

Research question 1: *Do product-centric SMEs require high intensities in all four strategic dynamic capabilities to begin servitization?*

3.4.2 Combinations of dynamic capabilities to begin servitization

In addition to which dynamic capabilities are required, and their intensity, Gebauer (2008) argues that it is not just about individual capabilities, but how they are combined which is often crucial. However, most studies usually analyse capabilities in isolation (Sjödin, Parida and Kohtamäki, 2016), which can imply all capabilities are equally important. For example, a research study by Kindström, Kowalkowski and Sandberg (2013) extends the examples of operational dynamic capabilities (Eisenhardt and Martin, 2000) by specifically considering the service aspect. This produced a non-exhaustive list of activities companies can undertake to develop or apply strategic dynamic capabilities for servitization but did not explain how they should be combined. This approach may be enough for large multi-national organisations, however SMEs have limited resources and cannot simultaneously develop or apply all the capabilities required and will need to prioritise.

It is essential that SME managers not only understand which capabilities are required, but also how they should be combined. This will enable an assessment of their existing capabilities in comparison to those required for determining readiness to begin (Böhm, Eggert and Thiesbrummel, 2017). It is therefore necessary to go beyond the direct effects of adapting individual resources and activities (Möller et al., 2006) by adopting a configurational approach. This is supported by Forkmann et al. (2017), who noted a lack of research in this area and called for more configurational research. Their study shows that more is not always better, and that successful services-led strategies can be achieved without fully developed service capabilities. However, with few exceptions (Böhm, Eggert and Thiesbrummel, 2017; Sjödin, Parida and Kohtamäki, 2016), qualitative studies on servitization assume that more is better with respect to the net-effect of individual capabilities. Similarly, quantitative research often applies statistical methods that do not fully account for the combinational nature of capabilities (Eggert et al., 2014; Antioco et al., 2008).

Black and Boal (1994) add that interdependencies between capabilities can enable or inhibit the servitization process (Sjödin, Parida and Kohtamäki, 2016; Parida and Örtqvist, 2015). This could

result in multiple causal combinations for an outcome (Amenta and Poulson, 1994) and suggests that all capabilities may not be required in all cases, particularly at the start of the servitization process. Alternatively, SMEs lacking any of them, could be setting themselves up for failure. Despite this, little consideration has been given to which combinations of capabilities lead to similar or differing outcomes (Sjödin, Parida and Kohtamäki, 2016), or the sequence of choices for development or deployment.

This led to the second research question:

Research question 2: *Which combinations of high and low intensities of the four strategic dynamic capabilities enable product-centric SMEs to begin servitization?*

3.4.3 Sequencing of dynamic capabilities during servitization

The previous section discussed the configurational nature of servitization, arguing that how capabilities are combined can be just as important as possessing the individual capabilities likely to be required. Gebauer, Paiola and Edvardsson (2012), highlight the capabilities required during servitization will vary depending on strategy and pathway, which is likely to be influenced by context (Turunen and Finne, 2014). This means that SMEs could start the process without processing all the capabilities which will be required and might not appreciate how they should be developed to enable success.

The Teece framework is designed to help structure the thinking of practitioners, in this case sensing and seizing opportunities for product-service innovation and reconfiguring resources and activities to build the necessary capabilities. It implies that the activities of sensing, seizing and reconfiguring should be undertaken sequentially and in a linear manner. However, this is unlikely in practice, particularly within SMEs where the environment can be chaotic at times. Sensing would be expected to come first, however, reconfiguration of some resources and activities is likely to be required before seizing activities can begin and perhaps even before sensing. In addition, it is envisaged there will be considerable back and forth movement. At corporate level, it might be necessary to manage these activities concurrently when numerous business units are undertaking different stages of transformation and proceeding at different rates. This emphasises the management imperative of prioritising and sequencing activities which operationalise both strategic and operational dynamic capabilities. SMEs have limited resources and will not be able to simultaneously develop all the capabilities required for servitization. However, literature is unclear on how dynamic capabilities should be sequenced during servitization to enable prioritisation.

This led to the third research question:

Research question 3*: How should product-centric SMEs sequence their development and application of the four strategic dynamic capabilities during early stage servitization?*

3.4.4 Theoretical framing of the research

Four key strategic dynamic capabilities are identified from the literature, namely: vision innovation; service innovation; product innovation; and organisational innovation. However, questions remain concerning the measurement and required intensity of these capabilities, along with how they should be combined and sequenced, particularly for SMEs.

Key assumptions and gaps in knowledge leading to …   *the research questions*

Intensity of dynamic capabilities

Companies with low levels of dynamic capabilities are susceptible to servitization failure and the consequences can be severe, particularly for SMEs … *however, the literature does not explain how they should be measured or levels required.*

Research question 1

Do product-centric SMEs require high intensities in all four strategic dynamic capabilities to begin servitization?

Combining dynamic capabilities

Most studies examine dynamic capabilities in isolation, implying equal importance. However, it is not just individual capabilities, but their right combination and fit which is important. The literature suggests that different pathways can be taken during servitization *… but does not explain how dynamic capabilities should be combined.*

Research question 2

Which combinations of high and low intensities of the four strategic dynamic capabilities enable product-centric SMEs to begin servitization?

Sequencing dynamic capabilities

SMEs have limited resources and cannot simultaneously develop all the dynamic capabilities required for servitization … *however, the literature does not explain how the development and application of dynamic capabilities should be sequenced to allow prioritisation.*

Research question 3

How should product-centric SMEs sequence their development and application of the four strategic dynamic capabilities during early stage servitization?

Figure 3.8 - Summary of theoretical framing for the research

Addressing these research questions will help SMEs to assess their capabilities in relation to those required to pursue servitization. This will enable determination of readiness to begin, which will build confidence and accelerate the adoption of servitization amongst SMEs.

3.5   Summary

This chapter thematically reviews the literature and develops the theoretical foundation for the research. Firstly, it examines the extant knowledge on servitization across four major research streams to establish the definitions, assumptions, and constructs (section 3.1). It develops its own insight (section 3.2) by drawing together supporting blocks of knowledge (figure 3.6). This establishes the notion that servitization is facilitated by the combination and sequencing of four key capabilities, namely: vision innovation; service innovation; product innovation and organisational innovation. These key capabilities are subsequently categorised as strategic dynamic capabilities (section 3.3.2), arguing that during servitization a manufacturing company should sense opportunities for advanced services (vision innovation) and seize these opportunities (service innovation and product innovation) and reconfigure their operational capabilities as required (organisational innovation).

Literature suggests that manufacturer's attempting to provide services without sufficiently reconfiguring their operational capabilities (section 3.3.3) are prone to failure. This is attributed to low levels of dynamic capabilities (Kindström and Kowalkowski, 2014). In addition, how dynamic capabilities are combined (Gebauer, 2008) and interdependencies (Black and Boal, 1994; Parida and Örtqvist, 2015) can enable or inhibit servitization success. However, literature is unclear on the level of dynamic capabilities required or how they should be measured (section 3.4.1), along with how they should be combined (section 3.4.2), and sequenced (3.4.3) for servitization success, particularly for SMEs. This led to three research questions (figure 3.8).

The next chapter explains the process of research design. A set of principles are developed to shape a research programme which provides the most appropriate way of addressing the research questions. Answering these questions will make an important contribution to knowledge, plus enable UV Light Technology Limited and other SMEs to assess their strategy-capability fit to determine organisational readiness for servitization towards advanced services.

Chapter 4

Development of Research Programme

The previous chapter reviewed the state of the art in the literature and developed the theoretical foundation for the research. It framed the servitization transformation process as the combination and alignment of four key capabilities, namely: vision innovation; service innovation; product innovation and organisational innovation. These core elements were subsequently categorised as dynamic capabilities (section 3.3), to sense opportunities for advanced services (vision innovation), then seize them (service innovation and product innovation) whilst reconfiguring their capabilities (organisational innovation). Literature suggests that manufacturers attempting to provide services without sufficiently transforming are prone to failure, which is attributed to low levels of dynamic capabilities (Kindström and Kowalkowski, 2014). However, literature is unclear on the level required or how dynamic capabilities should be measured (section 3.4.1), along with how they should be combined (section 3.4.2), and sequenced (3.4.3) for servitization success, particularly for SMEs. This led to three research questions (figure 3.8).

This chapter explains the process of research design, which through development of a set of principles shapes a research programme to provide the most appropriate way of addressing the research questions. It first sets out the aim and research questions (section 4.1), then explains the process of research design (section 4.2), which culminates in the research programme (section 4.3) to answer the research questions. The research design considers the different options available to answer the research questions and explains the reasons behind the choices made. An explanation is provided on how a researcher's philosophical position (section 4.2.1) and approach to theory development (section 4.2.2) influences the choice of methodology (section 4.2.3), strategy (4.2.4), time horizon (4.2.5), methods and techniques (4.2.6). This provides the methodological link between the research aim and questions on one hand and the strategy and methods chosen to collect and analyse data on the other.

4.1   Aim and Research Questions

The aim of the research is to help accelerate the adoption of servitization within SMEs, by understanding and explaining the capabilities they require for servitization and how their development and application should be prioritised. Four strategic dynamic capabilities (section 3.2) along with the operational capabilities required for their development and application (section 3.3.2) are evident from the literature. However, questions remain concerning the required intensity of these capabilities, along with how they should be combined and sequenced for servitization success, particularly for SMEs. This led to the following research questions:

> **Research Question 1** (section 3.4.1) - Do product-centric SMEs require high intensities in all four strategic dynamic capabilities to begin servitization?

Research Question 2 (section 3.4.2) - Which combinations of high and low intensities of the four strategic dynamic capabilities enable product-centric SMEs to begin servitization?

Research Question 3 (section 3.4.3) - How should product-centric SMEs sequence their development and application of the four strategic dynamic capabilities during early stage servitization?

To answer these research questions requires data with breadth and depth. Research question 1 requires broad data for development of a data analysis instrument to measure and assess the intensity of dynamic capabilities required to begin servitization. To answer research questions 2 and 3, in-depth insights are essential to examine how dynamic capabilities should be combined and sequenced to begin servitization. To meet these criteria a series of choices are necessary to develop a structured and coherent research design, culminating in a set of principles which are subsequently translated into a research programme (section 4.3). The next section explains the choices made during each stage of the research design.

4.2   Research Design

According to Saunders, Lewis and Thornhill (2016) the choices to be made during each stage of a research design can be represented as a series of layers, depicted by their research onion, an adapted version of which is shown in figure 4.1. This framework breaks down into 6 stages, which are: (1) philosophy; (2) approach to theory development; (3) methodology; (4) strategy; (5) time horizon; (6) methods and techniques. Each of these stages contain the options available. Sections 4.2.1 to 4.2.6 consider and reflect on each option in turn, from the outer layer to the core, leading to a series of choices which establish a set of principles shaping the research programme (section 4.3).
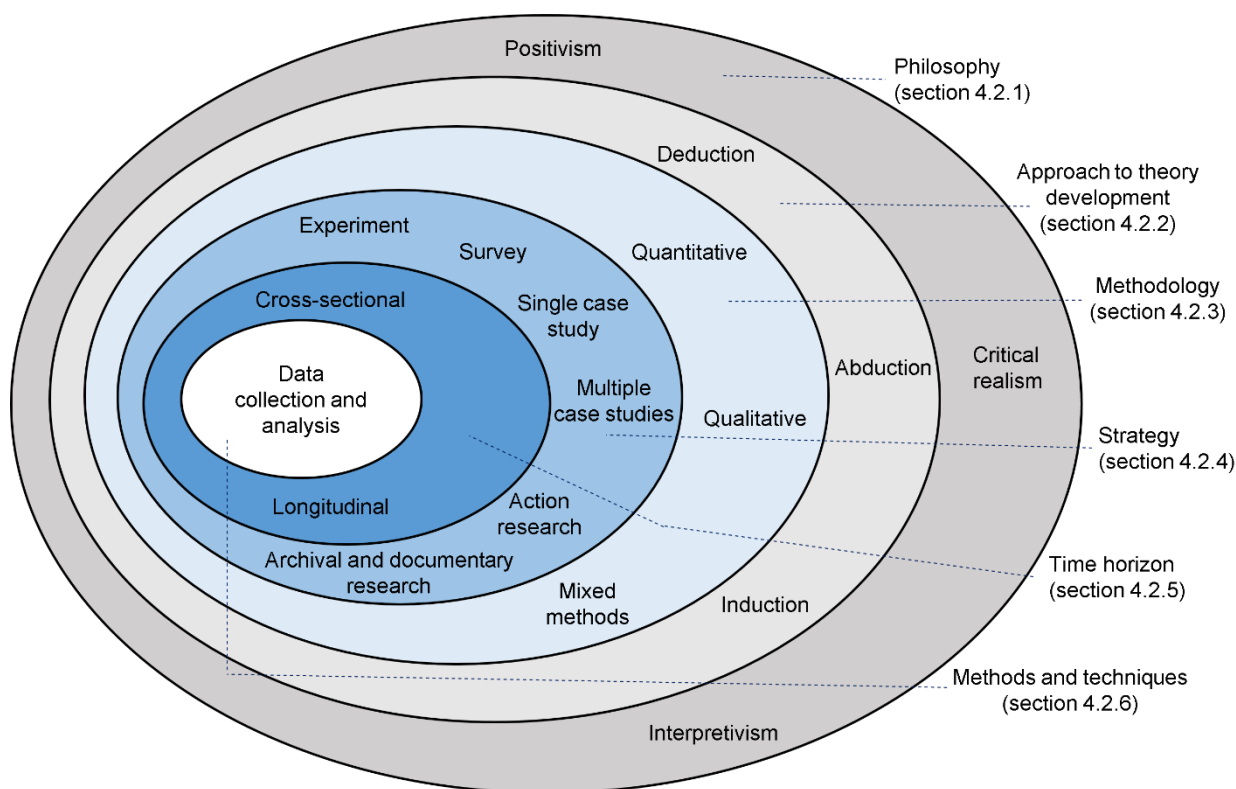
Figure 4.1 - Summary of choices to be made at each stage of the research design
Adapted from Saunders, Lewis and Thornhill (2016)

4.2.1 Philosophy

Philosophy is the way a researcher thinks about organisational realities and makes assumptions on what constitutes valid, relevant knowledge (Saunders, Lewis and Thornhill, 2016). Business and management disciplines have absorbed philosophies from natural sciences, social sciences, arts and humanities. This offers a rich diversity of philosophical choices and associated methodologies for business administration researchers, which can be positioned on a continuum between two extremes of objectivity (positivism) and subjectivity (interpretivism). The choices can be summarised as positivism, interpretivism or critical realism.

Positivism incorporates the assumptions of natural science, arguing that knowledge exists as a single reality and can only be discovered through observation and measurement to enable subsequent generalisation. Positivists argue that research should be free of values which could bias findings, viewing organisations as a collection of defined roles and procedures within a formal structure. Alternatively, interpretivism incorporates assumptions from social sciences, arts and humanities, arguing that knowledge is socially constructed and embedded in the interactions between people and their environments. Interpretivists argue that managers should be free to attach their individual meanings to a role and how it is performed. This leads to multiple realities based on opinions and narratives rather than numbers.

Critical realism takes a middle ground on the objective to subjective continuum. Whereas positivists argue that our observations portrait the world accurately (or what you see is what you get), a critical realist focusses on explaining what we observe in terms of underlying causal mechanisms (Bhaskar, 1978) and not by reducing to quantitative statistical correlations (Reed, 2005). This often requires in-depth, longitudinal studies, where researchers cannot detach themselves from the research process, but seek to minimize bias and be as objective as possible.

This research is based on Engaged Scholarship, which is inclusive in nature. Ontologically, it adopts Bhaskarian critical realism, but with an interpretivist evolutionary epistemology. It embraces a collaborative approach to leverage the different perspectives and competencies of academics and practitioners. The aim is to co-produce insightful and penetrating knowledge of mutual benefits. Research questions are grounded in practice and involve practitioners in theory building, research design and problem solving (Van de Ven and Johnson, 2006). This increases the likelihood of advancing knowledge, whilst enlightening the practice of a profession by engaging people whose perspectives are relevant for each step of the research process. This is summarised below in figure 4.2 which is an adapted version of Van de Ven's Engaged Scholarship Model.

Problem Formulation

Situate, ground, diagnose and infer the problem up close and from afar.

Engage those who experience and know the problem.

Criterion – relevance

Theory and practice

Research Design

Develop a process or variance model to create theoretical framework.

Engage research method experts and people providing access and information.

Criterion – rigour

Practical application framework

Collaborative learning environment where practitioners and academics come together to solve problems of mutual benefit

Theoretical framework

Problem Solving

Communicate, interpret and negotiate findings with intended audience.

Engage intended audience to interpret meanings and uses.

Criterion – impact

Solution

Theory Building

Create, elaborate and justify a theory by abduction, deduction and induction.

Engage knowledge experts, in relevant disciplines to discuss theory and its plausible alternatives.

Criterion – validity

Figure 4.2 - Approach based on Engaged Scholarship. Adapted from Van de Ven (2007)

The research questions require the capture of broad and in-depth data, which enables the identification of causal mechanisms to provide explanation. The engaged scholarship approach aligns well with both a critical realist and interpretivist philosophical position. Therefore, critical realism with elements of interpretivism is the choice of philosophy for this research. This decision will influence subsequent choices at each stage of the research design (Burrell and Morgan, 1979; Crotty, 2021). These include choices on approach to theory development (section 4.2.2); methodology (4.2.3); strategy (4.2.4); time horizon (4.2.5); methods and techniques (4.2.6).

4.2.2 Approach to theory development

The objective of theory building is to develop a plausible conceptual model or framework to answer the research questions. The central theme of the engaged scholarship model (figure 4.2) is the close interplay between theory and practical reality, with theory building involving three activities: (1) conceiving or creating a theory; (2) constructing or elaborating the theory; and (3) justifying or evaluating the theory. These activities entail different patterns of reasoning which can be summarised as deduction, induction and abduction.

Research which starts with theory, often from a literature review, is designed to provide an explanation or prediction by testing the theory and is known as a deductive approach. Conversely, where research starts by collecting data to explore a phenomenon and build theory (often in the form of a theoretical framework), this is an inductive approach. Alternatively, instead of moving from theory to data (deduction) or data to theory (induction), these approaches can be combined by moving back and forth between theory and data. This known as an abductive approach.

A topic on which there is a wealth of literature from which a theoretical framework or hypothesis can be defined and systematically tested lends itself more readily to deduction. This is best suited to searching for causal relationships between concepts and variables, particular in scientific research and is favoured by positivists. For new topics, with limited existing literature, it may be appropriate to work in an exploratory manner to inductively generate data for identification of themes or patterns to build or modify theory. This approach is favoured by interpretivists. Alternatively, a topic with a wealth of information in one context, but far less within a particular research context, will suit an abductive approach to enable elaboration of existing theories to suit.

A review of literature (chapter 3) reveals a wealth of information in the context of large multi-national organisations but far less for SMEs. The research questions are specifically related to SMEs and require a richer theoretical perspective than already exists for SMEs. This aligns well with an abductive approach and the choices made in the first layer of the research onion.

Therefore, the choice of approach for the three theory building activities for this research are (1) conceiving or creating a theory is inductive; (2) constructing or elaborating the theory is abductive; and (3) justifying or evaluating the theory is deductive.   These choices and the choice of philosophy (section 4.2.1) influence subsequent choices for research design, which are represented by the next four layers of the research onion. The research design starts with a methodological choice, which is covered by the next section.

4.2.3 Methodology

The previous section on building a plausible theory to answer research questions which aim to address practical problems, sets the scene for research design. Since theories cannot be directly observed, they need to be represented by a research design for operationalisation. There are three approaches for designing research, namely, quantitative, qualitative or a mixture of both (mixed methods). Each of these methodologies are associated with a particular philosophy (section 4.2.1) and approach to theory development (section 4.2.2).

Quantitative research is generally associated with positivism and used with pre-determined, highly structured experimental or survey data collection techniques, to investigate variance or causal questions of 'what causes what'. It usually takes a deductive approach to explanation, by examining relationships between known independent input variables and dependant output variables to test theory. These are measured numerically and analysed using statistical methods. Evidence of causality is based on co-variation, temporal precedence, and absence of spurious associations between the independent and dependent variables (Tsoukas, 1989).

Conversely, qualitative research is generally associated with interpretivism and used for exploratory studies to investigate process questions of how things develop and change over time. It usually takes an inductive or abductive approach to explanations, which tell a story about how a sequence of events unfold over time to produce a given outcome. This builds theory, by developing a richer theoretical perspective than already exists in the literature, in this case servitization within SMEs. Stake (2005) argues the main difference between quantitative and qualitative research is that the former seeks explanations, while the later looks to gain understanding by exploration. Evidence of causality requires explanation of an observed sequence of events, in terms of an underlying generative mechanism which causes the events to happen in the circumstances. (Tsoukas, 1989).

Whereas, qualitative methods typically limit generalisability, due to small sample sizes, statistical quantitative approaches tend to reduce cases to variables, which are often unrealistic and cannot claim causality. For example, cluster analysis and deviation scores provide limited insights

regarding how capabilities work together (Fiss, 2011). The type and nature of the research questions require both understanding by exploration and explanation of causality. This aligns well with a mixed methods approach combining both quantitative and qualitative techniques within a research design. A mixed methods approach also aligns well with the approaches to building theory (section 4.2.1) and critical realist philosophy with elements of interpretivism (section 4.2.1). Therefore, mixed methods is the choice of methodology for this research. This methodological choice links the research questions and their context to the most appropriate strategy, which is covered in the next section.

4.2.4 Strategy

In general terms, a strategy is a plan of action to achieve objectives. A research strategy can therefore be defined as a plan of how a researcher will go about answering their research questions. In addition, more pragmatic concerns, such as time and resources available, plus access to participants should also be considered. It represents the methodological link between philosophy and approach to theory building on one hand and choice of methods to collect and analyse data on the other (Denzin and Lincoln, 2011). It must therefore demonstrate coherence with the researcher's philosophy, approach to building theory and methods employed.

A wide variety of research strategies can be employed to gather evidence in the form of empirical data to answer the research questions. Various options were explored, some of which were quickly discounted, for example, ethnography which is used to study culture and in this case was too narrow in scope. Those considered in more detail include:- experiment; survey; archival and documentary research; action research. These are all covered below, with reasons why they are considered inappropriate for this research, leading to the final option of case study.

Experiment

Experiments with their roots in the natural sciences are considered the 'gold standard' by positivists. An experiment is a deductive form of research, which studies the probability of a change in an independent variable causing a change in another dependent variable. Predictions, known as hypothesis, are used rather than research questions and the aim is to determine whether there is a link between variables. Quantitative scholars argue that experiments are esteemed, because they aim to address the effectiveness of an intervention (Jadad and Enkin, 2007). However, experiments have limited ability to explain how or why an intervention was effective or not, whilst case studies can investigate these issues (Shavelson and Towne, 2002). Therefore, an experiment is considered inappropriate, because the study is primarily concerned with understanding how capabilities are combined and sequenced during servitization.

Survey

A survey is usually associated with a deductive approach and frequently used to answer 'what', 'who', 'where', 'how much' and 'how many' questions. Applications are therefore exploratory and suit descriptive studies. These seek to collect structured data from a sizeable population in an economical manner for easy comparison. However, surveys are now irritatingly overused, particularly by organisations constantly asking for feedback. It is therefore not unreasonable to expect difficulties in obtaining the engagement of respondents and their goodwill is only likely to be maintained if the number and complexity of questions is limited. In addition, people are reluctant to give long written responses in surveys, limiting the depth and richness of data which can be collected (Saunders, Lewis and Thornhill, 2016). These reasons meant that a survey is inappropriate, because an important element of the study is explanatory in purpose, as indicated by the nature of the research questions, which require rich in-depth insights.

Archival and documentary research

Digitalisation of data and on-line archives are likely to increase the interest and scope in this research strategy. However, in common with a survey, this is ruled out as a source of primary empirical data because of the nature of the research questions. Archival and documentary research is appropriate to collect secondary data for supplementing primary data and triangulation purposes.

Action research

This would require the researcher to participate in events by identification of issues, then planning, executing and evaluating actions. It represents an emergent and iterative process designed to promote change within an organisation. This may have been a viable option if the study was limited to a single case study, however action research is ruled out on the grounds of generalisability.

Case study

A case study is a comprehensive inquiry into a topic within its real-life setting (Yin, 2018). This enables the examination of the interactions between the subject of the case and its context, with potential to generate rich, in-depth insights. Various approaches have been adopted, depending on the researcher's perspective, for example, Stake (2005) favours an interpretive and inductive approach, whilst Yin (2018) is very systematic and leans towards positivism. A case based approach which represents the middle ground between qualitative and quantitative analysis is qualitative comparative analysis (QCA). This combines the strengths of variable and case based analysis. It enables the capture of broad data which recognises the complexities of servitization, whilst retaining the perspectives of individual cases and their context (Fiss, 2007; Fiss, 2011).

The research questions require broad data for developing a data analysis instrument to measure and assess the required intensity of four strategic dynamic capabilities to begin servitization. In addition, in-depth data is required to explore how and why these capabilities should be combined and sequenced. This, along with the focus on contemporary events within their context aligns well with a case study research strategy. Therefore, multiple case studies is the choice of strategy for this research. This choice aligns well with the approaches to building theory and critical realist philosophical position. It also provides the link between the research questions and their context to the mixed methods methodology discussed in the previous section. The next section discusses the time horizon of the research programme.

4.2.5 Time horizon

The time horizon is the time frame for collecting and analysing data to answer the research questions. This depends on whether the study is cross-sectional or longitudinal. A cross-sectional study collects data in one shot, at a single point in time. Longitudinal studies collect data at more than one point in time and can establish sequences of events.

To answer research questions 1 and 2 requires broad data to inductively develop a data analysis instrument, involving multiple case studies comprising of a relatively large number of cases. This aligns well with a cross-sectional study. In contrast, research question 3 requires in-depth data to explain how sequencing dynamic capabilities enables or inhibits servitization, which aligns well with a longitudinal study. Therefore, a cross-sectional study is the choice of time horizon to answer research questions 1 and 2, whilst a longitudinal study is the choice to answer research question 3. This led to the work been carried out in two phases. The choice of methods and techniques used to collect and analyse data in both phases of the research programme are discussed in the next section.

4.2.6 Methods and techniques

Case study research can use various methods for data collection. The six major sources of evidence are: documentation; archival records; interviews (including focus groups); direct observations; participant observation and physical artifacts. Examples and their comparative strengths and weaknesses are summarised in table 4.1. These are complementary, and triangulation of multiple independent sources of evidence allows a deeper understanding of contextual conditions (Eisenhardt, 1989; Driva, 1997).

To answer research question 1 narrative data from semi-structured interviews is collated and thematically analysed (chapters 5 and 6). This prepares the ground for a qualitative comparative

analysis (QCA) to answer research question 2 and complete phase 1 of the research programme. The configurational nature of QCA enables the examination of combinations of dynamic capabilities required to begin servitization, rather than individual capabilities. It is a formalised analysis of empirical cases to examine configurational relationships between conditions and equifinality of outcomes. QCA is a set theoretic approach where conditions (variables) and outcomes are conceived as sets, in which the cases have membership or non-membership (Ragin, 1987; Rihoux and Ragin, 2009). Boolean algebra reveals causal mechanisms by identifying the common conditions of cases with the same outcome to reveal the different combinations (pathways) leading to the outcome. These are expressed as solution formula, which only make sense if the constitutive conditions are related to theory and subsequently re-interpreted by returning to the cases. This iterative movement between induction and deduction align well with the critical realism perspective of observing and analysing the mechanisms underlying the occurrence of events.

Gerrits and Verweij (2013) argue that critical realism links complexity and QCA through four properties of reality: non-decomposable; contingent; non-compressible and time asymmetric (Byrne, 2011). They posit that although QCA is inevitably reductive and partial, its core premises are built on the notions of contingency and time asymmetry. This leads to their conclusion that QCA is not only a powerful method for conducting complexity informed research but is also a complexity informed method. QCA is both an approach and technique which has been used previously in servitization studies to understand equifinality, in other words, how different combinations of conditions can result in the same outcomes (Forkmann et al., 2017; Lexutt and Fliess, 2018). It also finds support from Ganter and Hecker (2014), who argue that QCA is particularly suitable for configurational analysis of organisational innovation.

Visser et al. (2005) highlight that different data collection methods and techniques capture different levels of knowledge (figure 4.3). To answer research question 3 (phase 2) requires rich and in-depth data, which goes beyond the fragmented narratives and structural constraints of interviews. Therefore, a series of focus groups are used to generate longitudinal data based on deep level, tacit and latent knowledge, across a range of experiences.

Source of data evidence	Strengths	Weaknesses
Documentation e.g., news articles, brochures, web sites, blogs	• Stable - can be reviewed repeatedly • Unobtrusive - if not created during the case study • Specific - can contain names, references and details of an event • Broad - can cover a long-time span, over many events	• Access could be deliberately withheld • Biased selectivity if collection is incomplete • Reporting bias - reflects unknown bias of the author
Archival records e.g., Companies House	• (*Same as those for documentation*) • Usually quantitative and precise	• (*Same as those for documentation*) • Limited access due to confidentiality
Interviews: structured, un-structed, semi-structured, focus groups	• Targeted - to focus directly on topics • Provide explanations as well as personal views (e.g., perceptions, attitudes, and meanings)	• Bias due to poorly articulated questions • Response bias • Inaccuracies due to poor recall • Interviewee may say what interviewer wants to hear
Activity observation	• Immediacy - covers actions in real time and context	• Time consuming • Broad coverage difficult without a team of observers • Activities may proceed differently because participants know they are being observed • Potentially expensive
Participant observation	• (*Same as above for activity observation*) • Insightful into interpersonal behaviour and motives	• (*Same as above for activity observation*) • Bias due to participant or observer manipulation of events
Physical artifacts, devices and tools	• Insightful into technical operations and cultural features	• Selectivity • Availability

Table 4.1 - Strengths and weaknesses of different sources of case study evidence. Adapted from Yin (2018)
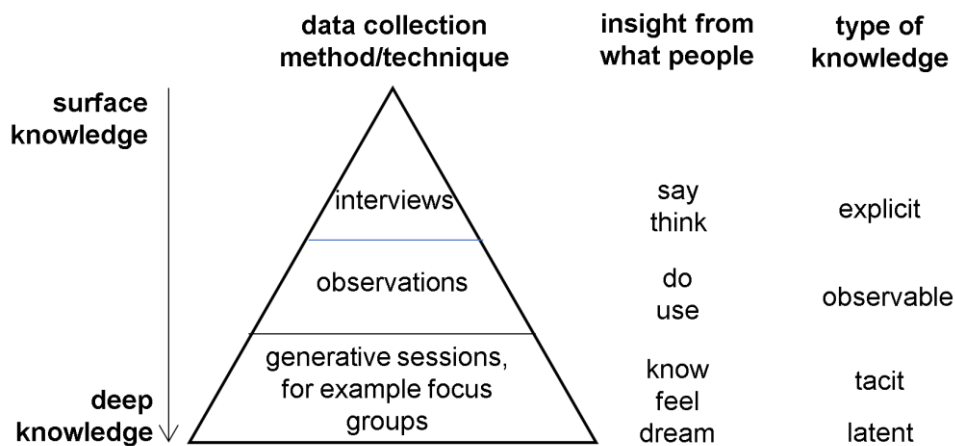
Figure 4.3 - Data collection methods and techniques to access different levels of knowledge. Adapted from Visser et al. (2005)

4.3 Research Programme

According to Saunders, Lewis and Thornhill (2016) to develop a research programme requires choices to be made at each stage of the research design process. The stages are represented as a series of layers, depicted by their research onion and comprising of: (1) philosophy; (2) approach to theory development: (3) methodology: (4) strategy; (5) time horizon; (6) methods and techniques. Each of these stages have been considered in turn, from the outer layer to the core in sections 4.2.1 to 4.2.6 respectively. Reflections led to a series of choices which are summarised below in figure 4.4.
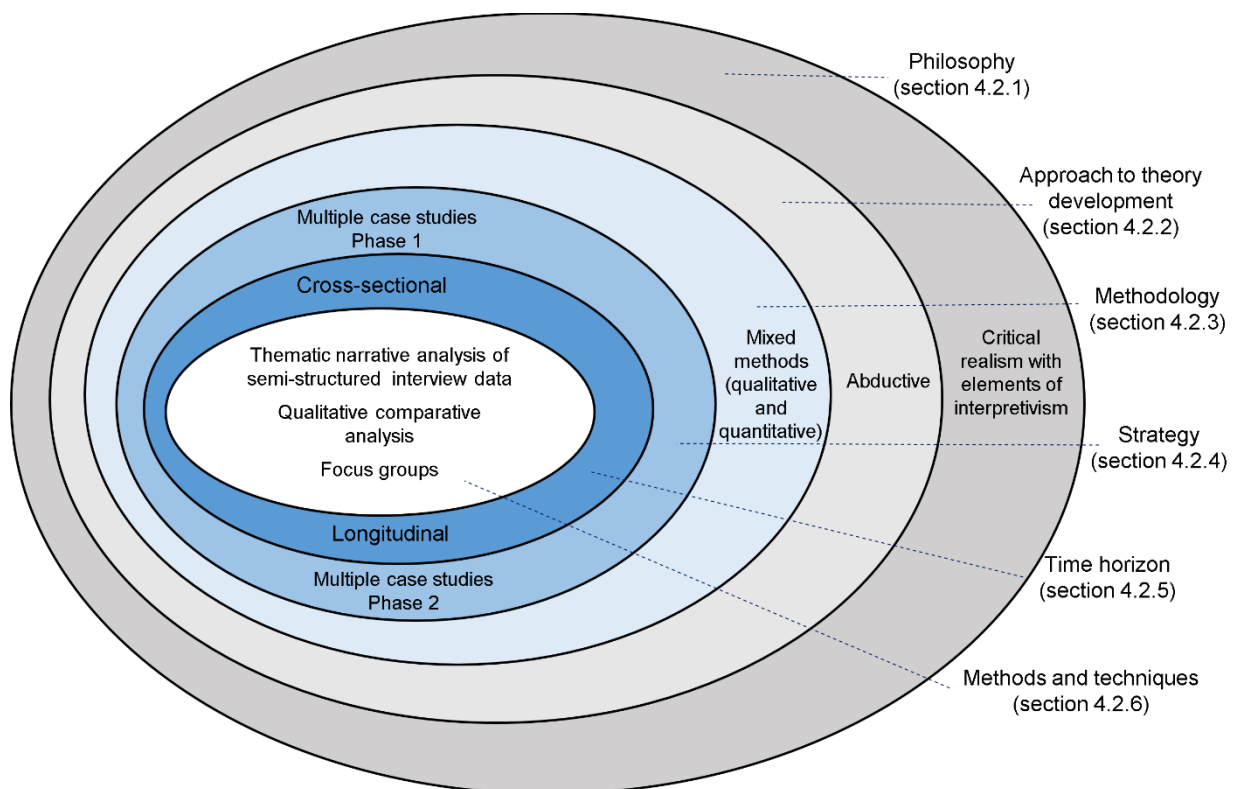
Figure 4.4 - Research design. Adapted from Saunders, Lewis and Thornhill (2016)

The first stage of a research design is to establish the philosophy (section 4.2.1). Three choices were considered, positivism, interpretivism and critical realism. The most appropriate is critical realism with elements of interpretivism. In the second stage the choice for approach to theory development activities (section 4.2.2) combines induction and deduction (abductive). The third stage considered numerous options for methodology (section 4.2.3) leading to the choice of mixed methods. The fourth stage also considered numerous options for strategy (section 4.2.4) and the choice was multiple case studies. The fifth stage chose a cross-sectional time horizon to answer research questions 1 and 2, whilst a longitudinal time horizon was the choice for collecting data to answer research question 3. This led to a research programme comprising of two separate but

related phases. The sixth and final stage considered numerous options before choosing semi-structured interviews as the method to collect data for answering research questions 1 and 2 in phase 1, along with focus groups in phase 2 to answer research question 3. This series of choices establishes a set of principles which shape the research programme, comprising of a sequence of activities summarised below in figure 4.5.
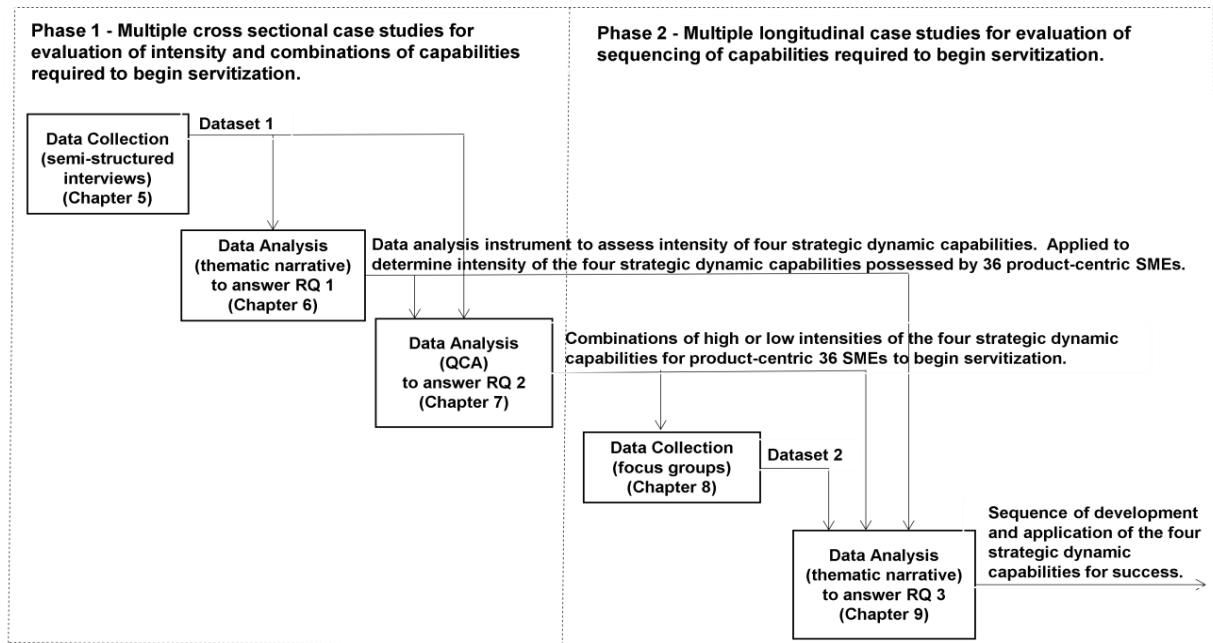
Figure 4.5 - Research programme

Phase 1 is a cross sectional study for generation of a broad data set (chapter 5) to determine the intensity (chapter 6) and combinations (chapter 7) of four strategic dynamic capabilities required by SMEs to begin servitization. It comprises of multiple case studies, analysing 36 SMEs exploring servitization, some of whom began to servitize, whilst others failed to progress. A theoretical framework based on four strategic dynamic capabilities and the operational capabilities for their development and application (table 3.3) is elaborated from empirical data to identify indicators and scoring criteria (table 6.2). This creates a data analysis instrument to measure and assess the intensity of the four strategic dynamic capabilities possessed by each company to answer research question 1. A subsequent qualitative comparative analysis examines which combinations of high or low intensities of the four strategic dynamic capabilities enable the case companies to begin servitization to answer research question 2.

Phase 2 is a longitudinal study comprising of 6 SMEs from the first phase who began to servitize. Participants attended a series of 6 focus groups over a period of 12 months. These multiple case studies generate in depth data to explore how the sequence in which the four strategic dynamic capabilities are applied during the initial stages of servitization enable or inhibit progress, to answer research question 3.

4.4 Summary

This chapter sets out the aim and research questions (section 4.1), then explains the process of research design (section 4.2). During each stage of the research design, the different options available to answer the research questions are considered and explanations provided for the choices made. It establishes a set of principles to shape a two-phase research programme (section 4.3). This represents the formulation of the most appropriate way to address the research questions within a coherent programme of study, comprising of two separate but related multiple case studies. The next chapter covers the design and execution of multiple case studies in phase 1 for collecting data to answer research questions 1 and 2.

Chapter 5
Design and Execution
of Multiple Case Studies
(Phase 1)

The previous chapter set out the aim and research questions (section 4.1), then explained the process of research design (section 4.2), which established a set of principles (figure 4.4) to shape a two-phase research programme (section 4.3).   This represented the formulation of the most appropriate way to address the research questions within a coherent programme of study. It comprises of two separate but related multiple case studies (figure 4.5) for collection and analyse of data with both breadth and depth.

This chapter covers the design and execution of multiple case studies during phase 1, which generates data for analysis in chapters 6 and 7 to answer research questions 1 and 2 respectively. It follows a process for design and execution of case studies adapted from a section of Eisenhardt's (1989) protocol for case study research. This comprises of a series of activities in four stages, which are summarised below in table 5.1. These are: design of case studies (section 5.1); selection of cases (section 5.2); data collection method (section 5.3) and measures to ensure rigour in data collection (section 5.4).

Stage	Activity	Reason
Design of case studies (section 5.1)	Design multiple case studies following the 5 aspects recommended by Yin (2018) - see table 5.2.	Described in section 5.2.
Selection of cases (section 5.2)	Selection of 36 SMEs from product-centric organisations exploring the concept and opportunities of servitization towards advanced services.	Ensure common background features and context to define the domain of investigation, with sufficient heterogeneity to avoid limited diversity issues and allow modest generalisation within SMEs of the same type. This enhanced external validity.
Data collection method (section 5.3)	View short videos of SME leaders describing their company vision and roadmap for services, compiled during semi-structured interviews	Generation of broad cross-sectional data
Measures to ensure rigour in data collection (section 5.4)	Compile comprehensive database, including how entire case study was conducted.

Also see table 5.4 | Step by step instructions and formalised QCA technique enhanced replicability. |

Table 5.1 - Process of design and execution of multiple case studies - phase 1. Adapted from a section of Eisenhardt's (1989) protocol for case study research

First a cross sectional study is designed (section 5.1) which incorporates the recommendations of Yin (2018). The aim is to develop a data analysis instrument to measure the intensity of capabilities, then determine the combinations of high or low intensities which lead SMEs to begin servitization. Thirty six SME leaders or senior managers are selected who had all explored the concept and opportunities of servitization (section 5.2). Some companies had begun servitization,

whilst others failed to progress beyond their initial exploration. A data collection method using semi-structured interviews to develop a vision and servitization road map for each SME is described (section 5.3), along with the measures taken to ensure rigour in data collection (section 5.4). The chapter concludes by summarising the data set generated and compiled for analysis in the next chapter.

5.1 Design of Case Studies

The design of the multiple case studies incorporate the recommendations of Yin (2018), to ensure a clear chain of evidence is established which connects empirical data to the research questions. He advocates that the design of case studies should incorporate five aspects, these are: selection of cases; research questions; assumptions, linking data to assumptions and criteria for interpreting findings. The emphasise on the research questions within the design aspects led to splitting this section into two parts to separately address research question 1 (section 5.1.1) and research question 2 (section 5.1.2).

5.1.1 Design aspects to answer research question 1

The first design aspect to answer research question 1 is selection of cases, which is covered in section 5.4. The second aspect is development of the research questions, which has been covered previously in section 3.4.4. The third aspect is assumptions, which are based on constructs developed in section 3.3.2, explaining that strategic dynamic capabilities are developed and applied by operational capabilities in the form of resources and activities. Specifically, the four strategic level dynamic capabilities (identified in section 3.2 and defined in section 3.2.1) are each developed and applied by five operational capabilities (section 3.3.2). Developing a way of measuring these operational capabilities will enable assessment of high or low intensities of a corresponding strategic dynamic capability to answer research question 1. The fourth aspect linking data to assumptions is satisfied using a theoretical framework (table 3.3). It is subsequently elaborated by identifying indicators of the operational capabilities for each of the four strategic dynamic capabilities and developing a scoring system. This satisfies the fifth aspect of providing a criterion for interpreting the findings, by measuring the intensities of operational capabilities to assess intensities of strategic dynamic capabilities. These design aspects are summarised in column 1 of table 5.2. The execution of the fourth and fifth aspects relating to data analysis is described in chapter 6, which culminates in the answer to research question 1.

Design Aspects	Intensity of Strategic Dynamic Capabilities (Chapter 6)	Combinations of Strategic Dynamic Capabilities (Chapter 7)
Selection of cases	36 SMEs were analysed at organisational level, using information from directors or senior managers describing their resources, activities and vision for services.	
Research questions	*RQ1*: Do product-centric SMEs require high intensities in all four strategic dynamic capabilities to begin servitization?	*RQ2:* Which combinations of high and low intensities of the four strategic dynamic capabilities enable product-centric SMEs to begin servitization?
Assumptions	Strategic dynamic capabilities are developed and applied by operational capabilities. Developing a way of measuring operational capabilities will enable assessment of high or low intensity of corresponding strategic dynamic capabilities.	Possession of individual capabilities for servitization is subordinate to their right combination and fit.
Linking data to assumptions	A theoretical framework originating in literature enables resources and activities described to be grouped into themes, then refined and reduced by aggregation to identify indicators of five operational capabilities for each strategic dynamic capability and a scoring system.	Indicator scores of operational capabilities are used to assess high or low intensities of corresponding strategic dynamic capabilities for each of the SMEs, which become conditions for a qualitative comparative analysis (QCA).
Criteria for interpreting findings	Indicators scored either 0,1 or 2 depending on evidence of incremental renewing or regenerative levels of dynamic capabilities.	QCA to determine necessary and/or sufficient combinations of high or low intensities of strategic dynamic capabilities which enable SMEs to begin servitization, or fail to progress beyond their initial exploration.

Table 5.2 - Process for design of multiple case studies - phase 1. Adapted from Yin (2018)

5.1.2 Design aspects to answer research question 2

The first design aspect to answer research question 2 is selection of cases, which is covered in section 5.4. The second aspect is development of the research questions, which has been covered previously in section 3.4. The third aspect is assumptions, which are based on constructs developed in section 3.4.2, explaining that possession of individual capabilities is subordinate to their right combination and fit. The fourth aspect linking data to assumptions is satisfied using indicator scores of operational capabilities, to assess high or low intensities of corresponding strategic dynamic capabilities for each SME. These become conditions for a qualitative comparative analysis, which satisfies the fifth aspect by providing a criterion for interpreting the findings. These design aspects are summarised in column 2 of table 5.2.

5.2 Selection of Cases

The cases comprise of 36 video recordings of SME directors or senior managers describing their vision and roadmap for services. All had participated in a regional servitization programme, designed to increase awareness and adoption of advanced services. This ensured that all the case companies represented product-centric organisations who had explored the concept and potential benefits of servitization, since they had registered for and spent time attending events. Some had moved on to begin servitization, whilst others failed to progress beyond their initial exploration (positive and negative outcomes). A summary of participants is provided in table 5.3.

The criteria for case selection followed best practice design for QCA, by selecting cases with common background features to define an initial domain of investigation with sufficient homogeneity. Within this investigative domain the companies selected represent a wide range of industry sectors and product-service offerings, providing maximum heterogeneity to avoid limited diversity issues during subsequent analysis (Berg-Schlosser and De Meur, 2008). This controlled for contextual idiosyncrasies in a quasi-experimental way, enabling cross case necessity and sufficiency analysis to identify regularities of strategic dynamic capability combinations and outcomes. Importantly, this allows limited causality statements (Rihoux and Ragin, 2009) and modest generalisation beyond the observed cases, within boundaries of SMEs of this type.

Case	Participant position	Industry sector	Annual revenue (£)	No of employees
1	Managing Director	Food Processing Equipment	<1m	5
2	Managing Director	Information and Communications	<1m	8
3	Senior Manager	Specialist Packaging	11.8m	125
4	Managing Director	Architectural Metalwork	2.1m	48
5	Director	Plastics and Electrical Insulations	1.2m	12
6	Managing Director	Printing Equipment	<1m	2
7	Managing Director	Printing and Stationary	3.2m	44
8	Managing Director	Metal Fasteners	4.5m	43
9	Head of Services	Information and Communications	3m	24
10	Director	Metal Pressings	5.3m	64
11	Managing Director	Aerospace Components	6.1m	55
12	Director	Information and Communications	<1m	4
13	Managing Director	Industrial Automation	7.7m	43
14	Managing Director	Industrial Tooling	3.5m	60
15	Managing Director	Sheet Metal Components	<1m	11
16	Managing Director	Wire Forming and Pressings	<1m	4
17	Managing Director	Investment Castings	1.5m	35
18	Director	Transport - Railways	10.3m	88
19	Managing Director	Printing	<1m	12
20	Managing Director	Heat Treatment of Metals	<1m	4
21	Chief Executive Officer	Information and Communications	1m	7
22	Director	Hospitality	1.7m	6
23	Director	Bags and Luggage	<1m	12
24	Managing Director	Forensic Science Products	<1m	3
25	Director	Information and Communications	10m	100
26	Director	Information and Communications	2m	29
27	Director	Door Handles and Fittings	1m	9
28	Senior Manager	Information Technology Hardware	6m	26
29	Director	Electroplating	4.2m	35
30	Product Director	Information and Communications	4.5m	70
31	Director	Metal Cutting	5m	28
32	Director	Electrical Control and Instrumentation	10.2m	105
33	Director	Metal Spinning's	<1m	3
34	Operations Director	Industrial Process Control	<1m	4
35	Director	Thread Rolling Dies	2m	15
36	Director	Energy	3m	20

Table 5.3 - Description of case companies

5.3   Data Collection Method

Directors or senior managers described their company roadmaps towards advanced services during semi-structured interviews. This included: history; key events; current capabilities; service vision and perceived changes required to resources and activities. The involvement of a single respondent for each case is often considered inappropriate, due to a need for triangulation. However, in this case it was appropriate, because the relatively small size of the businesses meant these single individuals had a large scope of influence and comprehensive understanding. All interviews were video recorded, and the narrative data analysed as described in the next section.

5.4   Measures Taken to Ensure Rigour

Case studies are particularly suitable to create relevant knowledge for application in practice (Amabile et al., 2001; Leonard-Barton, 1992). However, without rigour, relevance in management research cannot be claimed (Scandura and Williams, 2000). Four quality criteria for assessing the rigour of a case study design are: construct validity, internal validity, external validity and reliability. These are adapted for case study research from positivist models (Cook and Campbell, 1979) by Yin (2018) and Eisenhardt (1989) and described below for different stages of case studies. A summary is provided in table 5.4, along with the measures taken during the multiple case studies to ensure rigour by satisfying these validity and reliability criteria. This addresses the principal criticisms of case study research, most notably methodological rigour and generalisability.

Internal validity

Internal validity is concerned with the data analysis stage. It refers to whether the researcher has provided a plausible causal argument, which is logical and compelling enough to explain the relationship between variables and findings (Yin, 2018). The measures taken to ensure rigour by enhancing internal validity are provided in table 5.4.

Construct validity

Construct validity represents the quality of the conceptualisation or operationalisation. It refers to the extent to which a study investigates what it claims to investigate, i.e., the extent to which a process leads to an accurate observation of reality (Denzin and Lincoln, 2011). The measures taken to ensure rigour by enhancing construct validity are provided in table 5.4.

External validity

External validity, or generalisability, represents the extent to which the findings can be applied in cases other than those studied. Multiple case studies do not allow for statistical generalisation, i.e., inferring conclusions about a population, however they do allow analytical generalisation from empirical observations to theory (Yin, 2018). Eisenhardt (1989) argues that case studies can be a starting point for theory development and suggests a cross case analysis involving four to ten case studies may provide a good basis for analytical generalisation.

Reliability

Reliability refers to the absence of random error, enabling other researchers to arrive at the same insights by reproducing the study (Denzin and Lincoln, 1994). The key is transparency and replication. In addition, the QCA analytical approach of reducing each case to a series of variables (conditions and an outcome), enhances the replicability of a study (Berg-Schlosser et al., 2008). The measures taken to ensure rigour by enhancing reliability are provided in table 5.4.

Quality Criteria	Case study stage	Measures taken to ensure rigour
Construct validity	Data collection	Multiple sources of evidence for data triangulation. (Yin, 2018: Denzin and Lincoln, 2011).
		Clear chain of evidence from data to case report through coding framework derived from literature. This allows the reader to reconstruct how the researcher went from the research question to final conclusions (Yin, 2018).
		Triangulation method of sequential switching between empirical data and theory (Yin, 2018).
Internal validity	Data analysis	Theoretical research framework derived from literature.
		Formalised analytical approach (QCA) to reduce each case to a series of variables.
External validity	Design	Careful selection of multiple case studies within the domain of investigation. This controls for contextual idiosyncrasies, enabling cross case necessity and sufficiency analysis. Identification of regularities in strategic dynamic capability combinations leading to progress or no progress in beginning servitization reveals causal mechanisms. This allows modest generalisation beyond observed cases, within the boundaries of SMEs of the same type.
Reliability	Data collection	Careful documentation of case study process and data base compiled of all evidence.
		A second researcher was provided with the data analysis instrument and instructions on use. The scores obtained were compared with the researcher scores to check intercoder reliability. This established an intercoder reliability of 85%.
		QCA approach of reducing each case to a series of variables (conditions and outcomes) enhances reliability.

Table 5.4 - Measures taken to ensure rigour during the design of multiple case studies, data collection and analysis - Phase 1. Adapted from Yin (2018) and Eisenhardt (1989)

5.5 Data Set

Case	Participant position	Industry sector	Annual revenue (£)	No of Staff	Roadmap video	Web site link	Servitization progress Yes/No
1	Managing Director	Food Processing Equipment	<1m	5	Completed	✓	Yes
2	Managing Director	Information and Communications	<1m	8	Completed	✓	No
3	Senior Manager	Specialist Packaging	11.8m	125	Completed	✓	Yes
4	Managing Director	Architectural Metalwork	2.1m	48	Completed	✓	No
5	Director	Plastics and Electrical Insulations	1.2m	12	Completed	✓	No
6	Managing Director	Printing Equipment	<1m	2	Completed	✓	Yes
7	Managing Director	Printing and Stationary	3.2m	44	Completed	✓	Yes
8	Managing Director	Metal Fasteners	4.5m	43	Completed	✓	No
9	Head of Services	Information and Communications	3m	24	Completed	✓	Yes
10	Director	Metal Pressings	5.3m	64	Completed	✓	No
11	Managing Director	Aerospace Components	6.1m	55	Completed	✓	No
12	Director	Information and Communications	<1m	4	Completed	✓	Yes
13	Managing Director	Industrial Automation	7.7m	43	Completed	✓	Yes
14	Managing Director	Industrial Tooling	3.5m	60	Completed	✓	Yes
15	Managing Director	Sheet Metal Components	<1m	11	Completed	✓	No
16	Managing Director	Wire Forming and Pressings	<1m	4	Completed	✓	Yes
17	Managing Director	Investment Castings	1.5m	35	Completed	✓	No
18	Director	Transport - Railways	10.3m	88	Completed	✓	No
19	Managing Director	Printing	<1m	12	Completed	✓	Yes
20	Managing Director	Heat Treatment of Metals	<1m	4	Completed	✓	No
21	Chief Executive Officer	Information and Communications	1m	7	Completed	✓	Yes
22	Director	Hospitality	1.7m	6	Completed	✓	Yes
23	Director	Bags and Luggage	<1m	12	Completed	✓	No
24	Managing Director	Forensic Science Products	<1m	3	Completed	✓	No
25	Director	Information and Communications	10m	100	Completed	✓	No
26	Director	Information and Communications	2m	29	Completed	✓	No
27	Director	Door Handles and Fittings	1m	9	Completed	✓	No
28	Senior Manager	Information Technology Hardware	6m	26	Completed	✓	Yes
29	Director	Electroplating	4.2m	35	Completed	✓	No
30	Product Director	Information and Communications	4.5m	70	Completed	✓	Yes
31	Director	Metal Cutting	5m	28	Completed	✓	No
32	Director	Electrical Control and Instrumentation	10.2m	105	Completed	✓	Yes
33	Director	Metal Spinning's	<1m	3	Completed	✓	No
34	Operations Director	Industrial Process Control	<1m	4	Completed	✓	No
35	Director	Thread Rolling Dies	2m	15	Completed	✓	No
36	Director	Energy	3m	20	Completed	✓	No

Table 5.5 - Data set compiled during the data collection stage - phase 1

5.6 Summary

This chapter covers the design and execution of multiple case studies during phase 1 of the research programme. It explains how a process was followed as proposed by Eisenhardt (1989), comprising of a series of activities in four stages, which are: design of case studies (section 5.1); selection of cases (section 5.2); data collection method (section 5.3) and measures to ensure rigour in data collection (section 5.4). The chapter culminates in a broad data set for analysis to answer research questions 1 and 2 (table 5.5). This systematic process contributes to addressing the major concerns about case studies. It demonstrates how best practice design and execution for data collection is used to embed rigour and satisfy the quality criteria for validity and reliability. The next chapter describes how the systematic process is extended to analyse the data set and provide the answer to research question 1.

Chapter 6

Data Analysis and Findings - Intensity of Strategic Dynamic Capabilities

The previous chapter described the design and execution of multiple case studies during phase 1 of the research programme. It explained how a systematic process was followed for design and execution of the multiple case studies, as proposed by Eisenhardt (1989). This comprised of a series of activities in four stages, which are: design of case studies (section 5.1); selection of cases (section 5.2); data collection method (section 5.3) and measures to ensure rigour in data collection (section 5.4). The chapter culminated in a broad data set for analysis to answer research questions 1 and 2.

This chapter describes how this systematic process (table 6.1) is extended during analysis of the data set to answer research question 1. This comprises of a series of activities in two stages, which are summarised in table 6.1. These stages are data analysis and reaching closure. Section 6.1 elaborates a theoretical framework originating from literature (table 3.3), to create a data analysis instrument for determining the intensity of the four strategic dynamic capabilities possessed by SMEs. Section 6.2 assesses the intensity of four strategic dynamic capabilities (section 3.2) possessed by 36 SMEs and the status of their servitization progress in a three-stage process. Firstly, the data analysis instrument is developed and applied to score the intensity of the four strategic dynamic capabilities (section 6.2.1). Secondly, the scores are attributed to be either high or low intensity (section 6.2.2) and thirdly, the status of servitization progress is assessed as progress or no progress (section 6.2.1). Section 6.3 analyses the findings to understand if the SMEs required high intensity in all four strategic dynamic capabilities to begin servitization and answers research question 1.

Stage	Activity	Reason
Data analysis (part 1)	Thematic narrative analysis to further develop the theoretical framework, based on four key strategic dynamic capabilities and the operational capabilities for their development or application (table 3.3).	To identify indicators of the operational capabilities and develop a scoring system to assess high or low intensity of the four strategic dynamic capabilities.
Reaching closure	Continual interaction between the theoretical framework, empirical data and validation of analysis findings with participants led to concluding the study.	To reach theoretical saturation when marginal improvements become small.

Table 6.1 - Data analysis process for multiple case studies (part 1) - phase 1. Adapted from a section of Eisenhardt's (1989) protocol for case study research

6.1 Development of Data Analysis Instrument

There are limited options for measuring and assessing dynamic capabilities in relation to those required for servitization. A tool which attempts to meet these requirements is proposed by Coreynen, Matthyssens and Gebauer (2018). This consists of 48 questions (7-point scale) on three service-related organisational factors, these are: capabilities for service development; capabilities for service deployment and service orientation of corporate culture. However, although claiming to be holistic, it neglects several important capabilities, for example: pricing and communicating the value proposition; adapting activities and resources and understanding product usage to inform product innovation. In addition, its theoretical framework is applied inconsistently, implying that the strategic dynamic capabilities of sensing, seizing, and reconfiguring relate to service development only. These limitations indicate there is a need for a new measurement and assessment instrument for dynamic capabilities.

This section creates a new data analysis instrument (table 6.2) for determining the intensity of four strategic dynamic capabilities possessed by SMEs, which are developed and applied by operational dynamic capabilities. Dynamic capabilities cannot be measured directly, therefore operationalisation relies on measuring activities and resources which indicate the intensity of capabilities for creating, modifying, or extending ordinary capabilities. This incorporates the recommendations of Laaksonen and Peltoniemi (2018) and represents evolution 1 of the original theoretical framework.

Narrative data from the 36 SME road map videos is initially analysed to identify indicators of the operational dynamic capabilities for each of the four strategic dynamic capabilities (section 3.3.2) and elaborate the original theoretical framework (table 3.3). This followed a grounded approach (Strauss and Corbin, 1998) by starting with open coding, followed by axial coding and then selective coding, with a return to literature in between each stage in an abductive manner (Järvensivu and Törnroos, 2010; Dubois and Gadde, 2002). This method of theoretical triangulation by sequentially switching between empirical data and theory substantiated conclusions (Gibbert, Ruigrok and Wicki, 2008), plus enhanced internal validity (Yin, 2018).

The first round of open coding identifies themes and keywords from the interview data without being overly restricted by the theoretical framework. Subsequent rounds of axial coding enable the themes to be systematically refined and reduced by aggregation (Miles and Huberman, 1994). Ultimately selective coding using strategic and operational capabilities (table 3.3), led to the identification of indicators for the twenty operational capabilities. Indicators of the operational capabilities required for servitization are necessary at this stage because assessment is based on existing resources and activities prior to beginning servitization.

The theoretical framework was further elaborated by developing a scoring criterion for each of the indicators. This is based on levels defined by Ambrosini, Bowman and Collier (2009), who proposed three distinct levels of dynamic capabilities, which from low to high are incremental, renewing, and regenerative. *Incremental dynamic capabilities* are required for minor adjustments and adaptations to existing products, services, and processes, representing iterative changes for continuous improvement. *Renewing dynamic capabilities* must be deployed to create new resources, or combine existing ones in new ways, for example, design and development of new products or services or adapting existing products or services for new markets. *Regenerative dynamic capabilities* represent the absorptive capacity of managers to perceive the need to adapt inappropriate incremental and renewing dynamic capabilities due to business environment disruptions, such as societal demands for advanced services. Indicators of incremental level capabilities are scored 0, renewing 1 and regenerative 2, meaning that each strategic dynamic capability can be scored out of a possible 10 points.

Strategic dynamic capability	Operational dynamic capability (activity or resource)	Indicator of operational dynamic capability	Scoring criteria for assessing the intensity of indicators
Vision Innovation (Sense)	**Sense** opportunities for advanced service	Gather customer, market and competitor intelligence	0 – No 1 – Partially 2 – Yes
	Customer, market and competitor data	Undertake data analysis and interpretation	0 – No 1 – Limited 2 – Extensive
	Seize by evaluating opportunities and developing a new vision	Describe an image of a future business model to compete through advanced services	0 – No 1 – Underdeveloped 2 – Clear and compelling
	Influential champion to gain stakeholder support	Vision co-produced with the team	0 – No support 1 – Partial support 2 – Full support
	Reconfigure existing vision and create a roadmap for implementation	Describe a clear plan to implement servitization	0 – No plan 1 – Plan without targets/milestones 2 – Plan with targets/milestones
Service Innovation (Seize)	**Sense** potentially receptive customers for advanced service	Customer relationship management processes	0 – No 1 – Partially 2 – Yes
	Customer relationship management system to segment and target based on needs	Demonstrate knowledge of customer problems associated with product usage.	0 – No 1 – Broad overview of application 2 – Understand customer pains
	Seize by collaborating with customers to explore problems and design advanced service	Key account management practices	0 – Very little collaboration 1 – Consider customer feedback 2 – Co-create solutions with customers
	Devices to collect and analyse data on problems solved to demonstrate the value of advanced service	Monitor product condition	0 – No 1 – Developing 2 – Remote condition monitoring
	Reconfigure product-service offerings to include advanced service	Cross functional teams	0 – No processes 1 – Adhoc processes 2 – Formalised routines

Strategic dynamic capability	Operational dynamic capability (activity or resource)	Indicator of operational dynamic capability	Scoring criteria for assessing the intensity of indicators
Product Innovation **(Seize)**	**Sense** product development required to enable advanced service	Connected installed base to understand how products are used	0 – No 1 – Partially 2 – Yes
	Cross functional systems to understand product usage, customer problems and needs	Integrated MRP/ERP and CRM systems	0 – No 1 – Developing 2 – Yes
	Seize by designing new or adapted products	Original equipment manufacturer	0 – No design influence 1 – Some design influence 2 – Design authority
	Research and development facilities	Patents and trademarks	0 – No 1 – Developing 2 – Yes
	Reconfigure product range to combine with advanced service	Evidence of project management	0 – No processes 1 – Adhoc processes 2 – Formalised routines
Organisational Innovation **(Reconfigure)**	**Sense** changes required to resources and activities for design and provision of advanced service	Management planning routines	0 – No 1 – Partially 2 – Yes
	Recruitment, training and incentives	HR policies	0 – No processes 1 – Adhoc processes 2 – Formalised processes
	Seize by adapting resources and activities to build the required capabilities	Evidence of previous re-structuring	0 – No 1 – Partially 2 – Yes
	Finance to fund investments	Strong financial management	0 – Finance not explored 1 – Finance pending 2 – Finance available
	Reconfigure by integrating the adapted resources and activities	Communication channels for knowledge transfer	0 – Chaotic 1 – Reactive to priorities 2 – Pro-active

Table 6.2 - Evolution 1 of the theoretical framework (table 3.3) by removing references, then adding indicators of operational dynamic capabilities and scoring criterion to create a data analysis instrument

Examples are provided below to illustrate the application of the data analysis instrument to score the case companies and assess their possession of high or low intensities of the four key strategic dynamic capabilities. The scores within the text demonstrate how these are derived from the narratives. The findings can be presented in a radar diagram format (figure 6.1) for ease of understanding and interpretation.

Vision innovation

An exemplar of a business with high intensity capabilities in *vision innovation* was company 1 (8/10). They describe a compelling vision for an advanced service (2/2), underpinned by market, environment, and competitor research (2/2). Their concept of food processing by the hour recognises opportunities for capturing mutual value (1/2). Their champion has ensured support throughout the team but recognises the need to improve engagement of external stakeholders (1/2), which could be helped by their comprehensive roadmap (2/2). In comparison, company 20 (0/10) is representative of companies with low intensities in this strategic dynamic capability. The business leader describes a chaotic set of ideas for adding base level services, with very little opportunity recognition or vision for more sophisticated services.

Service innovation

Company 21 demonstrate high intensity capabilities in *service innovation*, with a total score of (9/10) and as a result have built on the foundations of less sophisticated services (2/2). They have developed advanced services based on managed private cloud infrastructure, monitoring and security (1/2). In common with company 3, their technology savvy team develop intimate customer relationships (2/2), particularly with small businesses, who often have limited IT resources and skills (2/2). This enables co-creation of fully managed and operational services, which alleviate the need for their customers to commit scarce resources and learn new skills in this area (2/2).

By comparison, company 20 is representative of the opposite. This is a metal processing business, lacking dynamic capabilities and displaying virtually no evidence of service innovation, other than aspirations for incremental improvements to business-as-usual (total score 2/10).

Product innovation

A company demonstrating the highest intensity in all four strategic dynamic capabilities is company 3, who provide an exemplar for high intensity capabilities in *product innovation*. Their in-house research and development team worked closely with key customers to understand their pains and usage needs (2/2). A cross functional (2/2) project (2/2) led to development of digital technology, incorporating sensors within packages to remotely monitor, shock, tilt, humidity, temperature and moisture in real-time (2/2). Their design authority (2/2) is key to co-creating an

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advanced service, which shifts the conversation from price of packaging materials to the provision of a capability for protection of assets during transit. In stark contrast company 7 are innovating their business model around existing products only and have no resources for product innovation (total score 2/10).

Organisational innovation

Another organisation demonstrating high intensities of strategic dynamic capabilities across the board is company 13, who provide an excellent example of high intensity capabilities in *organisational innovation*. A recently developed service credit scheme enables customers to purchase blocks of time, which can subsequently be redeemed against engineering expertise for feasibility studies, design and prototypes (2/2). This innovative 'proof of principle' service is de-risking projects for all parties at the front end, enabling flexible engineer to engineer negotiations. It has required allocation of resources (2/2), with associated investment (2/2), however, its immediate impact has reduced administration time and associated costs, leading to quicker responses. Increased revenue, reduced costs and upfront payment has positively impacted cash flow (2/2). In addition, the company has aligned its network partners to provide necessary support (2/2).

In contrast, company 1, scored highly in all strategic dynamic capabilities except organisational innovation. This business has recognised the benefits and opportunities offered by advanced services and commenced the servitization process without due consideration of the changes required to their revenue model or securing the necessary finance (total score 4/10).
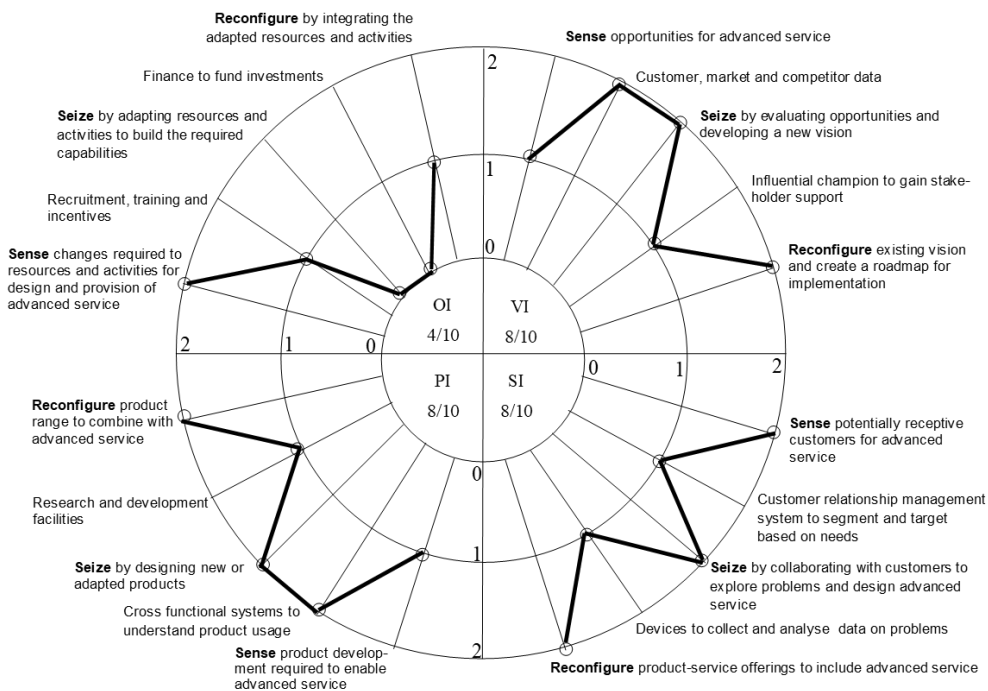
Figure 6.1 - Radar diagram presenting the findings for case company 1

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6.2 Determining the Intensity of the Four Strategic Dynamic Capabilities

To understand what intensity of capabilities are required for a product-centric SME to begin servitization, this section investigates the intensities of the four strategic dynamic capabilities (section 3.2) possessed by 36 SMEs and their status of servitization progress in a three-step process. Firstly, the data analysis instrument is applied to score the intensity for each of the four strategic dynamic capabilities (section 6.2.1). Secondly, the scores are attributed to be either high or low intensity (section 6.2.2) and thirdly, the status of servitization progress is assessed as progress or no progress (section 6.2.3).

6.2.1 Applying the data analysis instrument

The first step required a return to the narrative data to score indicators of operational capabilities possessed by each of the 36 SMEs, using the data analysis instrument developed in section 6.1. Companies are scored 0, 1 or 2 for each indicator of five operational capabilities. This produces an overall score out of 10 for each strategic dynamic capability (table 6.3). A second researcher followed the coding procedure and results were compared to check inter-coder reliability for replicability (Yin, 2018). To substantiate interpretations, the findings are verified with participants, as a precaution against errors and omissions (Gibbert, Ruigrok and Wicki, 2008).

Strategic dynamic capability	Operational dynamic capabilities (Scored 0, 1 or 2 to give a total out of 10) 0 = incremental, 1 = renewing, 2 = regenerative					Total score (/10)
Vision innovation (Sense)	**Sense** opportunities for advanced service	Customer, market and competitor data	**Seize** by evaluating opportunities and developing a new vision	Influential champion to gain stakeholder support	**Reconfigure** existing vision and create a roadmap for implementation	
Company 1	1	2	2	1	2	8
Company 20	0	0	0	0	0	0
Service innovation (Seize)	**Sense** potentially receptive customers for advanced service	Customer relationship management system to segment and target based on needs	**Seize** by collaborating with customers to explore problems and design advanced service	Devices to collect and analyse data on problems solved to demonstrate the value of advanced service	**Reconfigure** product-service offerings to include advanced service	
Company 21	2	2	2	2	1	9
Company 20	0	1	0	1	0	2
Product innovation (Seize)	**Sense** product development required to enable advanced service	Cross functional systems to understand product usage, customer problems and needs	**Seize** by designing new or adapted products	Research and development facilities	**Reconfigure** product range to combine with advanced service	
Company 3	2	2	2	2	2	10
Company 7	0	0	1	1	0	2
Organisational innovation (Reconfigure)	**Sense** changes required to resources and activities for design and provision of advanced service	Recruitment, training and incentives	**Seize** by adapting resources and activities to build the required capabilities	Finance to fund investments	**Reconfigure** by integrating the adapted resources and activities	
Company 13	2	2	2	2	2	10
Company 1	2	1	0	0	1	4

Table 6.3 - Strategic dynamic capability scores determined from scoring operational dynamic capabilities for two companies to illustrate high or low intensities

Company	Strategic Dynamic Capability Scores			
	Vision Innovation	Service Innovation	Product Innovation	Organisational Innovation
1	8	8	8	4
2	3	3	6	4
3	10	10	10	10
4	2	4	6	2
5	0	7	8	0
6	7	8	8	6
7	3	7	2	7
8	2	6	4	2
9	6	8	4	7
10	3	3	3	4
11	3	6	3	4
12	9	7	8	8
13	10	10	10	10
14	8	8	10	9
15	1	3	4	3
16	2	7	7	8
17	0	4	4	1
18	1	4	7	3
19	7	7	8	4
20	0	2	4	0
21	6	9	7	8
22	9	8	7	7
23	0	2	2	1
24	0	3	8	3
25	1	2	8	1
26	4	4	8	2
27	0	2	8	0
28	8	10	9	8
29	0	6	6	2
30	10	10	10	10
31	0	3	3	0
32	8	8	10	7
33	0	4	7	0
34	2	6	8	0
35	0	3	2	1
36	0	2	1	0

Table 6.4 - Raw data matrix of total scores for each of the strategic dynamic capabilities (conditions)

6.2.2 Attributing intensity scores as high or low

The second step attributes cases to sets of either low or high intensity for each of the four strategic dynamic capabilities (conditions), depending on their scores in the raw data matrix (table 6.4). This is known as calibration. Scores greater than or equal to 6.5 (calibration anchor) qualified for membership in the high intensity set (indicated as 1) and scores less than 6.5 in the low intensity set (indicated as 0). The cross over point was chosen by relying on informed judgment based on theory and intimate case knowledge. The cause of failing to sufficiently transform has been attributed to low levels of appropriate dynamic capabilities (Gebauer, Haldimann and Saul, 2017; Kindström, Kowalkowski and Sandberg, 2013), which prevents for example: effective service innovation (Morelli, 2006); business model change (Kindström and Kowalkowski, 2014) or replicating for scale (Coreynen et al., 2017). Setting the cross over point at 6.5 means that possession of high intensity strategic dynamic capabilities is considered more important than just not low intensity. This also ensures that no cases are on the cross over point.

Each case is therefore defined as a combination of high or low intensities of the four strategic dynamic capabilities (table 6.5). This prepares the ground for a qualitative comparative analysis (QCA), which is the subject of the next chapter. It is an appropriate number of variables for a QCA (chapter 7), bearing in mind the number of cases, to reduce the possibility of limited diversity issues during subsequent analysis. The number of cases (N= 36) exceeds the minimum amount recommended ($N>2^C$) for four explanatory variables, i.e. (36 > 16), to reduce the possibility of limited diversity issues during QCA analysis.

6.2.3 Assessing servitization status

The third step attributes cases to an outcome set. Case membership in an outcome set is determined according to progress to begin servitization or no progress beyond initial exploration of advanced services. This is done following case attribution to high or low intensity for each of the conditions and without linking to condition scores. Progress is indicated as 1 and no progress as 0 in the dichotomised data matrix (table 6.5). Progress is defined as moving beyond exploration to the engagement stage of servitization. This is where companies investigate potential demand for new services by interacting with customers to co-create mutually beneficial added value around product usage. This led to the following definitions for progress and no progress:

> **Progress:** *SMEs who move beyond their initial exploration of advanced services to begin the engagement stage of servitization, by working with potential customers to design and validate new services.*

No progress: SMEs who failed to move beyond their initial exploration of advanced services by beginning the engagement stage of servitization.

Company	Intensity of Strategic Dynamic Capability High = 1 Low = 0				Outcome PROGRESS = 1 no progress = 0
	Vision Innovation	Service Innovation	Product Innovation	Organisational Innovation	
1	1	1	1	0	1
2	0	0	0	0	0
3	1	1	1	1	1
4	0	0	0	0	0
5	0	1	1	0	0
6	1	1	1	0	1
7	0	1	0	1	1
8	0	0	0	0	0
9	0	1	0	1	1
10	0	0	0	0	0
11	0	0	0	0	0
12	1	1	1	1	1
13	1	1	1	1	1
14	1	1	1	1	1
15	0	0	0	0	0
16	0	1	1	1	1
17	0	0	0	0	0
18	0	0	1	0	0
19	1	1	1	0	1
20	0	0	0	0	0
21	0	1	1	1	1
22	1	1	1	1	1
23	0	0	0	0	0
24	0	0	1	0	0
25	0	0	1	0	0
26	0	0	1	0	0
27	0	0	1	0	0
28	1	1	1	1	1
29	0	0	0	0	0
30	1	1	1	1	1
31	0	0	0	0	0
32	1	1	1	1	1
33	0	0	1	0	0
34	0	0	1	0	0
35	0	0	0	0	0
36	0	0	1	0	0

Table 6.5 - Dichotomised data matrix showing the four strategic dynamic capability intensities as high or low

6.3 Intensities of the Four Strategic Dynamic Capabilities Required to Begin Servitization

The findings show that the four strategic dynamic capabilities are evident at varying intensity across the 36 SMEs (table 6.4). Overall, eight companies possess high intensity in all four strategic dynamic capabilities, whilst others have high intensity in some, but not all and others have low intensities across the board. From the sample of 36 companies exploring the opportunities and benefits of competing through a services-led strategy, 15 progress to begin the servitization process, whilst the others fail to progress. Examination of the 15 companies who progress reveals the following:

> 8 companies possess high intensities in all 4 capabilities
>
> 5 companies possess high intensities in 3 capabilities
>
> 2 companies possess high intensities in 2 capabilities

This shows that a high intensity in all four strategic dynamic capabilities is not required to begin servitization and different combinations of high and low intensities enable SMEs to progress. Therefore, in response to:

> **Research Question 1** (section 3.4.1) - Do product-centric SMEs require high intensities in all four strategic dynamic capabilities to begin servitization?

The answer is as follows: *Product-centric SMEs do not require high intensities in all four strategic dynamic capabilities to begin servitization.*

This prepares the ground for a qualitative comparative analysis (chapter 7), to examine which combinations of high or low intensities of the four strategic dynamic capabilities (conditions) result in a company's success or failure to begin servitization (outcome) to answer research question 2.

6.4 Summary

This chapter describes how the data set compiled in chapter 5 was analysed to answer research question 1. Section 6.1 elaborates a theoretical framework originating from literature (table 3.3) to create a data analysis instrument for scoring the intensity of indicators of operational capabilities for each of the four strategic dynamic capabilities possessed by SMEs. This enables assessment of the intensity of the four strategic dynamic capabilities in a three-step process (section 6.2). Firstly, the data analysis instrument is applied to score the intensity of the four strategic dynamic capabilities (section 6.2.1). Secondly, the scores are attributed to be either high or low intensity (section 6.2.2) and thirdly, the status of servitization progress is assessed as progress or no progress (section 6.2.3). Section 6.3 analyses the findings to reveal that SMEs do not require high intensity in all four strategic dynamic capabilities to begin servitization, which provides the answer to research question 1.

The next chapter examines how different combinations of high or low intensities of the four strategic dynamic capabilities result in a company's success or failure to begin servitization to answer research question 2.

Chapter 7

Data Analysis and Findings - Combinations of Strategic Dynamic Capabilities

The previous chapter described how a theoretical framework originating from literature was elaborated to create a data analysis instrument for measuring and assessing the intensity of four strategic dynamic capabilities possessed by 36 SMEs. Findings revealed that SMEs do not require high intensity in all four strategic dynamic capabilities to begin servitization, which provided the answer to research question 1.

This chapter examines how different combinations of high or low intensities of the four strategic dynamic capabilities result in a company's success or failure to begin servitization and answers research question 2. A qualitative comparative analysis (section 7.1) identifies the necessary (section 7.2) and/or sufficient conditions (section 7.3) for an outcome, which is both theoretically and case informed. This allows connections across cases, by systematic cross comparison to identify regularities and subsequently enables modest generalisation (Rihoux and Ragin, 2008). Evaluation of both positive and negative outcomes provides a more holistic and fine-grained view, by drawing on insights which distinguish between pathways leading to success or failure. This represents a systematic process followed throughout the design and execution of the multiple case studies during phase 1, by drawing on the relevant sections of Eisenhardt's (1989) protocol for case study research (table 7.1).

Stage	Activity	Reason
Data analysis (part 2)	Qualitative comparative analysis	To determine the combinations of conditions leading to similar or different outcomes. Interpretation through the cases and triangulation with theory provided plausible causal arguments to enhance internal and external validity.
Reaching closure	Continual interaction between the theoretical framework, empirical data and validation of analysis findings with participants led to concluding the study.	To reach theoretical saturation when marginal improvements become small.

Table 7.1 - Data analysis process for multiple case studies (part 2) - phase 1. Adapted from a section of Eisenhardt's (1989) protocol for case study research

7.1 Qualitative Comparative Analysis

Qualitative comparative analysis (QCA) explores the relationships between SMEs who possess high or low intensities of the four strategic dynamic capabilities (conditions or causal variables) and progress or no progress beyond their exploration of services-led strategies (outcomes). It is the combination of sets, rather than any condition alone, which determines outcomes.

Software developed by the R Core Team (2019) is used to conduct the 'analytical moment' of the QCA. Firstly, a skewness statistic shows that no set has less than 20% occurrence (or non-occurrence), which indicates there will be no problems from skewed set membership during analysis (Schneider and Wagemann, 2012). Secondly, the analysis of necessary conditions (section 7.2) is conducted separately from the analysis of sufficient conditions (section 7.3), for both the presence and absence of the outcome, to avoid false positive or negative indications (Schneider and Wagemann, 2010). Thirdly, the truth table (table of combinations, table 7.3) is constructed from the dichotomised data matrix (table 6.5) and used for analysis of sufficiency. This cross-case comparison identifies regularities of necessary and/or sufficient conditions for progress and no progress, whilst remaining sensitive to cases and context.

7.2 Analysis of Necessary Conditions

The results of the analysis of necessary conditions for both progress and no progress are presented below in table 7.2 below.

Condition	PROGRESS			no progress		
	Consistency	Coverage	RoN	Consistency	Coverage	RoN
Vision innovation	0.73	1.0	1.0	0.27	0.16	0.34
Service innovation	1.0	0.94	0.95	0.0	0.0	0.44
Product innovation	0.87	0.62	0.65	0.13	0.13	0.62
Organisational innovation	0.80	1.0	1.0	0.20	0.13	0.36

Table 7.2 - Analysis of necessary conditions for progress and no progress beyond exploration of services-led strategies

Inspection of table 7.2 reveals that service innovation has a value of 1.0 for empirical consistency, indicating there are no contradictory cases and this condition is necessary for progress. The coverage (% of the outcome explained) and relevance of necessity (RoN) are greater than their parameters of fit thresholds of 0.6 and 0.5 respectively, indicating empirical relevance. This confirms service innovation is a necessary condition for progress beyond exploration of services-

led strategies and is considered to represents a meaningful concept of causal connection. The value of 0.0 for negation of the outcome is in alignment with expectations.

7.3 Analysis of Sufficient Conditions

Analysis of sufficiency seeks to identify the combinations of strategic dynamic capabilities (conditions) for cases with the same outcome, to reveal different pathways which can be taken and uncover causal mechanisms. The truth table constructed for the analysis of sufficiency is shown in table 7.3. The columns represent the conditions and outcomes. The 16 rows comprise all logically possible combinations of conditions (2^4), first those empirically observed, followed by the logical remainders (N=0). There are no contradictory combinations.

Strategic Dynamic Capability Intensity = high (1) or low (0)					N	incl	PRI	cases
Vision Innovation	Service Innovation	Product Innovation	Organisational Innovation	Outcome				
1	1	1	1	1	8	1.00	1.00	3,12,13,14,22,28,30,32
1	1	1	0	1	3	1.00	1.00	1,6,19
0	1	0	1	1	2	1.00	1.00	7,9
0	1	1	1	1	2	0.00	0.00	16,21
0	0	0	0	0	13	0.00	0.00	2,4,8,10,11,15,17,20,23,29, 31,35,36
0	0	1	0	0	7	0.00	0.00	18,24,25,26,27,33,34
0	1	1	0	0	1	-	-	5
0	1	0	0	?	0	-	-	
0	0	0	1	?	0	-	-	
0	0	1	1	?	0	-	-	
1	0	0	0	?	0	-	-	
1	0	1	0	?	0	-	-	
1	1	0	0	?	0	-	-	
1	0	0	1	?	0	-	-	
1	0	1	1	?	0	-	-	
1	1	0	1	?	0	-	-	

Strategic dynamic capability = high (1) or low (0), Outcome = PROGRESS (1) or no progress (0), N = number of cases in configuration, incl = sufficiency inclusion score, PRI = proportional reduction in inconsistency

Table 7.3 - Truth table showing the combinations of strategic dynamic capabilities (conditions) and outcomes (progress or no progress), along with all logical remainders

Inspection of rows 1 and 2 of the truth table reveals that both are linked to the same outcome (progress) and differ in only one condition (organisational innovation), which is present in row 1 and absent in row 2. The principles of logical minimization therefore led to organisational innovation being omitted in the first pathway solution from an explanatory perspective. This was considered appropriate during the engagement stage of servitization, however if progress

continues to the expansion stage it is expected that organisational innovation capabilities will be required.

Inspection of rows 3 and 4 reveals that both rows are linked to progress and differ in only one condition (product innovation), which is present in row 4 and absent in row 3. This leads to product innovation being omitted from the second pathway solution from an explanatory perspective. Again, this was considered an acceptable solution at this stage, but context will dictate whether it will be required further down the line.

Logical minimisation, by paired comparisons of observed rows sufficient for progress, removes any causally redundant conditions for explanation and lead to the shortest conservative solution expression (minimal formula) shown in table 7.4 below. The conservative solution for failure to progress is shown in table 7.5. The results are in alignment with the underlying assumptions of causal complexity, namely: configurational causality; equifinality and asymmetry.

The intermediate and parsimonious solutions are provided for completeness in appendices 3 and 4 respectively. The conservative solutions are chosen as the most plausible, because they are comprehensively explained through the cases and align well with theory. Further simplification by inclusion of logical remainders, which can introduce contradictory simplifying assumptions, is therefore considered inappropriate.

Solution (Conservative)	vi * OI * SI	+	VI * SI * PI	$\rightarrow$	PROGRESS
Single case coverage	7,9; 16, 21		1,6,19; 3,12,13,14,22,28,30,32		
Consistency	1.0		1.0		
Raw coverage	0.27		0.73		
Unique coverage	0.27		0.73		
				Solution consistency	1.0
				Solution coverage	1.0

Table 7.4 - Sufficient conditions for progress beyond exploration of a services-led strategy to begin servitization

Solution (Conservative)	vi * oi * si	+	vi * oi * PI	→	no progress
Single case coverage	2,4,8,10,11,15,17, 20,23,29,31,35,36		5		
Consistency	1.0		1.0		
Raw coverage	0.95		0.38		
Unique coverage	0.62		0.05		
				Solution consistency	1.0
				Solution coverage	1.0

Table 7.5 - Sufficient conditions for failure to progress beyond the initial exploration of a services-led strategy

The minimal formula in tables 7.4 and 7.5 reveal how high or low intensities of strategic dynamic capabilities result in progress or failure to begin servitization.

7.4 Combinations of the Four Strategic Dynamic Capabilities Required to Begin Servitization

The minimal formula (table 7.4) reveals two different combinations of high and low intensities of the four key strategic dynamic capabilities (solutions) which are sufficient to deliver the same outcome of progress to begin servitization. These solutions are:

Pathway 1:   VISION INNOVATION * SERVICE INNOVATION * PRODUCT INNOVATION → PROGRESS

Pathway 2:   vision innovation * SERVICE INNOVATION * ORGANISATIONAL INNOVATION → PROGRESS

The solutions show that a high intensity in service innovation must be combined with high intensity in product innovation and vision innovation (pathway 1) or low intensity in vision innovation and high intensity in organisational innovation (pathway 2) to begin servitization.

The results reveal that no single strategic dynamic capability in isolation will enable progress and different combinations can lead to the same outcome, which demonstrates equifinality. Therefore, there is more than one way of combining the strategic dynamic capabilities to achieve the outcome, further demonstrating that high intensities in all four are not required to begin servitization. However, without high intensity in service innovation, progress is absent and cannot be compensated by high intensities in other capabilities.   It will therefore not guarantee success but should increase the probability of success.

The first step for small businesses with a high intensity of vision innovation (a clear and compelling vision for services) and looking to begin servitization (pathway 1), should be to focus on the development of service innovation, as this is a necessary condition.   This reinforces the

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recognition by Smith, Maull and Ng (2014) and Parida and Örtqvist (2015) that customer value propositions should be viewed as the first step towards value creation. Service innovation capabilities can be applied, for example, by encouraging the sales team to recognise opportunities for services which are based on alleviating customer pains associated with use of a product. However, if service innovation capabilities are only possessed at low intensities, then development will be required and may necessitate significant reconfiguration of recruitment policies, training and incentives (Ulaga and Loveland, 2014). The second step should be to develop product innovation capabilities. The remaining strategic dynamic capability (organisational innovation) is likely to be required in due course.

The first step for a small business without a clear vision for services, but following pathway 2, should also be to focus on the development of service innovation. However, in this bottom up approach the second step should be to develop organisational innovation capabilities, knowing that either one or both remaining strategic dynamic capabilities are likely to be required in due course.

To interpret both pathways comprising the QCA minimal formula in table 7.4, some case narratives are re-examined. This dialog between theoretical and case orientated knowledge align the illustrative cases below with theory.

Pathway 1

An exemplar of pathway 1 is company 1, who demonstrate a clear and compelling vision for services (high vision innovation). They are working closely with customers on service innovation to co-create new value propositions. Their engineering expertise and strategic partnerships are beginning to drive product innovation based on customer usage data. However, significant organisational innovation is required for revenue capture and financing. This illustrates how a company can begin the servitization process with only high intensity capabilities in vision innovation, service innovation and product innovation. This pathway leading the company to begin servitization is considered a company-led route.

Pathway 2

An exemplar of pathway 2 is company 7, who fail to demonstrate a clear and compelling vision for services (low vision innovation). Their intimate customer relationships enabled service innovation to meet the needs of one particular customer. Organisational innovation was undertaken by adapting their resources and activities, requiring significant investment. However, focussing on one customer overwhelmed their resources and resulted in a service offering which was not of value to others, leading to replication barriers. This illustrates how a company can begin the servitization process with only high intensity capabilities in service innovation and organisational

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innovation. In this case, the business is a distributor of products and there is no need to undertake internal product innovation. This pathway leading the company to begin servitization is considered a customer-led route.

Therefore, in response to:

> **Research Question 2** (section 3.4.2) - Which combinations of high and low intensities of the four strategic dynamic capabilities enable product-centric SMEs to begin servitization?

The answer is as follows: *Product-centric SMEs can begin servitization with either: high intensity strategic dynamic capabilities in vision innovation, service innovation and product innovation; or high intensity in service innovation and organisational innovation and low intensity in vision innovation for company-led or customer-led pathways respectively.*

7.5 Summary

This chapter examines how different combinations of high or low intensities of the four strategic dynamic capabilities result in a company's success or failure to begin servitization and provides the answer to research question 2. A qualitative comparative analysis (section 7.1) identifies the necessary (section 7.2) and/or sufficient conditions (section 7.3) for an outcome, which are both theoretically and case informed. This allows systematic cross comparison of cases to identify two combinations (pathways) leading to success. These solutions show that high intensity capabilities in service innovation must be combined with high intensity capabilities in product innovation and vision innovation (pathway 1) or low intensity capabilities in vision innovation and high intensity capabilities in organisational innovation (pathway 2) to enable progress to begin servitization.

The findings reveal that no single strategic dynamic capability in isolation will enable progress and different combinations can lead to the same outcome, which demonstrates equifinality. Therefore, there is more than one way of combining the strategic dynamic capabilities to achieve the outcome, reinforcing the answer to research question 1 that high intensities in all four are not required to begin servitization. However, without high intensity capability in service innovation, progress is absent and cannot be compensated for by high intensities in other capabilities.

The next chapter covers the design and execution of multiple case studies for collecting data to answer research question 3. This is phase 2 of the research programme, which is designed to uncover deep insights for examining how the sequence in which the four key capabilities are developed and applied enables or inhibits servitization.

Chapter 8
Design and Execution
of Multiple Case Studies
(Phase 2)

The previous chapter examined how different combinations of high or low intensities of the four key strategic dynamic capabilities (section 3.2) resulted in a company's success or failure to begin servitization by entering the engagement stage. This answered research question 2 by identifying two combinations (pathways) leading to success.

This chapter covers the design and execution of multiple case studies during phase 2. The aim is to uncover deep insights for examining how the sequence in which the four key capabilities are developed and applied during the engagement stage enables or inhibits servitization. It follows a process for design and execution of case studies proposed by Eisenhardt (1989). This comprises of a series of activities in four stages, which are summarised below in table 8.1. These four stages are: design of case studies (section 8.1); selection of cases (section 8.2); data collection method (section 8.3) and measures to ensure rigour in data collection (section 8.4). The chapter culminates in a data set for analysis in chapter 9 to answer research question 3.

Stage	Activity	Reason
Design of multiple case studies (section 8.1)	Design multiple case studies following the 5 aspects recommended by Yin (2018) – see table 8.2.	Ensured a logical sequence connecting empirical data to the research questions.
Selection of cases (section 8.2)	Theoretical selection of 6 participants from SMEs who progressed to begin servitization in phase 1.	Focussed effort on theoretically useful cases to extend theory within their conceptual categories.
Data collection method (section 8.3)	Focus groups 1 and 2 – narrate servitization journeys using storyboard exercise.	To capture activities undertaken and resources allocated to develop and apply the four strategic dynamic capabilities.
	Focus group 3 – mapped servitization journey (activities undertaken and resources allocated) onto data collection and analysis instrument (figure 8.5).	To establish sequences of development and application of the four strategic dynamic capabilities.
	Focus group 4 – Servitization journey stories.	To establish enablers and inhibitors of progress through the engagement stage of servitization.
	Focus group 5 – Progress evaluation.	To validate data analysis.
	Focus group 6 – evaluation of practical application framework.	To assess future value.
Ensuring rigour in data collection (section 8.4)	See table 8.4.	Ensure integrity and quality.

Table 8.1 - Process of design and execution of multiple case studies - phase 2. Adapted from a section of Eisenhardt's (1989) protocol for case study research

The process of design and execution of the multiple case studies creates a longitudinal study (section 8.1) incorporating the recommendations of Yin (2018). Six SME leaders or senior managers are selected from phase 1 who had all progressed to begin servitization (section 8.2) by entering the engagement stage. A data collection method is described, comprising of a series of focus groups within a community of practice set up to conduct the research (section 8.3), along with the measures taken to ensure rigour in data collection (section 8.4). The chapter concludes by summarising the data set generated and compiled for analysis in the next chapter.

8.1   Design of Case Studies

The design of the multiple case studies incorporates the recommendations of Yin (2018) to ensure a clear chain of evidence connects empirical data to the research questions. He advocates that the design of case studies should incorporate five aspects, which are: selection of cases; research questions; assumptions, linking data to assumptions and criteria for interpreting findings (table 8.2).

The first aspect is selection of cases, which is covered in section 8.4. The second aspect is development of the research questions, covered previously in section 3.4.4. The third aspect is assumptions, which are based on constructs developed in section 3.3.3, explaining that operational dynamic capabilities are required to develop and apply the four strategic dynamic capabilities (section 3.2) to facilitate servitization. The fourth aspect linking data to assumptions is satisfied using a data collection and coding instrument transposed from the theoretical framework (figure 8.5). It is used to analyse the deployment of operational dynamic capabilities (activities undertaken and resources allocated) to develop and apply the four strategic dynamic capabilities. This enables the identification of enablers and inhibitors of servitization progress within the cases as a prelude to cross case analysis. The fifth aspect is satisfied by providing a criterion for interpreting findings using the scoring system developed in phase 1 to score coded resources and activities during within case analysis (section 9.1.1). The scores determine the intensity of the four strategic dynamic capabilities, which are subsequently used to group companies for cross case comparison to search for similarities and differences (section 9.2). This identifies enablers and inhibitors of progress during the engagement stage of servitization. These design aspects are summarised in table 8.2. The execution of the fourth and fifth aspects relating to data analysis are described in chapter 9, which provides the answer to research question 3.

Design aspects	Sequences of strategic dynamic capabilities (Chapter 9)
Selection of cases	Six SMEs from phase 1 who progressed to begin servitization by entering the engagement stage. .
Research question	**RQ3:** How should product-centric SMEs sequence their development and application of the four strategic dynamic capabilities during early stage servitization?
Assumptions	Operational dynamic capabilities are required to develop and apply the four strategic dynamic capabilities (section 3.2) to facilitate servitization.
Linking data to assumptions	The theoretical framework (evolution 1) is transposed into a data collection and coding instrument (evolution 2) to analyse the deployment of operational dynamic capabilities (resources allocated and activities undertaken) to develop and apply the four strategic dynamic capabilities. This enables the identification of enablers and inhibitors of servitization progress within the cases to develop case descriptions as a prelude to cross case analysis.
Criteria for interpreting findings	The scoring system developed in research phase 1 is added to evolution 2 of the theoretical framework (evolution 3) and used to score coded resources and activities (within case analysis). The scores are used to group the companies for cross case comparison to search for similarities and differences of enablers and inhibitors.

Table 8.2 - Process of design of multiple case studies - phase 2. Adapted from Yin (2018)

8.2   Selection of Cases

Six participants were recruited from phase 1, ensuring commonality of experience, with the added benefit that people had prior knowledge of each other. This helped to develop a strong community of practice where everyone felt at ease in a safe environment. The limited number of cases was a deliberate choice, based on manageability and direct connection access. Intimate case knowledge enabled theoretical selection of participants, ranging from micro-businesses to small companies, with annual revenues up to £6.1 million and 2-55 employees. A summary of participants is provided in table 8.3.

Company	Participant position	Industry sector	Annual revenue £	Number of employees
A	Senior Manager	Information Technology Hardware	6m	26
B	Managing Director	Printing and Stationary	3.2m	44
C	Managing Director	Aerospace Components	6.1m	55
D	Managing Director	Printing Equipment	<1m	2
E	Managing Director	Food Processing Equipment	<1m	3
F	Operations Director	Industrial Process Control	<1m	4

Table 8.3 - Description of case companies - phase 2

8.3   Data Collection Method

A community of practice set up to conduct the research developed trust and friendship amongst 6 SME leaders and academics from the first study. This engaged scholarship approach (section 4.2.1) enabled the generation of in-depth insights. Data was collected using focus groups, consisting of a maximum of ten participants, including 6 SME practitioners, invited academics and videographer. The sessions were designed to last around four hours. Agendas for each focus group are provided in figure 8.1.

Focus groups were designed as interactive workshops to generate insights within a collaborative learning environment. This allowed participants to challenge and probe ideas, generating in depth, socially constructed understanding of mutual benefit (Belzile and Öberg, 2012). The researcher set the agenda and played the role of facilitator. Responses were invited from any quiet ones. The study was not designed to analyse participants interactions, however this proved useful during reflection on the engaged scholarship approach and assessing the mutual value of the community of practice. At the end of each meeting a mutually convenient date, time and place was set for the next meeting.

Six focus groups were conducted over 12 months to capture longitudinal data in real-time, rather than post-hoc. This novel approach enabled the researcher and participants to jointly construct and interpret the meaning within the narratives of each servitization story to understand how development and application of the four key strategic dynamic capabilities enable or inhibit servitization progress. The process also helped participants to make sense of their reality.

Storytelling techniques were used in focus groups 2-5 to describe processes, or sequences of events unfolding over time to connect cause and effect. Capturing the whole story rather than just elements is greater than the sum of its parts and ideal for communicating change (Denning, 2006). This meant that the narratives were not abstract, remote, or inaccessible and instead were familiar, informative and relevant (Moen, 2006). Therefore, this interpretive, qualitative approach to narrating sequences of events connecting cause and effect enabled better understanding (Kendall and Kendall, 2012). It allowed examination of underlying processes, generating patterns and commonalities, by revealing specific events and their relationships. Events of particular interest included, activities conducted, resources allocated and the sequence which enabled or inhibited progress. This is described by Pentland (1999) as moving from the surface structure to deep structure, which enables explanation rather than just description. It revealed a level of insight rarely possible, due to common constraints of traditional methods and restricted access to suitable cases.

Focus Group 1	Focus Group 2	Focus Group 3
Kick Off **@ Villa Park** **15th December 2018** **12:30** **Arrival and tea/coffee** **13:00** **Welcome and introduction** Building a community of practice for mutual benefits Ethics and consent forms **14:00** **Lunch** **14:50** **Enjoy the match – Aston Villa vs Stoke City** **15:45** **Half time – tea and cakes** Agree location, date and time for FG2 **17:00** **Introduction to research topic** **18:00** **Closing remarks**	**Servitization Stories** **@ Participant Factory** **14th February 2019** **13:00** **Arrival and buffet lunch** **13:30** **Welcome and introduction** Summary of meeting on 15th Dec 2018 **14:00** **Enablers of success and barriers to progress** Post-it notes and discussion **14:30** **Factory tour** **15:00** **Tea/coffee break** **15:15** **Capture your servitization stories** Storyboarding *(Dr Dan Andrews)* Working in pairs with an academic – storyteller and writer, then swap roles **17:30** **Closing remarks** Agree location, date and time for FG3	**Pathways to Services** **@ Aston Business School** **3rd April 2019** **13:30** **Arrival and tea/coffee** **14:00** **Welcome and introduction** Summary of meeting on 14th February 2019 and research framework **14:30** **Enablers of success and barriers to progress** Post-it notes and discussion **15:15** **Tea/coffee break** **15:30** **Map your servitization paths** Worked example, then working in pairs (FG2) with an academic - map your servitization stories on the framework **17:30** **Closing remarks** Agree location, date and time for FG4 **18:00** **Dinner** Aston Conference Centre
Focus Group 4	Focus Group 5	Focus Group 6
Evaluate your Journey **@ Researchers home** **16th July 2019** **12:30** **Arrival and tea/coffee** **13:00** **Welcome and introduction** Summary of meeting on 3rd April 2019 **13:45** **Enablers of success and barriers to progress** Post-it notes and discussion **14:45** **Tea/coffee break** **15:00** **Your servitization journey** Each person to present their populated research framework. **17:00** **Closing remarks** **17.30** **BBQ** Discussion – Benefits of our community of practice so far. Agree location, date, and time for FG5	**Servitization Outcomes** **@ 11th Floor, Aston University** **14th November 2019** **12:45** **Arrival and tea/coffee** **13:15** **Welcome and introduction** Summary of meeting on 16th July 2019 **13:45** **Enablers of success and barriers to progress** Post-it notes and discussion **14:45** **Tea/coffee break** **15:00** **Roundtable discussion** Evaluation and outcome of your servitization journeys **17:00** **Closing remarks** FG6, 'The Final Whistle' – 21st December – Aston Villa vs Southampton, meet at 12:00 pm for 3:00 pm kick off. **18:30** **Dinner** **Asha's Restaurant, Newhall Street, Birmingham**	**The Final Whistle** **@ Villa Park** **21st December 2019** **12:00** **Arrival and tea/coffee** **12:15** **Welcome and introduction** Summary of meeting on 14th Nov 2019 **12:30** **Discussion and evaluation of practical application framework** Individual reflections (5 mins) Group discussion on practical application framework and suggestions for further development **14:00** **Lunch** **14:50** **Aston Villa vs Southampton** **15:45** **Half time – tea and cakes** **17:00** **Discussion and evaluation of community of practice** **18:00** **Closing remarks**

Figure 8.1 - Focus group agendas

A common theme for focus groups 2-5 was a session to capture enablers of success and barriers to progress, both internal and external, which were most relevant at the time. The SME participants were provided with different coloured post it notes. Once everyone had written down their thoughts, each person positioned their notes on a poster (figure 8.2 and photograph 8.1) and described the situation. The researcher facilitated discussion around the emerging themes, including ideas of support or inspiration. This session acted as an ice breaker.
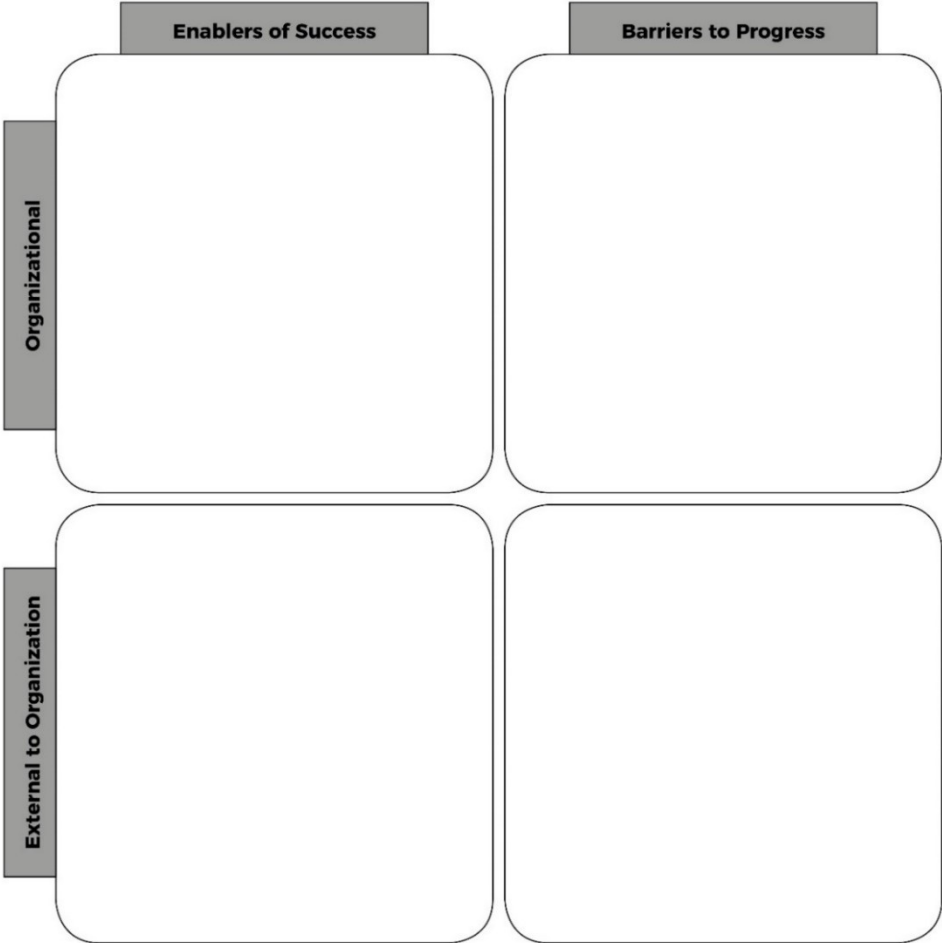
Figure 8.2 - Data collection tool used during the enablers of success and barriers to progress sessions (focus groups 2-5)

Photograph 8.1 - Enablers of success and barriers to progress session

Different types of exercises and discussions were used as each session progressed, which broadly followed the categories of introduction, opening, transition, key and closing (Krueger and Casey, 2015).   The essential thing was going through a process to capture a cross section of views and contributions to generate well grounded, valuable data. The closing sections were used as a summary of key topics discussed and provided an opportunity for participants to reflect on the discussions collectively.   It enabled elaboration, challenge, and most importantly respondent validation to increase the validity of the research (Parker and Tritter, 2006). At the start of follow-on sessions, the introduction included findings and analysis from the previous session, which were presented back to participants for validation.

8.3.1 Focus group 1 - introduction, ethics and consent

The initial meeting brought the participants together for the first time in a corporate hospitality setting at Villa Park. This was chosen to provide a friendly, relaxed, and private environment. The principle of developing a community of practice for conducting the research was explained, with the aim of creating a collaborative learning environment. It was emphasised that the purpose of the focus group series was to gain insights into a research topic which is important to all participants, and in the process develop mutual benefits.

The formalities were conducted, including: ethics; consent; and data protection issues. The research was conducted strictly in accordance with Aston Business School Research Ethical Guidelines for Postgraduate Students. Ethical approval by Aston University Ethics Committee was obtained prior to commencing work. It was explained that the research was designed in line with the ethical principle of not causing harm, whilst protecting the rights, dignity and welfare of all participants. This involved anticipating any issues or risks and exercising choices to avoid conflict and harm, along with any likely consequences. The risk of harm was considered low.

Participation was based on informed consent. It was entirely voluntary, and nobody was coerced to grant access. Anyone was free to withdraw consent for any reason at any time up to the end of the research process and could request deletion or a summary of information already provided. Care would be taken to avoid intrusive or sensitive questions and excessive pressing for answers. Furthermore, it was made clear that it is acceptable to decline to answer a particular question or set of questions. All participants signed a consent form (appendix 1) and were encouraged to discuss any potential concerns or seek clarification of context regarding any issues. It was emphasised that decisions taken because of the research should only have positive consequences for the collective interest of all those who participate.

All data collected was stored securely and treated as strictly confidential. Participants were granted anonymity and any information which could reveal the identity of a person or company would be removed in any form of reporting the research findings.

8.3.2 Focus group 2 - servitization journeys

The purpose of the second focus group was to capture each company's servitization story in terms of deployment of their operational dynamic capabilities (activities undertaken and resources allocated) to develop and apply the four strategic dynamic capabilities. Participants worked in pairs, each taking turns as a storyteller and writer. An academic worked with each pair to provide guidance on the process and ensure both stories were completed within the time available. The

storyteller described their servitization journey to the writer, who first made notes using the storyboard template (figure 8.3) and then told the story back. The storyboard template enabled the writers to first establish the storyteller's reasons for servitizing, then frame the stories into units of activities conducted and resources allocated over the period of time (comic book style). The timeline helped the storyteller to put things in sequence. During the subsequent telling of the story by the writer, the storyteller interjected comments or additional details. Several participants said that the process of reflection during storytelling had enabled them to think about things in a different way.

Company name: ……………………………………………………………………..		
Storyteller: …………………….………		Writer: ……………….………
Prologue When and why did you start to explore servitization?		
Servitization story so far ….		
Activities conducted	Timeline -------------	Resources allocated
Activities conducted		Resources allocated
Activities conducted		Resources allocated
Activities conducted		Resources allocated
Activities conducted		Resources allocated

Figure 8.3 - Story board template used to collect data during focus group 2

Photograph 8.2 - Telling and writing stories of servitization journeys

The output from focus group 2 was a detailed sequence of events, comprising of activities undertaken and resources allocated over the timeline. These represented the deployment of operational capabilities to develop or apply the four strategic dynamic capabilities.

8.3.3 Focus group 3 - servitization pathways

The purpose of the third focus group was to understand the sequence of development and application of the four strategic dynamic capabilities by each of the companies. This required evolution 2 of the theoretical framework to construct a data collection instrument. The first two columns of the theoretical framework (table 3.3) were transposed into a circular format. The five operational dynamic capabilities were split into activities (sensing, seizing and reconfiguring) and resources. This is illustrated by figure 8.4, using vision innovation as an example. This was designed as a circle to avoid influencing a starting position or sequence. Figure 8.5 shows the transposition in full to create the data collection instrument.

Strategic dynamic capability	Operational dynamic capability (activity or resource)
Vision Innovation (Sense)	**Sense** opportunities for advanced service
	Customer, market and competitor data
	Seize by evaluating opportunities and developing a new vision
	Influential champion to gain stakeholder support
	Reconfigure existing vision and create a roadmap for implementation

Figure 8.4 - Evolution 2 of theoretical framework by transposing columns 1 and 2 of table 3.3 into a circular data collection and analysis instrument
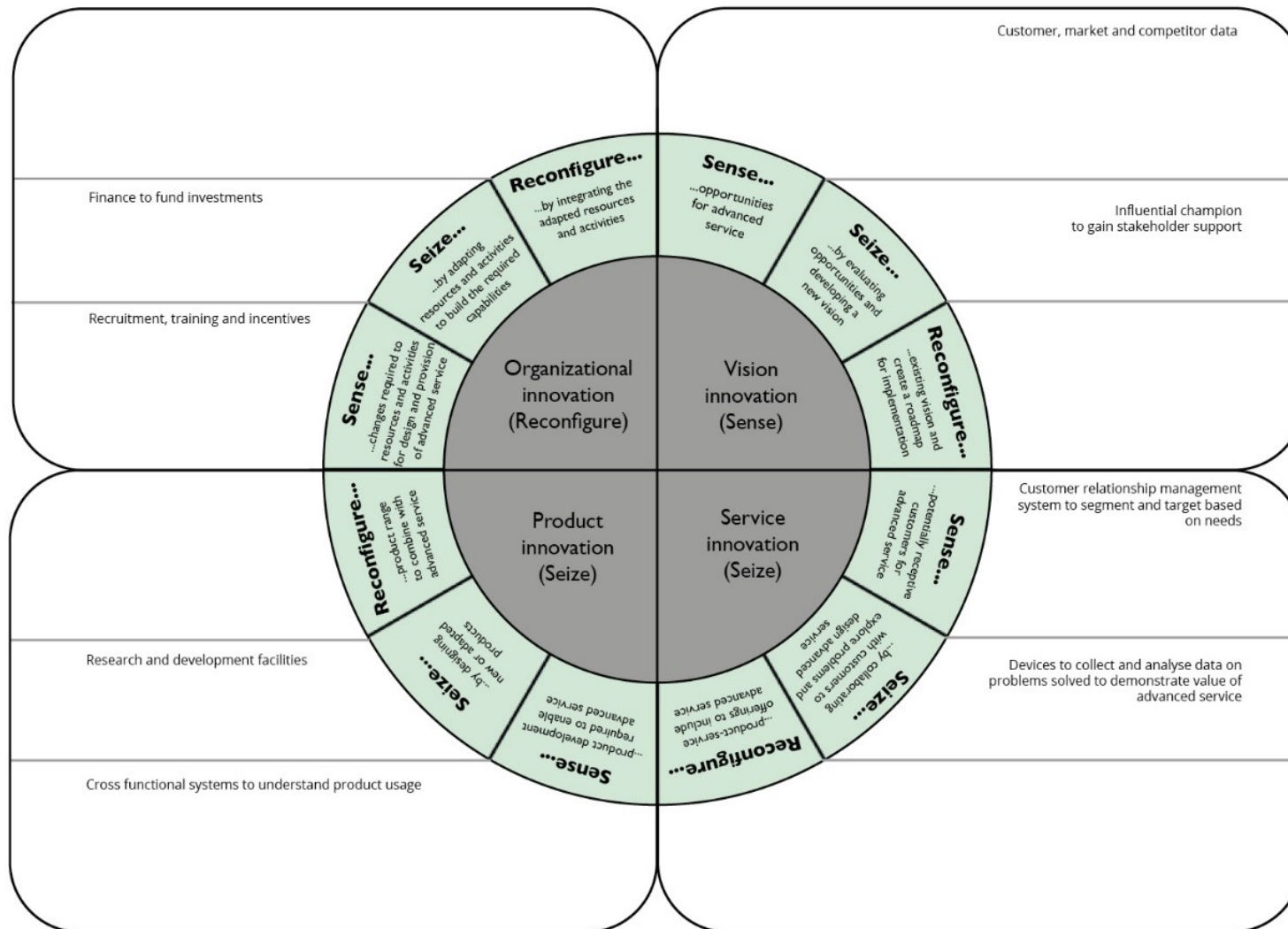
Figure 8.5 - Data collection and analysis instrument used during focus groups 3 and 4

The participants worked with their partners from focus group 2, plus an academic. Using their storyboard templates created in focus group 2, each mapped their sequences of activities conducted and resources allocated on the data collection and analysis instrument (figure 8.5).

Photograph 8.3 - Mapping servitization pathways

The output from focus group 3 was a pathway through the data collection and analysis instrument. This provided data on how each SME sequenced the development and application of the four strategic dynamic capabilities by deploying their operational dynamic capabilities (activities undertaken and resources allocated).

8.3.4 Focus group 4 - enablers and inhibitors of progress

The purpose of the fourth focus group was to understand how the servitization pathways mapped during focus group 3 enable or inhibit progress. Each participant presented their story using data generated during focus groups 2 and 3. The data collection and analysis instrument (figure 8.5) was used as a prop to guide the audience through the sequence of activities undertaken and resources allocated (operational dynamic capabilities). Interaction within the group during and after each presentation elicited greater details, which went beyond description and provided explanation on how servitization progress had been enabled or inhibited. This open process with negotiated meanings uncovered sub-plots, for example, cultural or communication issues. It revealed successes and challenges, whilst explaining why certain decisions were made.

Photograph 8.4 - Determining enablers and inhibitors of servitization progress

The output from focus group 4 was a more holistic view of each company's servitization journey, experiences along the way and progress to date. It showed how the sequence of development and application of the four strategic dynamic capabilities by deploying their operational dynamic capabilities (activities undertaken and resources deployed) enabled or inhibited servitization progress.

8.3.5 Focus group 5 - validation of data analysis

The purpose of the fifth focus group was two-fold. Firstly, to validate the data collected and analysed to this point with each of the participants. The researcher presented back to the group his interpretation of the populated data collection and analysis instrument for each company.

Photograph 8.5 - Validation of data analysis

Secondly, the status of each company's servitization journey was discussed, agreed and then added to figure 9.2. The status for each company was determined as:

Success: Completed their transition through the engagement stage of servitization by validating their advanced service with a customer, winning the first contract, and then moving on to the expansion stage to begin scaling.

Failure: Abandoned their attempt to transition through the engagement stage of servitization due to lack of customer validation of their advanced service and no first contract won.

Ongoing: Partial transition through the engagement stage of servitization, but yet to validate their advanced service with a customer or win their first contract.

The output from focus group 5 was a populated data collection and analysis instrument for each SME which had been validated by participants, plus their servitization status.

8.3.6 Focus group 6 - evaluation of practical application framework

The purpose of focus group 6 was to discuss and evaluate the practical application framework translated from the data collection and analysis instrument used in focus groups 3, 4 and 5. Each participant provided their individual reflections, followed by a group discussion to generate suggestions for further development of the framework in future work.

8.4   Measures Taken to Ensure Rigour

Case studies are particularly suitable to create relevant knowledge for application in practice (Amabile et al., 2001; Leonard-Barton, 1992). However, without rigour, relevance in management research cannot be claimed (Scandura and Williams, 2000). Four quality criteria for assessing the rigour of a case study design are: construct validity, internal validity, external validity and reliability. These are adapted for case study research from positivist models (Cook and Campbell, 1979) by Yin (2018) and Eisenhardt (1989) and described below for different stages of case studies. A summary is provided in table 8.4, along with the measures taken during the multiple case studies to ensure rigour by satisfying these validity and reliability criteria. This addresses the principal criticisms of case study research, most notably methodological rigour, and generalisability.

Internal validity

Internal validity is concerned with the data analysis stage. It refers to whether the researcher has provided a plausible causal argument, which is logical and compelling enough to explain the relationship between variables and findings (Yin, 2018). The measures taken to ensuring rigour by enhancing internal validity are provided in table 8.4.

Construct validity

Construct validity represents the quality of conceptualisation or operationalisation and refers to the extent to which a study investigates what it claims to investigate, i.e., the extent to which a process leads to an accurate observation of reality (Denzin and Lincoln, 2011). The measures taken to ensuring rigour by enhancing construct validity are provided in table 8.4.

External validity

External validity, or generalisability, represents the extent to which the findings can be applied in cases other than those studied. Multiple case studies do not allow for statistical generalisation, i.e., inferring conclusions about a population, however they do allow analytical generalisation from empirical observations to theory (Yin, 2018). Eisenhardt (1989) argues that case studies can be a starting point for theory development and suggests a cross case analysis involving four to ten case studies may provide a good basis for analytical generalisation.

Reliability

Reliability refers to the absence of random error, enabling other researchers to arrive at the same insights by reproducing the study (Denzin and Lincoln, 1994). The key is transparency for replication. The measures taken to ensuring rigour by enhancing reliability are provided in table 8.4.

Quality criteria	Case study stage	Measures taken to ensure rigour
Construct validity	Data collection	Multiple sources of evidence: videos; storyboards; mapped pathways; successes and challenges post-it notes; researcher and academics notes; web sites; publications. Clear chain of evidence from data to case report through coding framework.
Internal validity	Data analysis	Followed case study protocol (Eisenhardt, 1989). Clear theoretical framework used with scoring system from phase 1. Triangulation method of sequential switching between empirical data and theory (Yin, 2018).
External validity	Research design	Multiple case studies allowing cross case analysis for analytical generalisation. 6 cases are in line with Eisenhardt's (1989) recommendations of 4 to 10 cases.
Reliability	Data collection	Followed case study protocol (Eisenhardt, 1989; Yin, 2018). Careful documentation of case study process and compiled data base of all evidence. A second researcher was provided with the transcribed data and asked to populate the code books. The results obtained were compared with the researcher to check intercoder reliability. This established an intercoder reliability of 90%.

Table 8.4 - Measures taken to ensure rigour during the design of multiple case studies, data collection and analysis - Phase 2. Adapted from Yin (2018) and Eisenhardt (1989)

8.5   Dataset

Company	Participant position	Industry sector	Annual revenue £	Number of Employees	Focus group videos	Photos	Hand written notes	Success/ challenges poster	Story board	Pathway map	Web site link	Pathway (phase 1)
A	Senior Manager	Information Technology Hardware	6m	26	✓	✓	✓	FG2-5	FG2	FG3	✓	Company-led
B	Managing Director	Printing	3.2m	44	✓	✓	✓	FG2-4	FG2	FG3	✓	Customer-led
C	Managing Director	Aerospace Components	6.1m	55	✓	✓	✓	FG2-4	FG2	FG3	✓	Company-led
D	Managing Director	Printing Equipment	<1m	2	✓	✓	✓	FG2-4	FG2	FG3	✓	Company-led
E	Managing Director	Food Processing Equipment	<1m	3	✓	✓	✓	FG2-5	FG2	FG3	✓	Company-led
F	Director	Industrial Process Control	<1m	4	✓	✓	✓	FG2-5	FG2	FG3	✓	Company-led

Table 8.5 - Dataset compiled during the data collection stage - phase 2

8.6 Summary

This chapter covers the design and execution of multiple case studies during phase 2 of the research programme. It explains how a process is followed as proposed by Eisenhardt (1989), to examine how the sequence of development and application of the four strategic dynamic capabilities enables or inhibits servitization. This comprises of a series of activities in four stages, which are: design of case studies (section 8.1); selection of cases (section 8.2); data collection method (section 8.3) and measures to ensure rigour in data collection (section 8.4). This systematic process contributes to addressing the major concerns about case studies. It demonstrates how best practice design and execution for data collection is used to embed rigour and satisfy the quality criteria for validity and reliability. The chapter culminates in a broad data set for analysis to answer research question 3 (table 8.5). The next chapter describes how the systematic process is extended to analyse the data set and provide the answer to research question 3.

Chapter 9

Data Analysis and Findings - Sequences of Strategic Dynamic Capabilities

The previous chapter described the design and execution of multiple case studies during phase 2 of the research programme, explaining how a systematic process was followed as proposed by Eisenhardt (1989). This comprised of a series of activities in four stages, which are: design of case studies (section 5.1); selection of cases (section 5.2); data collection method (section 5.3) and measures to ensure rigour in data collection (section 5.4). The chapter culminated in a broad data set for analysis to answer research question 3.

This chapter describes how the systematic process (table 9.1) is extended to analyse the data set and answer research question 3. This comprises of a series of activities in two stages, which are summarised in table 9.1. These stages are data analysis and reaching closure. A within case analysis (section 9.1) prepares the ground for a cross case analysis (section 9.2). The findings explain how the sequence of development and application of the four strategic dynamic capabilities enables or inhibits servitization (section 9.3). This provides the answer to research question 3.

Stage	Activity	Reason
Data analysis (sections 9.1 and 9.2)	Within and cross case analysis to search for evidence of relationships between the four strategic dynamic capabilities.	To confirm, extend and sharpen theory by explaining how the sequence of development and application of the four strategic dynamic capabilities enables or inhibits servitization. This builds internal validity.
Reaching closure	Continual interaction between the theoretical framework, empirical data and validating analysis of findings with participants led to concluding the study.	To reach theoretical saturation when marginal improvements become small.

Table 9.1 - Data analysis process for multiple case studies - phase 2. Adapted from a section of Eisenhardt's (1989) protocol for case study research

9.1 Within Case Analysis

To prepare the ground for cross case analysis, the data from the populated research frameworks and videos is coded using the code book shown in table 9.2 (evolution 3 of the theoretical framework). It was created by returning to evolution 1 (table 6.2) to add a score column and re-name the central section. This is done because evidence relating to actual development and application of operational dynamic capabilities can be scored rather than indicators of their possession used in phase 1.

9.1.1 Data coding and scoring

The coded evidence for development and application of each operational dynamic capability is assessed and scored using the same system from phase 1. The populated code books are provided in table 9.2 for company A and appendices 5 to 9 for companies B to F respectively. These are analysed in combination with storyboards and mapped pathways to construct a chronology of development and application of strategic dynamic capabilities for each company. This is shown for company A in figure 9.1 and in appendices 10 to 14 for companies B to F respectively. The chronologies of strategic dynamic capability development and application include:

- Timeline and sequence of strategic dynamic capability development and application.
- Epilogue providing the outcome of the servitization journey at the end of the research period.

A summary for all six companies is provided by figure 9.2.

Strategic dynamic capability	Operational dynamic capability (activity or resource)	Evidence of operational dynamic capability from empirical data	Intensity	Scoring Criteria
Vision Innovation **(Sense)** Total score 5/10	**Sense** opportunities for advanced service	"After buying a service company offering multi-year service agreements, we recognised the benefits of longer contracts, which would enhance our company valuation." "Interserve administration has created lots more opportunities."	2	0 - No 1 - Partially 2 - Yes
	Customer, market and competitor data	"Innovate engine provided access to an NHS trust. None of our competitors in the NHS market offer advanced services. We audited their data centre and produced a bespoke proposition. This was rejected because it didn't fit with their procurement system."	1	0 - No 1 - Limited 2 - Extensive
	Seize by evaluating opportunities and developing a new vision	"For us its about locking in customers for longer". "Our service to product ratio is 50:50, our vision is to achieve 70:30 within 2 years."	1	0 - No 1 - Underdeveloped 2 - Clear and compelling
	Influential champion to gain stakeholder support	"It's been like banging my head against a brick wall." "No advanced service contract was sold during 12 months and the owner pulled the plug. Our journey is over, the owners want a quick fix to everything and lack mindset and money."	0	0 - No support 1 - Partial support 2 - Full support
	Reconfigure existing vision and create a roadmap for implementation	"We were figuring it out as we went along." "We did them all (strategic dynamic capabilities), but not enough and perhaps not in the right order."	1	0 - No plan 1 - Plan without targets/milestones 2 - Plan with targets/milestones
Service Innovation **(Seize)** Total score 4/10	**Sense** potentially receptive customers for advanced service	"We missed opportunities to identify additional value, which could have been costed."	1	0 - No 1 - Partially 2 - Yes
	Customer relationship management system to segment and target based on needs	"In hindsight, we choose the wrong market, we've been going after schools, colleges and MOD contracts and should have tried our private sector customers in manufacturing, leisure or retail."	1	0 - No 1 - Broad overview of application 2 - Understand customer pains
	Seize by collaborating with customers to explore problems and design advanced service	"We offered solutions to problems not recognised by potential customers. We failed to win the costs vs downtime argument. People sitting in procurement departments making the decisions not the IT people."	0	0 - Very little collaboration 1 - Consider customer feedback 2 - Co-create solutions with customers
	Devices to collect and analyse data on problems solved to demonstrate the value of advanced service	"A new conventional multi-year contract was also launched, offering price discounts for longer commitment, which competed with our advanced service offering."	1	0 - No 1 - Developing 2 - Remote condition monitoring
	Reconfigure product-service offerings to include advanced service	"Potential customers are buying on price and not recognising our value proposition. Our service offer was based on our ideal customer and what we thought they would value. Customers still want CapEx solutions and prices is an issue."	1	0 - No processes 1 - Adhoc processes 2 - Formalised processes

Strategic dynamic capability	Operational dynamic capability (activity or resource)	Evidence of operational dynamic capability from empirical data	Intensity	Scoring Criteria
Product Innovation **(Seize)** Total score 5/10	**Sense** product development required to enable advanced service	"We needed to demonstrate customer return on investment and provide information for future budgeting. We sourced a new service software system."	1	0 - No 1 - Partially 2 - Yes
	Cross functional systems to understand product usage, customer problems and needs	"We needed to show that we didn't just want to take our customers money, but also wanted to add value. We are competing with facilities management companies, who are not experts and offer cheap prices. It will all start coming back in future when they realise these companies are not equipped to deal with this specialist area."	1	0 - No 1 - Developing 2 - Yes
	Seize by designing new or adapted products	"Created calculation spreadsheets for asset life-cycle costs."	1	0 - No design influence 1 - Some design influence 2 - Design authority
	Research and development facilities	"The new service software system provided product life-cycle information, such as parts due for renewal and visibility of call out remedies."	1	0 - No 1 - Developing 2 - Yes
	Reconfigure product range to combine with advanced service	"We integrated a new services software system and processes."	1	0 - No processes 1 - Adhoc processes 2 - Formalised routines
Organisational Innovation **(Reconfigure)** Total score 6/10	**Sense** changes required to resources and activities for design and provision of advanced service	"We installed and integrated new service software and conducted staff training. The company has grown rapidly, but the foundations weren't there. We are building our partnership relations with our suppliers for joined up thinking and integration of remote monitoring."	2	0 - No 1 - Partially 2 - Yes
	Recruitment, training and incentives	"We failed to overcome the deep rooted cultural and mindset problems, which led to costing mistakes, poor teamwork and lack of engagement. I've looked at projects we've done over last couple of years and cannot find the right documentation and there's bits missing."	1	0 - No processes 1 - Adhoc processes 2 - Formalised processes
	Seize by adapting resources and activities to build the required capabilities	"We created new service level agreements and marketing materials. I recognised our poor processes and procedures and I'm trying to improve them with the help of a mentor. We talked about cultural change and process improvement plans. The structures were not in place, which is a legacy problem, because the owner is a technical person and not really a businessperson."	1	0 - No 1 - Partially 2 - Yes
	Finance to fund investments	"We explored the financial implications with our bank."	1	0 - Finance not explored 1 - Finance pending 2 - Finance available
	Reconfigure by integrating the adapted resources and activities	"I recognised the need to address poor communication and cross functional co-operation. I've set up an improvement project with representatives from all departments. Everybody blames each other - design blame projects, projects blame sales, sales blame design. We all need to come together and find a solution."	1	0 - Chaotic 1 - Reactive to priorities 2 - Pro-active

Table 9.2 - Populated code book for Company A and scores attributed, (evolution 3 of theoretical framework)

2017

2018

2019

Vision Innovation

Acquired a
service company

Permission to
develop and
trial advanced
services

Stage 1 Roadmap
(to lock in customers
for longer)

Carried on
regardless
with public
sector

Market research - NHS
audit resulted in a
proposal, which was
rejected

Developed supplier
relationships

Launched advanced
services

Tried to overcome internal
communication and cultural issues

No contracts won and
owner pulled the plug

Organisational Innovation

New marketing
material and
documentation

Finance explored

Product Innovation

Installed new service
software system

Service Innovation

Developed
bespoke ROI
demonstrator

Potential customers buying
on price and not recognising
our value proposition

Epilogue: The company failed to win the first contract, the project was abandoned and the champion has left the company.

Figure 9.1 - Company A - chronology of strategic dynamic capability development and application

2017 **2018** **2019**

Vision Innovation 5/10

Organisational Innovation 6/10

Product Innovation 5/10

Company A (company-led pathway)
Servitization status: Failure - failed to
win first customer and abandoned

Service Innovation 4/10

Vision Innovation 5/10

Service Innovation   6/10

Company B (customer-led pathway)
Servitization status: Failure - abandoned
due to replication problems

Organisational Innovation   6/10

Product Innovation 1/10

Vision Innovation   7/10

Organisational Innovation   7/10

Product Innovation   8/10

Company C (company-led pathway)
Servitization status: Ongoing - no first
customer due to lack of customer
engagement

Service Innovation 5/10

Vision Innovation   10/10

Service Innovation   9/10

Product Innovation 7/10

Company D (company-led pathway)
Servitization status: Success - scaling
by replication

Organisational Innovation 9/10

Vision Innovation 9/10

Product Innovation 9/10

Organisational Innovation 7/10

Company E (company-led pathway)
Servitization status: Ongoing - unable to
gain traction for scaling due to lack of
customer engagement

Service Innovation 6/10

Vision Innovation 4/10

Product Innovation   4/10

Organisational Innovation   4/10

Company F (company-led
pathway)
Servitization status: Failure - failed to
win first customer and abandoned

Service Innovation 6/10

Figure 9.2 - Sequences of development and application of strategic dynamic capabilities

9.2 Cross Case Analysis

To search for interdependencies between high or low intensities of the four strategic dynamic capabilities, similarities and differences are identified which enable or inhibit servitization progress during the research period. The first step was to group the companies according to their scores for the each of the four strategic dynamic capabilities, either less than 6.5 or greater than 6.5. This was the same cross over point for low or high intensities of strategic dynamic capabilities used in phase 1. The results are provided below in tables 9.3 to 9.6. The second step was to combine the scores for service innovation (defined as the only necessary strategic dynamic capability during phase 1) with each of the others (vision innovation, product innovation and organisational innovation) in the form of two-by-two matrices. The scores for each case were plotted to determine their position within the matrices. These are shown in figures 9.3 to 9.5.

9.2.1 Interdependency between service innovation and vision innovation

The six companies are grouped according to high or low intensity scores for vision innovation. Cross comparison of code book data for cases within the same group identifies similarities and differences between their vision innovation capabilities.

Scores for vision innovation	Intensity (high or low)	Similarities and differences
Company A 5/10 Company F 4/10 Company E 9/10 Company B 5/10	**<6.5** **Low**	**Company A** were more interested locking in customers than trying to understand their problems and provide solutions (table 9.2). **Company F** thought they knew exactly what their customers wanted (appendix 9). **Company E** have an enduring vision, with strong internal support (appendix 8). **Company B** won a first customer for logistics, which was not replicable and quickly lost internal support (appendix 5). **Summary** **Companies A, E and F** only partially recognised, evaluated and validated opportunities. This led to underdeveloped visions, insufficient internal stakeholder support and roadmaps lacking clarity.
Company C 7/10 Company D 10/10	**>6.5** **High**	**Company C** internal stakeholders are encouraged by the boost to the company's credibility by offering their new service (appendix 6). **Company D** has a clear and compelling vision with strong support from all stakeholders (appendix 7). **Summary** **Companies C and D** both recognised and evaluated opportunities, resulting in a clear and compelling vision. This led to strong internal stakeholder support, with a roadmap containing key targets and milestones.

Table 9.3 - Scoring for vision innovation

The six companies are grouped according to high or low intensity scores for service innovation. Cross comparison of code book data for cases within the same group identifies similarities and differences between their service innovation capabilities.

Scores for service innovation	Intensity (high or low)	Similarities and differences
Company A 4/10 **Company F 6/10** **Company C 5/10** **Company B 6/10**	**<6.5** **Low**	**Company A** offered a service based on solutions to their internal pains and chose the wrong market (table 9.2). **Company F** failed to understand their customers real needs and validate a new service offer (appendix 9). **Company C** think they understand the problems of customers, however, their new concept is currently a step too far (appendix 6). **Company B** won a contract which was not replicable (appendix 5). **Summary** All four companies did not develop their customer relationships sufficiently to fully understand their problems and enable co-production of a validated service solution. Working closely with the wrong first customer can lead to an offering which is not replicable or aligned with the company's vision.
Company D 9/10 **Company E 6/10**	**>6.5** **High**	**Company D** have strong customer relationships which enabled collaboration to understand their problems and co-produce service solutions. This led to winning their first contracts (appendix 7). **Company E** work closely with customers and are running trials, but so far the offer is not gaining traction (appendix 8). **Summary** **Companies D and E** both work closely with customers, however offering services without co-production and validation risks customers not perceiving value.

Table 9.4 - Scoring for service innovation

Combining the scores for vision innovation and service innovation for each company enables construction of the two-by-two matrix shown in figure 9.3. This illustrates at a glance the intensity of vision and service innovation for each company and their position within the matrix.

Figure 9.3 - Intensity of service innovation vs vision innovation

Comparison of similarities and difference in tables 9.3 and 9.4 and the quadrant in which the companies are positioned (figure 9.3) led to the following insights with illustrative quotes.

Low intensities of service innovation: High intensities of vision innovation
Led to a clear service offering with internal support but lacking customer engagement. This inhibited winning the first contract, but a clear vision and belief provides conviction to carry on. Company C said … "We have been shouting about our advanced service in PR for about a year and started talking with customers. We have had some positive reactions, but others look at us as if we are crazy."

Led to engagement with potential customers to trial a service offering without first gathering and evaluating market receptiveness, which inhibited winning the first contract. Company E said … "We think we can disrupt the market, by offering new technology with lower life-cycle costs and business improvement opportunities. However, there is no problem in the customers eyes to solve".

High intensities of service innovation: Low intensities of vision innovation

No data.

High intensities of service innovation: High intensities of vision innovation

Led to a well researched and developed service offering with a clear roadmap which resonated with customers. This enabled the first customer to be won and subsequently scaled. Company D said… "The problem with the printer manufacturers is that you don't get personalised service and when you ring, you're speaking to someone who is somewhere else in the world. We offer personalised service, which we discussed and developed with friendly customers.   We understand that when a printer breaks down there's a lot of pain, a lot of unexpected costs maybe and downtime is the biggest pain".

Low intensities of service innovation: Low intensities of vision innovation

Led to the development of service offerings which were not perceived as valuable by customers and/or the internal team, with roadmaps lacking direction. This inhibited servitization and led to failure. Company A said … "We were figuring it out as we went along and missed opportunities to identify additional value. In hindsight, we chose the wrong market and offered solutions to problems not recognised by potential customers".

Company B said… "We recognised the need to diversify to ensure sustainability of the business. We had a session with our sales team to explore what this could look like for the business. There was a lack of buy-in from the sales team, who were nervous of hindering print sales and their changing roles. We're haven't developed the customer value proposition enough, you've got to run a pilot, we didn't."

Company F said … "We recognised an opportunity to get paid for a service we were already doing to a certain extent. We're speaking with engineers who want it, but cannot get to financial directors, it's a step too far.

Sequences of development and application of strategic dynamic capabilities

Examination of the chronologies for each company's development and application of the four strategic dynamic capabilities (figure 9.1 and appendices 10 to 14), in combination with the above data, shows that companies A, B, E and F applied their vision and service innovation capabilities separately. Companies A, B and F have abandoned servitization, whilst company E has failed to progress beyond their first customer, due to lack of traction. Company C only began to fully develop their vision and overlap with service innovation towards the end of the research period and have so far failed to win their first customer. Company D was the only one to overlap the

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development and application of their vision and service innovation capabilities from the start. This enabled the first customers to be won and they are now scaling in the expansion stage.

Summary

The findings show that a clear and compelling vision for a service offering must address validated customer needs. This demonstrates the importance of developing and applying market sensing capabilities of vision innovation in combination with customer linking capabilities of service innovation during the formation of a customer value proposition. Failure to align service solutions with problems recognised by customers will not enable the first customer to be won, or alternatively the wrong first customer will be won, leading to replication problem. Underdeveloped visions are not strong enough to overcome customer resistance, or internal loss of momentum and will inhibit servitization success. A strong vision enables resilience to try to overcome initial customer objections, however, it must begin to resonate with customers to enable success. A strong vision developed with the help of customers is an enabler for servitization success.

9.2.2 Interdependency between service innovation and product innovation

The six companies are grouped according to high or low intensity scores for product innovation. Cross comparison of code book data for cases within the same group identifies similarities and differences between their product innovation capabilities

Scores for product innovation	Intensity (high or low)	Similarities and differences
Company A 5/10 **Company B 1/10** **Company F 4/10**	**<6.5** **Low**	**Company A** demonstrated limited product development, hampered by lack of team co-operation (table 9.2). **Company B** lost a key member of the team, which stalled any product development (appendix 5). **Company F** reported recruitment difficulties, meaning product development was not progressed (appendix 9). **Summary** **Companies A, B** and **F** did not significantly adapt their products to support services due to team capacity and collaboration issues.
Company C 8/10 **Company E 9/10** **Company D 7/10**	**>6.5** **High**	**Company C h**ad designed and developed a new product without involving potential customers (appendix 6). **Company E** have continued with product development in alignment with their vision, despite a lack of buy-in from potential customers (appendix 8). **Company D** benefitted from product development undertaken by third parties (appendix 7). **Summary** **Companies C** and **E** significantly adapted their products to support services. In both cases product innovation was prioritised over service innovation, which was not evident until the later stages of the research period. Failing to involve the potential customer during the design stage of product development risks non-acceptance. In addition, failing to pivot in accordance with potential customer feedback risks objections and ability to scale.

Table 9.5 - Scoring for product innovation

Combining the scores for product innovation and service innovation for each company enables construction of the two-by-two matrix shown in figure 9.4. This illustrates at a glance the intensity of product and service innovation for each company and their position within the matrix.
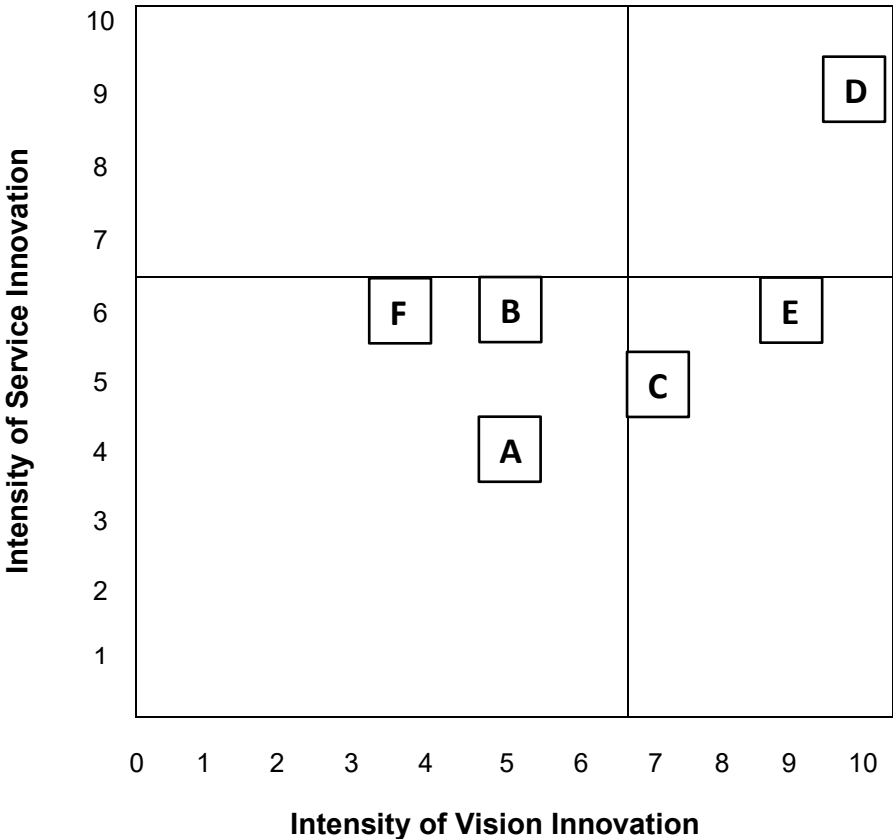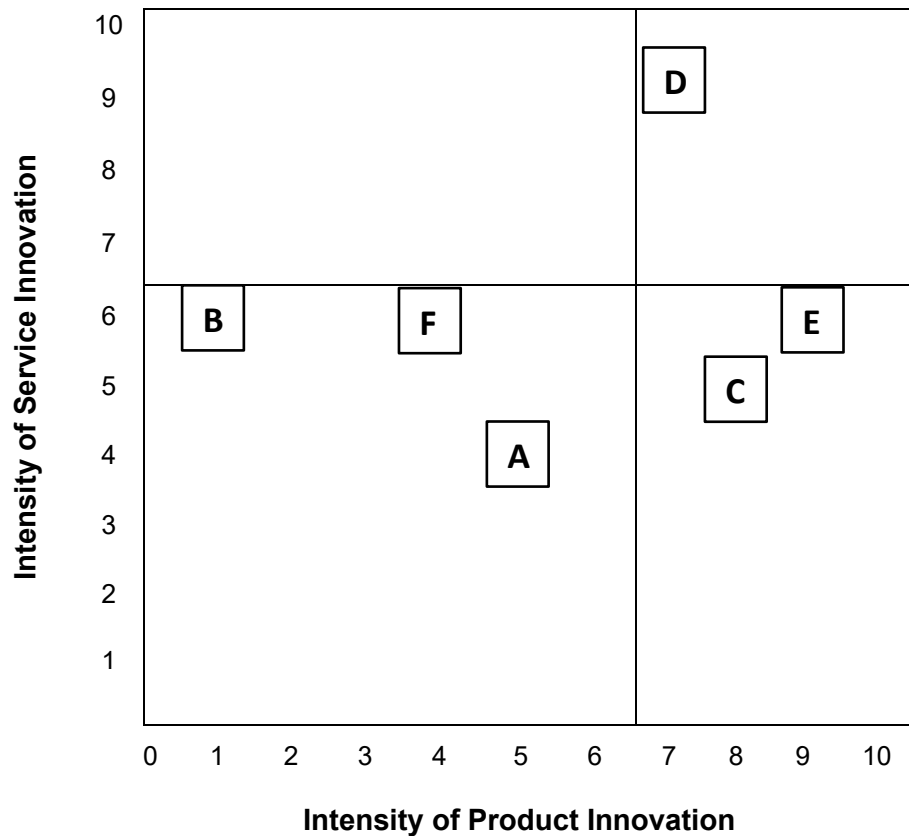

Figure 9.4 - Intensity of service innovation vs product innovation

Comparison of similarities and difference in tables 9.3 and 9.5 and the quadrant in which the companies are positioned (figure 9.4) led to the following insights with illustrative quotes.

Low intensities of service innovation: High intensities of product innovation

Company C said … "Customer cell configurations enable us to do things quicker, which gives us more capacity, which then means we can sell that additional capacity somewhere else. We then went further by designing the advanced service. This has taken three years and two site moves. We are now starting to communicate the new concept."

Company E said … "We've had great results with our new machine. Food processing by the hour will bring our customers from the stone age to the digital age, but we are struggling to convince potential customers who are fixated on capacity, not quality and waste."

High intensities of service innovation: Low intensities of product innovation

No data.

High intensities of service innovation: High intensities of product innovation

Company D said … "Product innovation is done by our partners. We use third party software for remote access to printer information, which costs us £3.00 per month for each printer and is added onto the customer's contract. We proposed - you invest in us and you're investing in a better future."

Low intensities of service innovation: Low intensities of product innovation

Company A said … "We needed to demonstrate customer return on investment and provide information for future budgeting. So, we integrated a new software system and processes. However, we failed to win the costs vs downtime argument, potential customers are buying on price and not recognising our value proposition."

Sequences of development and application of strategic dynamic capabilities

Examination of the chronologies for each company's development and application of the four strategic dynamic capabilities (figure 9.1 and appendices 10 to 14) in combination with the above data, shows that companies A, C, E and F all commenced product innovation before service innovation. All reported problems engaging potential customers with their value proposition, leading to A and F abandoning servitization. Companies C and E have both undertaken significant product development but have failed to engage customers. Company D was the only one, not only to overlap the development and application of their vision and service innovation capabilities, but also commenced product innovation once the needs of potential customers were established.

Summary

The findings show that product innovation should be aligned with delivering a service offering which addresses customers perceived problems and validated needs. This demonstrates the importance of undertaking product development after establishing a strategic fit between a service offering and validated customer needs.

9.2.3 Interdependency between service innovation and organisational innovation

The six companies are grouped according to high or low intensity scores for organisational innovation. Cross comparison of code book data for cases within the same group identifies similarities and differences between their organisational innovation capabilities.

Scores for organisational innovation	Intensity (high or low)	Similarities and differences
Company A 6/10 Company B 6/10 Company F 4/10	<6.5 Low	**Company A** failed to address poor communication and cross functional co-operation due to deep routed cultural issues (table 9.2). **Company B** failed to secure the support of the sales team who were nervous of hindering print sales and their changing roles, resulting in failure to engage potential customers (appendix 5). **Company F** failed to successfully recruit a new software engineer (appendix 9). **Summary** **Companies A, B, E** and **F** failed to adapt their resources and activities.
Company C 7/10 Company D 9/10 Company E 7/10	>6.5 High	**Company C** is experiencing difficulties integrating a new digital management system across functions, mainly due to brain fade amongst their staff since the company relocated (appendix 6). **Company D** enjoys full integration cross functionally (appendix 7). **Company E** collaborates cross functionally across their suppliers and potential customers at multiple levels, however lack of funding is a problem (appendix 8). **Summary** **Company D** adapted their resources and activities, whilst **companies C** and **E** are continuing to adapt their resources and activities.

Table 9.6 - Scoring for organisational innovation

Combining the scores for organisational innovation and service innovation for each company enables construction of the two-by-two matrix shown in figure 9.5. This illustrates at a glance the intensity of organisational and service innovation for each company and their position within the matrix.
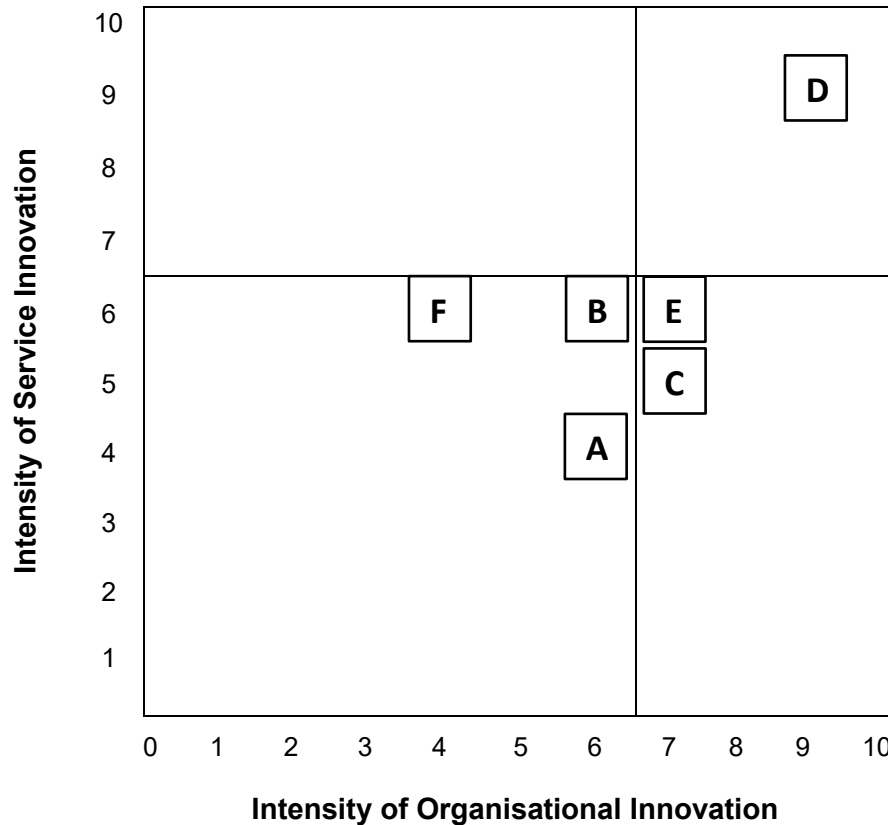
Figure 9.5 - Intensity of service innovation vs organisational innovation

Comparison of similarities and difference in tables 9.3 and 9.6 and the quadrant in which the companies are positioned (figure 9.5) led to the following insights with illustrative quotes.

Low intensities of service innovation: High intensities of organisational innovation
Company C said … "We have designed our on-line portal for customer access and re-organised the shop floor into customer cells. We have installed a new ERP system for in-house planning to support our new customer focussed approach." However, as reported in both previous sections, customers are not receptive to the value proposition and therefore company C have not moved beyond the exploration stage.

It is a similar story with company E, who are stuck in the engagement stage and said … "We are developing remote monitoring and fixes to support our overseas customers." Like company C considerable expenditure has been incurred, without first ensuring that customers will value the

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new service offering. In addition, company E have funding issues, the Managing Director said …
"We are still exploring finance options for overseas installations."

High intensities of service innovation: Low intensities of organisational innovation
No data

High intensities of service innovation: High intensities of organisational innovation
On the other hand company D, who are scaling, recognise the need for future process changes and recruitment once customers reach a critical mass. The Managing Director said … "Our processes work well for now, but will have to grow with the company and additional maintenance engineers will be required."

Low intensities of service innovation: Low intensities of organisational innovation
Companies A, B and F are similar to C and E. All have invested considerable time and money in organisational changes to design and develop a service offering which is ready for delivery, without first validating with customers.

Company A said … "We have wasted time and money on producing template contracts, marketing material, exploring finance options and new CRM software because not a single contract was won. The owner wanted quick fixes and pulled the plug".

Company B said … "Twelve months of investment down the drain. The marketing person found it harder than expected to get customers to recognise the value proposition and left. We need to start again, but business as usual has got in the way."

Company F added … "We created new sales and marketing material, plus updated our website, but we've had no success and all funding comes out of our own pockets, so its on the back burner for now."

Sequences of development and application of strategic dynamic capabilities
Examination of the chronologies for each company's development and application of the four strategic dynamic capabilities (figure 9.1 and appendices 10 to 14) in combination with the above data, shows that companies A, C and F all commenced organisational innovation before service and product innovation. It has been reported earlier that A and F have abandoned servitization and C is still trying to engage potential customers. Company B developed and applied organisational innovation capabilities in parallel with service innovation and has stalled. This is because a key member of staff left the company, however this was caused by failure to engage customers leading to disillusionment. Company E was similar, also carrying out organisational

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innovation and service innovation together, whilst failing to engage customers. Company D undertook organisational innovation in parallel with product innovation, following on from an overlapping period of vision and service innovation.

Summary

The findings show that organisational changes should only be undertaken once a strategic fit is established between a service offering and a validated customer need, plus, product development can facilitate delivery of the service offering.

9.3 Sequences of the Four Strategic Dynamic Capabilities During Early Stage Servitization

The findings show that the four strategic dynamic capabilities were developed and applied in different sequences by the six SMEs (figure 9.2). Overall, three companies have abandoned servitization, whilst two others are ongoing, and only one has progressed beyond the first contract to begin scaling.

The key insight from section 9.2.1 is that a clear and compelling vision for a service offering must address validated customer needs.

The key insight from section 9.2.2 is that product development must facilitate delivery of a service offering which addresses validated customer needs.

The key insight from section 9.2.3 is that organisational changes should only be undertaken once a company's vision for a service offering has been validated against customer needs and product development enables delivery.

Combining these key insights (9.2.1 to 9.2.3) provides the answer to research question 3. Therefore, in response to:

Research Question 3 (section 3.4.3) - How should product-centric SMEs sequence their development and application of the four strategic dynamic capabilities during early stage servitization?

The answer is as follows: *Product-centric SMEs should develop and apply the four strategic dynamic capabilities in the following sequence: Vision innovation and service innovation should be overlapped, followed by product innovation, and finally organisational innovation.*

P.T. Jackson, DBA Thesis, Aston University 2021

9.4 Summary

This chapter describes how a systematic process is used to analyse the data set compiled in chapter 8 to answer research question 3. This comprises of within case analysis (section 9.1) to prepare the ground for a cross case analysis (section 9.2). The findings explain how the sequence of development and application of the four strategic dynamic capabilities enables or inhibits progress during the engagement stage of servitization (section 9.3).

The next chapter first summarises the answers to all three research questions. The validity of the findings is discussed, before connecting with relevant literature to support the development of three research propositions, one for each of the research questions. The research propositions are then evaluated as a set and finally practical application frameworks are developed for use by practitioners.

Chapter 10

Discussion

This research is based on the notion that servitization is facilitated by the combination and sequence of four key capabilities, namely: vision innovation; service innovation; product innovation and organisational innovation (section 3.2). These core elements are categorised as strategic dynamic capabilities (section 3.3.2), explaining that a servitizing company should sense opportunities for advanced services (vision innovation), then seize them (service innovation and product innovation) and reconfigure their capabilities as required (organisational innovation). Literature suggests that product-centric companies attempting to provide services without sufficiently transforming their resources and activities are prone to failure, which is attributed to low levels of dynamic capabilities (Kindström and Kowalkowski, 2014). However, literature is unclear concerning the level of dynamic capabilities required, or how they should be measured (section 3.4.1), along with how they should be combined (section 3.4.2), and sequenced (3.4.3), particularly for SMEs. This led to the research questions (figure 3.8).

To address the research questions, chapter 4 develops a set of principles to shape a research programme (figure 10.1), comprising of two phases, each consisting of multiple case studies. The methods employed during phases 1 and 2 are covered in chapters 5 and 8 respectively. Data analysis and findings to answer research questions 1,2 and 3 are covered in chapters 6,7 and 9 respectively.
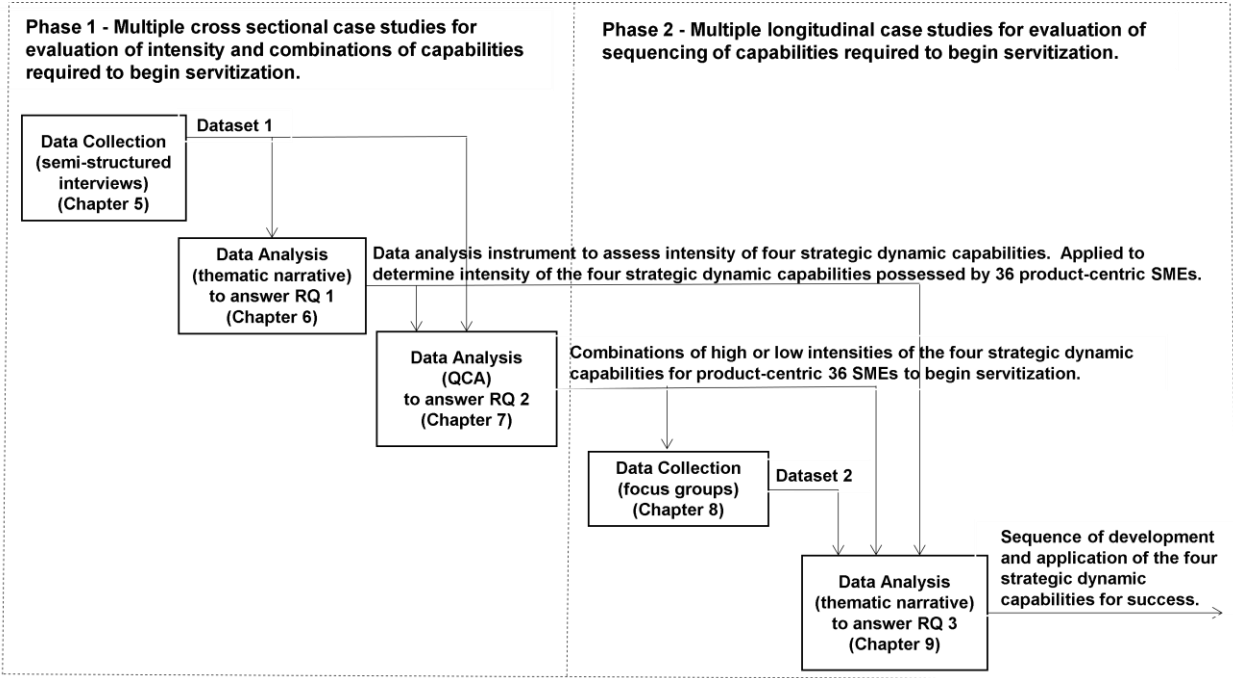
Figure 10.1 - Research programme

This chapter first summarises the answers to the research questions, then follows a process for developing and shaping research propositions adapted from a section of Eisenhardt's (1989) protocol for case study research. This comprises of a series of activities in two stages, which are summarised below in table 10.1. These are: connecting findings with relevant literature to support the development of three research propositions, one for each of the research questions (sections 10.1 to 10.3); and evaluating the research propositions (section 10.4). Finally, section 10.5 develops practical application frameworks.

Stage	Activity	Reason
Connecting findings with relevant literature (sections 10.1 to 10.3)	Comparison with relevant extant literature to support the development of research propositions.	Strengthen theoretical grounding by triangulation of evidence to enhance internal validity.
Evaluating the research propositions (section 10.4)	Evaluation of the set of research propositions for clarity, consistency, conciseness and contribution (Ulaga et al., 2021)	To modify or extend theory. Enhance internal and construct validity.

Table 10.1 - Process for developing and shaping research propositions. Adapted from a section of Eisenhardt's (1989) protocol for case study research

10.1 Intensities of the Four Strategic Dynamic Capabilities Required to Begin Servitization - Leading to Research Proposition 1

Literature suggests that product-centric companies who possess only low levels of dynamic capabilities and attempt servitization are prone to failure (Gebauer, Haldimann and Saul, 2017; Kindström, Kowalkowski and Sandberg, 2013). To measure and explain the levels of dynamic capabilities required for servitization, this research introduces the concept of intensity (section 3.3.3). Intensity is an important scientific concept to quantify for example, the strength of UV light required to produce a desired outcome. Used in the context of this research, it relates to the strength of dynamic capabilities required for servitization and provides a means of differentiating from the descriptive, typographical levels proposed by Ambrosini, Bowman and Collier (2009). However, it is not clear if high intensities are required in all four of the strategic dynamic capabilities identified (section 3.2) to begin servitization. This led to research question 1 (section 3.4.1) - *Do product-centric SMEs require high intensities in all four strategic dynamic capabilities to begin servitization?*

To address this question a theoretical framework originating in literature (table 3.3) is elaborated to develop a data analysis instrument (section 6.1). This is used to determine whether 36 SMEs

possess high or low intensities of the four strategic dynamic capabilities (section 6.2.1 and 6.2.2) and subsequently linked to their servitization progress (6.2.3). Analysis shows that the four strategic dynamic capabilities are evident at varying intensity across the 36 SMEs (table 6.4). Overall, eight companies possess high intensity in all four strategic dynamic capabilities, whilst others have high intensity in some, but not all and others have low intensities across the board. From the sample of 36 companies exploring the opportunities and benefits of competing through a services-led strategy, 15 progress to begin the servitization process, whilst the others fail to progress. Examination of the scores for the 15 companies who progress reveals the following:

> 8 companies possess high intensities in all 4 capabilities
> 5 companies possess high intensities in 3 capabilities
> 2 companies possess high intensities in 2 capabilities

This shows that high intensities in all four strategic dynamic capabilities are not required to begin servitization and that different combinations of high and low intensities enable SMEs to progress. Therefore, the answer to research question 1 is as follows: *Product-centric SMEs do not require high intensities in all four strategic dynamic capabilities to begin servitization.*

Reflection on validity of answer to research question 1

It is important to critically reflect upon the validity of the answer. To answer research question 1 required a way of assessing and scoring the dynamic capabilities possessed by an SME in relation to those required for servitization. Only one tool, was found in the literature to measure dynamic capabilities required for servitization (Coreynen, Matthyssens and Gebauer, 2018). This comprises of 48 questions, split between factors for services development, deployment, and culture. However, whilst claiming to be holistic, several important capabilities are absent, for example, those relating to creation of a customer value proposition and product usage data to inform product development. This might be explained by the inconsistent application of dynamic capability theory across the factors, implying that sensing, seizing, and reconfiguring capabilities only apply to service development. In addition, the tool does not differentiate between strategic and operational capabilities. It was therefore considered inappropriate for this research.

A new data analysis instrument is developed to answer research question 1 (section 6.1). In contrast to the tool proposed by Coreynen, Matthyssens and Gebauer (2018), it incorporates all key elements of a business model within a dynamic capabilities framework that applies the concepts of sensing, seizing and reconfiguring consistently at both strategic and operational level. It is designed to enable scoring of an SMEs operational capabilities from empirical data to assess their possession of high or low intensities of the four strategic dynamic capabilities.

Connection to literature to develop research proposition 1

To support the development of the first research proposition, the answer to research question 1 is connected to relevant literature. Kindström, Kowalkowski and Sandberg (2013) argue that dynamic capabilities are required for servitization and that companies possessing only low levels are prone to failure. Their study explores and identifies key operational dynamic capabilities (micro-foundations) specifically within the context of servitization, but in common with most servitization studies capabilities they are examined in isolation, implying that all are required. Therefore, the findings and answer to research question 1 builds on their research, by showing that SMEs can start the servitization process without high intensities in all the strategic dynamic capabilities which will be required. In other words, SMEs can begin servitization with low intensities in some of the four strategic dynamic capabilities, but not all. This is supported by the work of Forkmann et al. (2017), who advocate complex causality and equifinality during servitization. These connections to prior work support the answer to research question 1, which is subsequently taken forward to become the first research proposition as follows:

Research proposition 1: Product-centric SMEs do not require high intensities in all four strategic dynamic capabilities to begin servitization.

Answering research question 1 and connecting the findings with literature to support the development of the first research proposition, prepares the ground for a qualitative comparative analysis to answer research question 2 (chapter 7). This examines which combinations of high and low intensities of the four strategic dynamic capabilities result in an SMEs success or failure to begin servitization.

10.2 Combinations of the Four Strategic Dynamic Capabilities Required to Begin Servitization - Leading to Research Proposition 2

Gebauer (2008), argues it is not just individual capabilities, but their right combination and fit which is important. Despite this, research studies usually analyse capabilities in isolation (Sjödin, Parida and Kohtamäki, 2016), implying all are equally important and failing to link strategic choices. Little consideration is given to which combinations of capabilities during servitization lead to similar or differing outcomes. This led to research question 2 (section 3.4.2) – *Which combinations of high and low intensities of the four strategic dynamic capabilities enable product-centric SMEs to begin servitization?*

To address this question a qualitative comparative analysis examines which combinations of high and low intensities of the four strategic dynamic capabilities possessed by 36 SMEs led to their success or failure to begin servitization (section 7.4). Analysis shows that high intensity in service

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innovation must be combined with high intensity in product innovation and vision innovation (pathway 1) or low intensity in vision innovation and high intensity in organisational innovation (pathway 2) to begin servitization. The findings reveal that no single strategic dynamic capability in isolation will enable progress and different combinations can lead to the same outcome, which demonstrates equifinality. Therefore, there is more than one way of combining the strategic dynamic capabilities to achieve the outcome, further demonstrating that high intensities in all four are not required to begin servitization. However, without high intensity in service innovation, progress is absent and cannot be compensated by high intensities in other strategic dynamic capabilities.   It will therefore not guarantee success but should increase the probability of success. Therefore, the answer to research question 2 is as follows:

Product-centric SMEs can begin servitization with either: high intensity strategic dynamic capabilities in vision innovation, service innovation and product innovation; or high intensity in service innovation and organisational innovation and low intensity in vision innovation for company-led or customer-led pathways respectively.

Reflection on validity of answer to research question 2

It is important to critically reflect upon the validity of the answer to research question 2. Qualitative comparative analysis cannot guarantee the "true" causal grounds for an outcome because the issue of causality is a more complex matter (Abell, 2004; Gerring, 2005; Mahoney, 2004). It is a case orientated approach and technique based on multiple conjunctural causation which embraces equifinality and asymmetry. It rejects any form of true causality because of context and conjuncture sensitivity (Ragin, 1987). However, contextual idiosyncrasies are controlled during case selection, while cross case necessity and sufficiency analysis identify regularities of capability configurations.

The minimal solutions obtained from logical minimisation of the truth table are subsequently interpreted through the cases and aligned with theory, leading to new theoretical insights. Therefore, the data analysis process recognises the complexity of servitization, whilst remaining sensitive to individual cases to capture deep insights. The iterative nature of the back and forth dialog between empirical data and theory for reality checking enhances coherency and reliability of the findings. Thus, duality is achieved by situationally grounding empirical data, whilst transcending context to create broader theoretical understanding through abstraction.

The findings establish causal mechanisms existing amongst comparable cases and allow for causal complexity, whilst striving to achieve the most parsimonious explanations. This enables causality statements of limited scope (Rihoux and Ragin, 2009), allowing modest generalisation beyond the observed cases, but within the boundaries of SMEs of this type. These can be applied

with appropriate caution to other companies sharing similar characteristics defined by the domain of investigation.

Connection to literature to develop research proposition 2

To support the development of the second research proposition, the answer to research question 2 is connected to relevant literature. The findings reveal two combinations of the four strategic dynamic capabilities which enable SMEs to move beyond their initial exploration of advanced services and begin servitization. This demonstrates that SMEs who begin servitization cannot be explained by their possession or net effects of single individual capabilities. Instead, it can only be explained by the interplay of strategic dynamic capabilities within specific configurations. This aligns well with work by Forkmann et al. (2017), who advocate complex causality and equifinality during servitization. It also aligns well with the work of Gebauer (2008), who argues that it is not just individual capabilities which are important, but also their right combination and fit.

Pathway 1 is considered to represent a company-led route and pathway 2 a customer-led route, which are characterised by high and low intensities for vision innovation respectively. The company-led route (high intensity of vision innovation) was taken by SMEs who demonstrated a clear and compelling vison for services (Reichard, 2016). They all recognised the opportunities and benefits of offering new services to meet customer needs based on market research, competitor intelligence and environmental trends (Story et al., 2017; Kindström, Kowalkowski and Sandberg, 2013). Each vision was underpinned by a comprehensive roadmap for implementation, with specific targets and milestones (Cohen and Levinthall, 1990; Bartkus, Glassman and McAfee, 2000).

In stark contrast, companies taking the customer-led route (low intensity of vision innovation) failed to articulate a clear and compelling vision for services and described very limited market research, or knowledge of competitors and environmental trends. Instead, they had simply responded to customer demands and were undertaking organisational innovation to enable fulfilment. This illustrates the asymmetric effects of strategic dynamic capabilities, by showing that possession of high and low intensities for vision innovation are both part of configurations which enable SMEs to begin servitization. Therefore, this research addresses the call by Forkmann et al. (2017) to understand the interplay between drivers of servitization, particularly how the absence and presence of the same driver interact with other drivers for success. It also addresses their call for more research to understand the configurations of drivers leading to servitization success, particularly those that do not adhere to the assumption that 'more is better'.

This research goes further than other configurational studies by being the first to identify a necessary condition for servitization (service innovation). This aligns well with Smith, Maull and

Ng (2014), who argue that the customer value proposition should be the first step towards value creation. It also demonstrates that nothing can compensate for the absence of service innovation. This differs from the findings of previous studies which claim interdependencies between capabilities can lead to substitution (Sjödin, Parida and Kohtamäki, 2016) or compensation (Black and Boal, 1994) for one another in producing the same outcome. These connections to prior work support the answer to research question 2, which is subsequently taken forward to become the second research proposition as follows:

Research proposition 2a*: High intensities in vision innovation, service innovation and product innovation enable product-centric SMEs to begin a company-led path to servitization.*

Research proposition 2b*: High intensities in service innovation and organisational innovation and low intensity in vision innovation enable product-centric SMEs to begin a customer-led path to servitization.*

10.3 Sequences of the Four Strategic Dynamic Capabilities Required During Early Stage Servitization - Leading to Research Proposition 3

The answers to research questions 1 and 2 reveal that high intensity capabilities are not required in all four strategic dynamic capabilities to begin servitization. This is important, because SMEs are not simply smaller versions of larger companies and have limited resources (Möller et al., 2006), meaning they are unlikely to be able to apply or develop them all simultaneously. This means they will need to prioritise, particularly at the beginning (Böhm, Eggert and Thiesbrummel, 2017). The subsequent research propositions provide practitioners with insight on which activities are most relevant within their context and enable strategic orchestration of their precious resources at the beginning of the servitization process. The emphasis on contextual trade-offs supports the work of Turunen and Finne (2014), who posit that different pathways can be taken during servitization, depending on context. However, it is expected that SMEs will need to develop all four strategic dynamic capabilities during servitization. This led to research question 3 (section 3.4.3) - *How should product-centric SMEs sequence their development and application of the four strategic dynamic capabilities during early stage servitization.*

To address research question 3, a longitudinal study of 6 SMEs who progressed to begin servitization from phase 1, examines how the sequence in which the four strategic dynamic capabilities are developed and applied during servitization enables or inhibits progress. The key insights are as follows: (i) a clear and compelling vision for a service offering must address validated customer needs (section 9.2.1); (ii) product development must facilitate delivery of a service offering which addresses validated customer needs (section 9.2.2); organisational

changes should only be undertaken once a company's vision for a service offering has been validated against customer needs, and product development enables the delivery of the service offering (9.2.3). Combining these key insights provided the answer to research question 3, which is as follows: *Product-centric SMEs should develop and apply the four strategic dynamic capabilities in the following sequence: Vision innovation and service innovation should be overlapped, followed by product innovation, and finally organisational innovation.*

Reflection on validity of answer to research question 3

It is important to critically reflect upon the validity of the answer to research question 3. The community of practice set up to conduct the research represents a novel and collaborative approach. It leveraged the different perspectives and competencies of academics and practitioners to co-produce insightful and penetrating knowledge of mutual benefits. Storytelling techniques used to capture sequences of events unfolding over time were able to connect cause and effect (Denning, 2006), providing a rich understanding (Kendall and Kendall, 2012). Capturing the whole story rather than just elements, meant that narratives were not abstract or remote and instead were familiar, informative and relevant (Moen, 2006). This allowed examination of underlying processes, generating patterns and commonalities to reveal specific events and their relationships. Events of particular interest included, activities conducted, resources allocated and the sequence which enables or inhibits progress. This is described by Pentland (1999) as moving from the surface structure to deep structure, which enables explanation rather than just description. This enhanced validity of the findings by revealing a level of insight rarely possible due to the constraints of traditional methods.

Connection to literature to develop research proposition 3

To support the development of the third research proposition, the answer to research question 3 is connected to relevant literature. The findings show that SMEs should first overlap service innovation with vision innovation (section 9.2.1). This aligns well with Kindström, Kowalkowski and Sandberg (2013), who argue it is essential to align a clear and compelling vision for a service offering, with a full understanding of customer perceived problems and needs. It also demonstrates the importance of co-production and validation of value propositions (Vargo and Lusch, 2004) to win the first customer. It is shown that winning the first customer is important for SMEs on the company-led route to maintain internal support. It is also shown that companies on the customer-led route need to win the right first customer by avoiding too much focus on demands which are not replicable. This demonstrates the importance of striking a balance between customisation to provide customer perceived value and modularity to ensure profitable scaling is possible (Davies, Brady and Hobday, 2006). Therefore, customisation represents an example of an operational dynamic capability where possession of high intensity can either enable or impede servitization depending on context. This aligns with arguments of Black and Boal

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(1994), by demonstrating how the interdependencies between capabilities can enhance or suppress outcomes. Overall, section 9.2.1 highlights the importance of combining the market sensing capabilities of vision innovation with the customer linking capabilities of service innovation.

Insights from section 9.2.2 show that once a strategic fit is established between a service offering and customer needs, product innovation required for facilitation of the service should be undertaken. This is supported by Oliva and Kallenberg (2003), who argue products should be designed for services, rather than services been bolted on later. Finally, section 9.2.3 showed that organisational innovation should only be undertaken once a company's vision for a service offering has been validated against customer needs and product development allows delivery. This aligns well with Ulaga and Reinartz (2011) and Neu and Brown (2005).

The findings are similar to the work of Pawar, Beltagui and Riedel (2009) regarding the key strategic dynamic capabilities required for servitization, but differ in terms of the approach to be taken during their development. Their study is based on large multi-national organisations and concludes that creating value requires the simultaneous design of product, service, and organisation. However, this would be inappropriate for SMEs with limited resources for innovation, who should be encouraged to develop the capabilities required for servitization in an appropriate sequence. This will not only enable prioritisation of precious resources and activities, but also leverage the interdependencies identified in sections 9.2.1 to 9.2.3. These connections to prior work support the answer to research question 3, which is subsequently taken forward to become the third research proposition as follows:

Research proposition 3: Product-centric SMEs should develop and apply the four strategic dynamic capabilities in the following sequence: Vision innovation and service innovation should be overlapped, followed by product innovation, and finally organisational innovation.

Four key strategic dynamic capabilities are identified from the literature, namely: vision innovation; service innovation; product innovation; and organisational innovation. However, questions remain concerning the measurement and required intensity of these capabilities, along with how they should be combined and sequenced, particularly for SMEs.

Key assumptions and gaps in knowledge

Research questions

Research propositions

Intensity of dynamic capabilities
Companies with low levels of dynamic capabilities are susceptible to servitization failure and consequences can be severe, particularly for SMEs … *however, the literature does not explain how they should be measured or levels required.*

Research question 1
Do product-centric SMEs require high intensities in all four strategic dynamic capabilities to begin servitization?

Research proposition 1
Product-centric SMEs do not require high intensities in all four strategic dynamic capabilities to begin servitization.

Combining dynamic capabilities
Most studies examine dynamic capabilities in isolation, implying equal importance. However, it is not just individual capabilities, but their right combination and fit which is important. The literature suggests that different pathways can be taken during servitization … *but does not explain how dynamic capabilities should be combined.*

Research question 2
Which combinations of high and low intensities of the four strategic dynamic capabilities enable product-centric SMEs to begin servitization?

Research proposition 2a
High intensities in vision innovation, service innovation and product innovation enable product-centric SMEs to begin a company-led path to servitization.
Research proposition 2b
High intensities in service innovation and organisational innovation and low intensity in vision innovation enable product-centric SMEs to begin a customer-led path to servitization.

Sequencing dynamic capabilities
SMEs have limited resources and cannot simultaneously develop all the dynamic capabilities required for servitization, … *however, the literature does not explain how the development and application of dynamic capabilities should be sequenced to allow prioritisation.*

Research question 3
How should product-centric SMEs sequence their development and application of the four strategic dynamic capabilities during early stage servitization?

Research proposition 3
Product-centric SMEs should develop and apply the four strategic dynamic capabilities in the following sequence: Vision innovation and service innovation should be overlapped, followed by product innovation, and finally organisational innovation.

Figure 10.2 - Summary of theoretical framing, research questions and answers taken forward to research propositions

10.4 Evaluation of Research Propositions

The foundational premise of this research identifies and defines the concepts of vision innovation, service innovation, product innovation and organisational innovation, as core elements of a theoretical perspective. It is based on the notion that servitization is facilitated by their intensity, combination and sequence (section 3.2). These four core elements are categorised as strategic dynamic capabilities (section 3.3), arguing that to transform, a servitizing company should sense opportunities for advanced services (vision innovation), then seize them (service innovation and product innovation) and reconfigure their capabilities as required (organisational innovation). Three research propositions (10.1 to 10.3) are developed following a four-step process advocated by Ulaga et al (2021), comprising of grounding, crafting, relating and simplifying. These research propositions, comprising of novel statements specifying relationships between the core elements and causal mechanisms during servitization can be transformed into constructs and hypotheses for testing by future empirical studies.

Ulaga et al. (2021) propose four criteria for evaluating the rigour and relevance of a set of research propositions, these are: clarity, consistency, conciseness and contribution. Firstly, clarity refers to the extent to which the propositions identify relationships between the four concepts of vision innovation, service innovation, product innovation and organisational innovation. A clear chain of evidence from empirical data to findings enhance construct validity to define relationships and causal mechanism during servitization. The propositions were sequentially developed, by the second closely following the first and the third closely following the second. This demonstrates clarity through directionality, with no room for misinterpretation.

Secondly, consistency is demonstrated through the coherent research design, which enabled identification of relationships between the four innovation concepts through the theoretical framework. Careful selection of cases within the domain of investigation, combined with qualitative comparative analysis revealed causal mechanisms allowing modest generalisation. Reliability was enhanced by careful documentation and validated intercoder reliability.

Thirdly, conciseness is illustrated by the plain sentence form of the propositions, using clear and consistent terminology and presented using visual aids (figure 10.2). The use of qualitative comparative analysis ensured a parsimonious set of propositions, whilst the focus group series added rich understanding.

Finally, the propositions make an important contribution to theory, which can subsequently be applied in practice to help accelerate the adoption of advanced services. Immediate impact was seen by UV Light Technology Limited. Dissemination to a wider audience of SMEs and policy

makers will lead to greater economic, environmental, and societal benefits. The contributions are covered in more detail by sections 11.1 and 11.2.

10.5 Development of Practical Application Frameworks

To enable the research propositions (sections 10.1 to 10.3) and other insights to be applied in practice, the theoretical framework used throughout the research programme is translated into two practical application frameworks for use by practitioners (figures 10.4 and 10.5). This will help to accelerate the adoption of advanced services within SMEs in line with the aim of the research (section 4.1).

The theoretical framework evolved during the research programme to; (i) form a data analysis instrument for measurement of operational capabilities to assess high or low intensities of the four strategic dynamic capabilities possessed by SMEs (phase 1); and (ii) form a data collection and coding instrument for within case and cross case analysis (phase 2). This evolution process is shown in figure 10.3 for vision innovation only, in the interest of space and ease of understanding. The other three strategic dynamic capability sections within the framework evolved in the same way, and the evolution of the complete theoretical framework can be seen by combining table 3.3, table 6.2, figure 8.5 and table 9.2. Evolution followed a systematic process, whereby existing theory was elaborated and located within the theoretical framework by alternating between empirical data and theory, which was subsequently tested through additional data collection. This is supported by Dubois and Gadde (2002), who argue that taking an abductive approach is particularly beneficial for development of theory.   The sections shown in red highlight the four strategic dynamic capabilities and the operational capabilities for their development and application.   These are the core elements identified from literature, representing the foundational premise of the research, and therefore remained constant throughout.

The completeness of the framework was validated by its use with two different data sets, which did not highlight any omissions. The usefulness of the data analysis instrument developed and applied during stage 1 (figure 10.3 - evolution 1), along with the level of engagement by the six SMEs with the data collection instrument (figure 10.3 - evolution 2), indicate that both are high in future value. The data analysis instrument was therefore translated into a framework for SMEs to assess their readiness to begin servitization, which is shown in figure 10.4. The data collection and coding instrument was translated into a framework for planning the alignment of activities and resources during servitization, along with deployment sequence. This is shown in figure 10.5.

The framework for assessing SME readiness to begin servitization (figure 10.4) can be used as a self-assessment tool, however, results will depend on the honesty and accuracy of the user.

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The involvement of an external perspective, such as a consultant or advisor may be beneficial to enhance objectivity.   It can be used by directors and senior managers at strategic level only, or include operational level perspectives across functions to obtain a more holistic view. In the latter case, comparison of results will be useful to help develop an inclusive company vision for services, whilst also revealing possible internal resistance, such as communication or cultural issues. The results will allow a strategic focus for comparison of existing capabilities with those required for servitization to determine readiness to begin, or identify which resources and activities should be developed first. Emphasis can then be placed on trade-offs and prioritisation for development and application of capabilities, depending on contextual circumstances.

This study shows that transitioning towards a services-led competitive strategy is not appropriate for all companies and those with low intensities of the four strategic dynamic capabilities will be at greater risk of failure. It is therefore essential that potential benefits and opportunities are weighed up against the risks of failure, because financial losses and opportunity costs can lead to severe consequences for small businesses.

Managers who decide that servitization is right for their business and choose to proceed can then use the planning framework (figure 10.5). This will enable a plan to be developed which aligns activities and resources required for servitization, along with a deployment sequence. This is shown in figure 10.5. The findings show the importance of sequencing the development and application of capabilities during servitization, which will allow prioritisation of SMEs precious resources.

Formation of the theoretical framework - four strategic dynamic capabilities, along with operational dynamic capabilities for their development and application were identified from literature

Strategic dynamic capability	Operational dynamic capability (activity or resource)	Supporting references
Vision Innovation	**Sense** opportunities for advanced service	Kindström, Kowalkowski and Sandberg, 2013: Kindström and Kowalkowski, 2009 Edvardsson et al., 2006; Vargo and Lusch, 2008; Ulaga and Reinartz, 2011
	Customer, market and competitor data	Kindström, Kowalkowski and Sandberg, 2013; Parida et al., 2014; Story et al., 2017
	Seize by evaluating opportunities and developing a new vision	Reichard, 2016Treacy and Wiersema, 1997
	Influential champion to gain stakeholder support	Kotter, 1995
	Reconfigure existing vision and create a roadmap for implementation	Bartkus, Glassman and McAfee, 2000; Cohen and Levinthall, 1990

Evolution 1 - Developed indicators of operational capabilities and a scoring criterion to measure the intensities possessed by an SME during phase 1

Strategic dynamic capability	Operational dynamic capability (activity or resource)	Indicator of operational dynamic capability	Scoring criteria for assessing the intensity of indicator
Vision Innovation	**Sense** opportunities for advanced service	Gather customer, market and competitor intelligence	0 - No :1 - Partially: 2 - Yes
	Customer, market, and competitor data	Undertake data analysis and interpretation	0 - No: 1- Limited : 2 - Extensive
	Seize by evaluating opportunities and developing a new vision	Describe an image of a future business model to compete through advanced services	0 - No: 1 - Underdeveloped : 2 - Clear and compelling
	Influential champion to gain stakeholder support	Vision co-produced with the team	0 - No support: 1 - Partial support : 2 - Full support
	Reconfigure existing vision and create a roadmap for implementation	Describe a clear plan to implement servitization	0 - No plan: 1 - Plan without targets : 2 - Plan with targets

Evolution 2 - by transposing columns 1 and 2, into a circular data collection instrument for use during phase 2

Strategic dynamic capability	Operational dynamic capability (activity or resource)
Vision Innovation	Sense opportunities for advanced service
	Customer, market, and competitor data
	Seize by evaluating opportunities and developing a new vision
	Influential champion to gain stakeholder support
	Reconfigure existing vision and create a roadmap for implementation

Evolution 3 - by returning to evolution 1 to change the heading of columns 3 and 4, plus add column 5 for creation of a code book and scoring template. This was used for within case analysis of multiple case studies during phase 2

Strategic dynamic capability	Operational capability (activity or resource)	Evidence of operational capability	Intensity	Scoring criteria for assessing the intensity of operational capability
Vision Innovation	Sense opportunities for advanced service			0 - No 1 - Partially 2 - Yes
	Customer, market, and competitor data			0 - No 1 - Limited 2 - Extensive
	Seize by evaluating opportunities and developing a new vision			0 - No 1 - Underdeveloped 2 - Clear and compelling
	Influential champion to gain stakeholder support			0 - No support 1 - Partial support 2 - Full support
	Reconfigure existing vision and create a roadmap for implementation			0 - No plan 1 - Plan without targets/milestones 2 - Plan with targets/milestones

Figure 10.3 - Evolutionary steps of the theoretical framework during the research programme

Scoring Criteria

0 -Chaotic, 1 - Reactive to priorities
2 - Pro-active

0 - Finance not explored, 1 - Finance pending
2 - Finance available

0 - No, 1 - Partially, 2 - Yes

0 - No processes, 1 - Adhoc processes
2 - Formalised processes

0 - No, 1 - Partially, 2 - Yes

0 - No processes
1 - Adhoc Processes
2 - Formalised routines

0 - No, 1 - Developing, 2 - Yes

0 - No design influence, 1 - Some
   design influence, 2 - Design authority

0 - No, 1 - Developing, 2 - Yes

0 - No, 1 - Partially, 2 - Yes
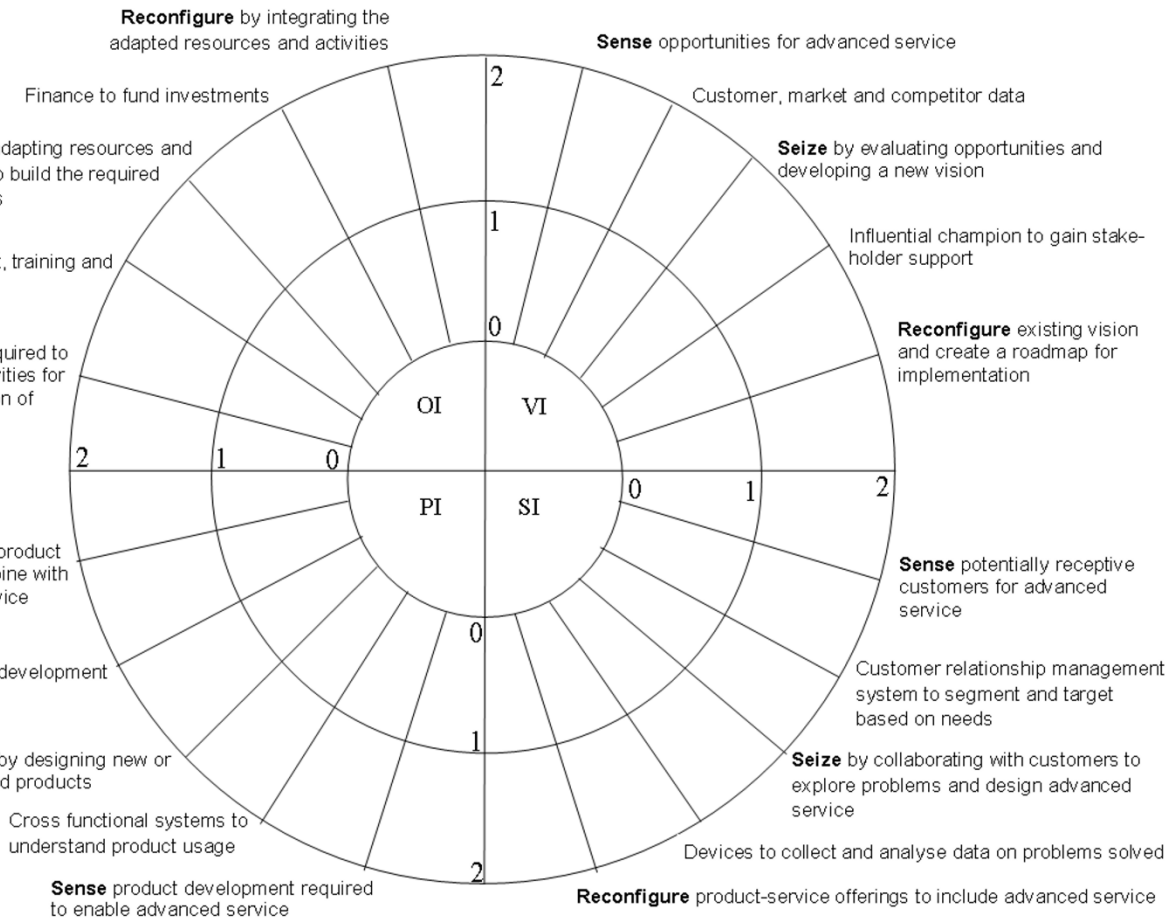
Scoring Criteria

0 - No, 1 - Partially, 2 - Yes

0 - No, 1 - Limited, 2 - Extensive

0 - No, 1 - Underdeveloped
2 - Clear and compelling

0 - No support
1 - Partial support
2 - Full support

0 - No plan
1 - Plan without targets/milestones
2 - Plan with targets/milestones

0 - No
1 - Partially
2 - Yes

0 - No
1 - Broad overview of application
2 - Understand customer pains

0 - Very little collaboration
1 - Consider customer feedback
2 - Co-create solutions with customers

0 - No, 1 - Developing
2 - Remote condition monitoring

0 - No processes, 1 - Adhoc processes
2 - Formalised processes

Reconfigure by integrating the adapted resources and activities

Finance to fund investments

Seize by adapting resources and activities to build the required capabilities

Recruitment, training and incentives

Sense changes required to resources and activities for design and provision of advanced service

Reconfigure product range to combine with advanced service

Research and development facilities

Seize by designing new or adapted products

Cross functional systems to understand product usage

Sense product development required to enable advanced service

Sense opportunities for advanced service

Customer, market and competitor data

Seize by evaluating opportunities and developing a new vision

Influential champion to gain stake-holder support

Reconfigure existing vision and create a roadmap for implementation

Sense potentially receptive customers for advanced service

Customer relationship management system to segment and target based on needs

Seize by collaborating with customers to explore problems and design advanced service

Devices to collect and analyse data on problems solved

Reconfigure product-service offerings to include advanced service

Figure 10.4 - Servitization Readiness Checker: a framework to assess an SMEs suitability for a services-led strategy

P.T. Jackson, DBA Thesis, Aston University 2021
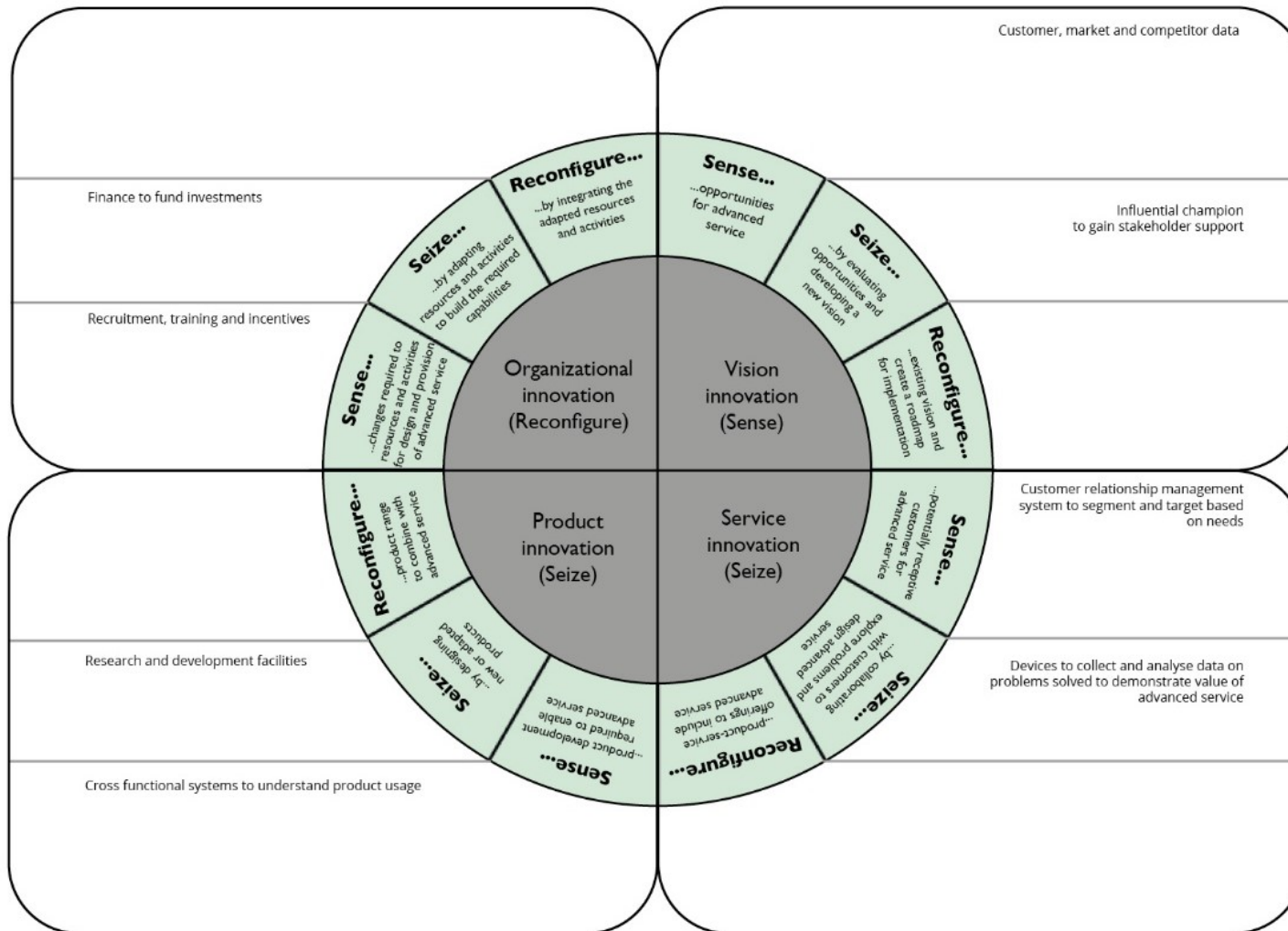
Figure 10.5 - Serivitzation Planner: a framework to help SMEs combine activities and resources in an appropriate sequence

10.6 Summary

This chapter first summarises the answers to the research questions, then follows a process for developing and shaping research propositions, adapted from a section of Eisenhardt's (1989) protocol for case study research. It includes reflection on the validity of findings and connection with relevant literature to support the development of three research propositions, one for each research question (sections 10.1 to 10.3). The research propositions are evaluated as a set (section 10.4) and finally, practical application frameworks are developed for use by practitioners in SMEs (section 10.5). The next and final chapter draws the conclusions, which include contributions to theory, contributions to practice, limitations, and future work.

Chapter 11

Conclusions

This research set out to contribute to knowledge, which can then be applied in practice to accelerate the adoption of advanced services by UV Light Technology Limited, and within SMEs in general (section 4.1). To reduce the risks of failure product-centric SMEs require dynamic capabilities to adapt their resources and activities for the design and provision of services. Four key strategic dynamic capabilities (section 3.2) are identified from literature, along with operational dynamic capabilities for their development and application (section 3.3.3). However, literature is unclear on the intensity required or how they should be measured (section 3.4.1), plus how they should be combined (section 3.4.2) and sequenced (section 3.4.3). To address these important questions the research design establishes a set of principles (section 4.2) leading to the development of a coherent research programme (section 4.3), comprising of two separate but related multiple case studies. This generates data with both breadth and depth within an evolving theoretical framework based on dynamic capability theory (chapters 5 and 8). Analysis provides insights to answer the research questions (chapters 6,7 and 9), leading to three research propositions (10.1 to 10.3), which can be applied in practice using practical application frameworks (figures 10.4 and 10.5). Therefore, the principal contribution of this study is a set of research propositions which advance theory and can be applied by practitioners to accelerate the adoption of advanced services within SMEs.

11.1 Contributions to Theory

The principal contribution to theory is a set of research propositions which reveal intensities, combinations, and sequence of four key strategic dynamic capabilities required by SMEs for servitization. These show that to begin servitization product-centric SMEs do not require high intensities in all four and can take one of two pathways, requiring different combinations of high and low intensities, depending on context. However, as servitization progresses all four strategic dynamic capabilities will be required and should be developed and applied in a particular sequence. In addition, this research makes several other contributions to theory.

Firstly, this research identifies five operational capabilities (micro-foundations) for development and application of each of the four strategic dynamic capabilities. These build on the micro-foundations proposed by Kindström, Kowalkowski and Sandberg (2013) and expand the range of examples provided by Eisenhardt and Martin (2000). They also close the gap concerning capabilities required for progress through and between the transformation stages associated with servitization (Baines et at., 2017; Baines et al., 2020; Brax and Visintin, 2017; Kowalkowski et al., 2017) and their interplay with contextual factors (Baines et al., 2017; Dmitrijeva et al., 2018; Finne, Brax and Holmström, 2013).

Secondly, this research develops a data analysis instrument to determine the intensity of the four strategic dynamic capabilities possessed by SMEs, based on indicator scores for their operational dynamic capabilities. This novel approach of scoring micro-foundational operational capabilities to determine the intensity of a corresponding strategic dynamic capability represents a methodological contribution in the field. It forms the basis of a methodology which can be used in combination with the practical application framework for assessing SME readiness to begin servitization (figure 10.4).

Thirdly, this research emphasises the configurational nature of servitization and addresses the call by Forkmann et al. (2017) for more Qualitative Comparative Analysis in this area. It increases the understanding of the variety and sequencing of the organisational change process during servitization, with links to context as called for by Baines et al. (2020). This represents the start of developing a prescriptive transformation roadmap, again as called for by Baines et al. (2020).

Finally, it adds to knowledge specifically within the context of SMEs navigating the exploration and engagement stages of the servitization process (Baines et al., 2020). To enable these contributions to theory to be applied in practice, the theoretical frameworks used throughout the research programme are translated into two practical application frameworks for use by SME practitioners.

11.2 Contributions to Practice

The primary contribution of this research to practice is the formation of two practical application frameworks for use by SMEs. Firstly, a framework for practitioners to assess their organisational readiness to begin servitization (Servitization Readiness Checker, figure 10.4) and secondly, a framework for planning the combination of activities and resources during servitization (Servitization Planner, figure 10.5). The Servitization Readiness Checker provides a way for managers to benchmark their existing capabilities against those required, to help determine if they are ready to begin servitization, or understand which resources and activities should be developed first. Emphasis is placed on trade-offs and prioritisation. It provides a strategic focus on configurational capability fit, with important insights for the development and application of capabilities, depending on contextual circumstances. Managers who decide their capabilities represent a good fit with those required and choose to proceed, can then use the Servitization Planner to combine their activities and resources in an appropriate sequence (figure 10.5). This is particularly important for SMEs looking to gain benefits from offering advanced services which are high in future value (chapter 2), whilst making the most effective use of their limited resources to mitigate risks of failure.

A good example where the practical application frameworks would have proved invaluable is provided by company A. During focus group 5 company A acknowledged their servitization journey was over and a visibly tearful senior manager said … "There really should be a way of checking if you're ready for servitization before starting." The following is an extract from a 'Harvard style' teaching case study, which was developed from the populated code book for company A (table 9.2).

It was a wet and windy day in December 2019. Victoria, head of marketing and operations, had just come out of a tense meeting with the company directors. She stared across the grey skyline of Birmingham and perhaps wasn't really surprised the directors had lost confidence in the new services-led strategy. After all, twelve months after launching their advanced service, not a single contract had been won. As the rain battered the windows of her eleventh floor office, she recalled the wrong pathway taken on their servitization journey.

Twelve months ago it had all started so well. The company was growing rapidly through acquisition and integrating a new service business. The plan was to adopt their multi-year service agreement model to replace existing annual maintenance contracts. At the time she was participating in a local business school programme aimed at accelerating the adoption of services-led strategies amongst SMEs in the region. Inspired by the potential opportunities and benefits, the directors had eagerly bought into her suggestions on design and provision of advanced services.

Trying to pick out landmarks in the worsening visibility across the city, she reflected on what had gone wrong. The service vision had been based on their perception of what customers would value, without enough market and competitor research and which had turned out to be wrong. It had been all about locking in customers for longer, which lead them to target public sector healthcare customers under threat from low cost new market entrants. Victoria's mind flashed back to a pivotal moment right at the beginning, "If only I knew then, what I know now about customer segmentation based on needs and collaboration to co-produce service offerings, the outcome could have been so different." She wished they had taken a step back after some early failures and tested their assumptions on private sector customers, who might have valued the opportunity to co-create and evaluate new service solutions. Perhaps this interactive process would have also engaged the sales team, whose only real interest was selling products and were reluctant to cannibalise their bolt on service contracts. It would also have been a great opportunity to address the deep rooted cultural issues across the organisation, which had resulted in poor cross functional communication and co-operation.

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Like the visibility across the city that day, Victoria realised their strategic vision had been unclear from the start and really they had made things up as they went along. She decided to call it a day and made her way to the lift. The company were consistently losing on price to low cost competitors. The owners wanted quick fixes and felt they had wasted enough time and money on producing new template contracts, marketing material, exploring finance options, plus new CRM software. The project had been abandoned and Victoria regretted their failure to pivot, which might have produced a few quick wins and made all the difference. She was still convinced that advanced services were essential for future competitive advantage and that the owners couldn't see the solution right in front of their eyes.

This case study highlights the chaotic nature of SMEs, which was also evident in the other five companies who participated in phase 2. All the leaders acted predominantly on intuition, with little market research or customer validation. Their scope of influence drove rapid implementation of strategy, however, two others also failed, two are ongoing and only one progressed to the expansion stage. This demonstrates that servitization is difficult for SMEs and provides evidence of the need for the practical application frameworks. These will become key tools for servitization to help guide strategic decisions of SME managers and their orchestration of scare resources. SMEs who possess the right intensity of the four strategic dynamic capabilities and combine these in an appropriate sequence depending on circumstances should reduce their risk of potential costly mistakes. This will enhance confidence and subsequently accelerate the successful adoption of advanced services within SMEs, in line with the aim of the research (section 4.1).

The practical application frameworks and the process of their development during the research had an immediate impact on the adoption of advanced services by UV Light Technology Limited. At the start of the research programme, 25% of the company's annual revenue was derived from base and intermediate services, with the rest coming from product sales. During 2020, the first advanced service was successfully piloted and is now being replicated for scale. The latest quarterly figures reveal that for the fist time in the company's 24 year history, 50% of revenue was generated from services. This has significantly increased productivity and is building resilience.

The Servitization Readiness Checker could also be used by policy makers to determine the suitability of an SME for grant funded interventions aimed at accelerating the adoption of servitization by product-centric organisations. Prediction of likely outcomes will allow a more structured and focussed approach to interventions for maximum impact.

11.3 Limitations and Future Work

This work provides three testable research propositions, which are clear, consistent, concise and make valuable contributions to theory (Ulaga et al., 2021). They can be applied in practice by using two practical application frameworks. These were developed by translating a robust theoretical framework which evolved during the research process. The novel application of an initial qualitative comparative analysis, combined with a related longitudinal study within a community of practice provided both breadth and depth. The design of the multiple case studies considered issues of validity and reliability, with extensive measures taken to ensure rigour (sections 5.4 and 8.4). The research process was therefore grounded in reality and underpinned by theory, providing a high level of confidence in the findings. However, like any other piece of research, the findings will have limitations.

11.3.1 Limitations

Some possible limitations are considered below, along with opportunities for future work (section 11.3.2).

Selection of cases

The data analysis instrument used to develop the theoretical framework is based on a relatively small sample of SMEs located within the Midlands region in the UK. It is expected that the findings will be generalisable across companies of the same type throughout the UK and overseas. However, this might not be the case and will need to be tested. Also, the criteria and scoring system may be considered complex, which could inhibit widespread use by SME managers.

Focus on capabilities

The theoretical framework and design of the multiple case studies is based on the notion that possession of high intensities for the four strategic dynamic capabilities and their appropriate orchestration is required for servitization success. The measure of servitization success or failure is clearly defined for phase 1 and 2 of the research programme. The drivers of success and causes of failure are attributed to the intensities of four strategic dynamic capabilities possessed by an SME and how these are combined and sequenced. However, empirical data (phase 2) also shows that development and application of the four strategic dynamic capabilities is enabled or impeded by factors such as cultural mindset, cross functional collaboration and communication. Therefore, it is recognised that organisational readiness for servitization will depend not only on the possession of high intensity capabilities, both dynamic and ordinary, but also willingness and capacity to proceed.

Researcher error and bias

Researcher error and bias can be a cause for concern, perhaps in this case because of the researcher's interest in the topic. However, the researcher understood the importance of consciously striving to remain objective. He recognised the need to utilize high levels of pre-understanding, whilst allowing the mind to expand freely in any direction, without prejudice (Gummesson, 2000). The data was collected and analysed accurately and transparently, with honest reporting. To minimise further any scope for bias during research stage 2, the data collection was a collaborative process. Analysis of all findings was validated with participants to avoid misinterpretation or misunderstanding to substantiate conclusions. The robustness of the findings was particularly evident during focus group 5. During the validation process some of the SMEs revealed their failures, with some looking visibly upset and one experiencing a eureka moment. These honest insights were only possible because of the trust and friendships built up within the community of practice over the twelve month research period.

Reliability

Reliability is another common cause for concern. This refers to the absence of random error, enabling other researchers to arrive at the same insights by reproducing the study (Denzin and Lincoln, 1994). The key is transparency to enable replication. The formalised and analytical approach of qualitative comparative analysis (phase 1) reduced each case to a series of variables (conditions and an outcome), which enhanced the replicability of a study (Berg-Schlosser et al., 2008). In addition, other measures taken to ensuring rigour by enhancing reliability are provided in table 5.4. The focus groups (phase 2) are not intended to be replicated, because they reflect socially constructed interpretations of the participants in a particular setting at the time. However, future work may benefit from following the research design and methods to replicate similar situations.

Qualitative Comparative Analysis (QCA)

The qualitative comparative analysis revealed two pathways to begin servitization, representing a company-led or customer-led route. The generation of logical remainders identified other possible pathways which were not observed in the data (appendices 3 and 4). However, whilst accepting that any generalisation involves going beyond observed cases, the conservative solution was adopted. It was considered the most plausible and no benefits are apparent from further simplification. This overcomes a common criticism of QCA that non-observed cases are used. Another criticism is QCA does not integrate the time dimension and therefore cannot sequence the conditions within a solution formula. However, this was addressed in phase 2 of the research programme, which provided both confirmation of the combinations and explanation of sequencing.

11.3.2 Future work

Future work should focus on testing and refining the practical application frameworks. The Servitization Readiness Checker would benefit from simplification of the scoring system (figure 10.4) to create a more user friendly benchmarking tool. This could be done by developing a series of Likert style questions for each of the twenty operational capabilities to derive the scores. It could also lead to gamification. Future work should also include the development of guidance notes for use with the Servitization Planner (figure 10.5) based on the research propositions. Also, the scope should be expanded to include the expansion and exploitation stages of servitization. This will shift the focus from targeting potential customers for co-production of new services towards their effective and efficient delivery.

Future work should capitalise on the engaged scholarship approach of co-producing knowledge through the collaboration of academics and practitioners. This will provide a good opportunity of advancing theory which can be readily applied in practice for immediate impact. This kind of research could be facilitated through the Doctor of Business Administration (DBA) programme, by encouraging broader collaboration with practitioners and recruiting a greater number of future students from SMEs. This might require innovation of the programme to provide greater support and guidance during the literature review and research design. This will enable students to focus on data collection and analysis of findings to accelerate the generation of mutually beneficial knowledge, with greater potential for impact. Embracing engaged scholarship, along with some innovations to the DBA programme will provide a great opportunity to close the academic-practitioner gap. In addition, emphasis should be placed on developing more cross disciplinary collaboration within academia and cross functional research in practice. This should focus on configurational research, in particular QCA, leading to more explanatory findings with greater potential for prediction of business model innovation outcomes.

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Consent Form

Research Study: Resource Orchestration to Engage Stakeholders in Advanced Services: An SME Readiness Perspective Based on Dynamic Capabilities

Researcher Details: Paul Jackson, Doctoral Researcher, Aston Business School, Aston Triangle, Birmingham, B4 7ET, Email: jacksop3@aston.ac.uk

This research will be conducted strictly in accordance with Aston Business School Research Ethical Guidelines. It has been approved by Aston University's Ethics Committee.

The researcher assures that all information will be kept strictly confidential and participants will be granted full anonymity. Any information which could reveal the identity of a person or company will be removed in any form of reporting of the research results.

Should you wish to discuss any potential concerns, or seek clarification regarding any issues, please contact the researcher.

Please initial boxes

I agree to take part in the above study. ☐

I confirm that I have read and understand the briefing document for the above study and have had the opportunity to ask questions. ☐

I understand that my participation is entirely voluntary and that I am free to withdraw at any time without giving reason and can request deletion, or a summary of any information already provided. ☐

I understand that I can choose to answer only the questions that I wish to answer. ☐

Please tick appropriate boxes

	Yes	No
I agree to the focus groups and interview being audio recorded for subsequent transcription and/or analysis.	☐	☐
I agree to the focus groups and interview being video recorded for subsequent transcription and/or analysis.	☐	☐
I agree to the use of anonymised extracts and quotes in publications for illustrative purposes related to this study.	☐	☐
I agree that my data gathered during this study may be securely stored and used for future research, analysis, teaching and publication.	☐	☐

_____   _____   _____
Name of Participant   Date   Signature

Aston University takes its obligations under data and privacy law seriously. For further information as to how the University processes personal data, please visit www.aston.ac.uk/dataprotection.

Strategy Deployment Matrix for the Research Programme

Research questions			Strategy	Methods and techniques								
				Literature review	QCA	Focus group 1 (15/12)	Focus group 2 (14/2)	Focus group 3 (3/4)	Focus group 4 (16/7)	Focus group 5 (14/11)	Focus group 6 (21/12)	
●			Identified four strategic dynamic capabilities required for servitization and the operational dynamic capabilities for their development and application	●								
●			Develop data analysis instrument to measure operational dynamic capabilities and assess high or low intensities of the four strategic dynamic capabilities		●							
●			Determine intensities of the four strategic dynamic capabilities required to begin servitization		●							
	●		QCA to identify combinations of high or low intensities of the four strategic dynamic capabilities enabling SMEs to begin servitization		●							
		●	Capture servitization journeys			●	●					
		●	Map pathways on data collection and analysis instrument (figure 8.5)					●				
		●	Examine how the sequence of development and application of the four strategic dynamic capabilities enables or inhibits servitization						●			
		●	Validate data analysis							●		
		●	Evaluate practical application framework								●	
Research question 1	Research question 2	Research question 3	**Purpose** **To help UV Light Technology Limited and other SME practitioners to understand the capabilities required for servitization and how they should be combined and sequenced for success.**	Literature review	QCA	Focus group 1 (15/12)	Focus group 2 (14/2)	Focus group 3 (3/4)	Focus group 4 (16/7)	Focus group 5 (14/11)	Focus group 6 (21/12)	
				2018				2019				
				Time Scale								

Analysis of sufficiency - intermediate solutions

Derive a minimal formula with the aid of only those logical remainders which are consistent with the researchers theoretical and substantive knowledge (Ragin and Sonnett, 2004; Ragin, 2008). This determined the directional expectations to be used by the R software.

Intermediate solution ➔ **PROGRESS**

Directional expectations: VI, SI, PI, OI

Solution (Intermediate)	OI * SI	+ VI * SI * PI	➔ PROGRESS
Single case coverage	7,9; 16,21	1,6,19	
Multiple case coverage	3,12,13,14,22,28,30,32	3,12,13,14,22,28,30,32	
Consistency	1.0	1.0	
Raw coverage	0.8	0.73	
Unique coverage	0.27	0.2	
			Solution consistency 1.0
			Solution coverage 1.0

Sufficient conditions for progress beyond exploration of services-led strategies to begin servitization

Intermediate solution ➔ **no progress**

Directional expectations: ~vi, ~si, ~pi, ~oi

Solution (Intermediate)	vi * oi	➔ no progress
Single case coverage	2,4,8,10,11,15,17, 20,23,29,31,35,36; 18,24,25,26,27,33,34; 5	
Consistency	1.0	
Raw coverage	1.0	
Unique coverage	-	
		Solution consistency 1.0
		Solution coverage 1.0

Sufficient conditions for failure to progress beyond the initial exploration of services-led strategies

Analysis of sufficiency - parsimonious solutions

A radical strategy which allows the software to exploit all useful logical remainders to derive the most parsimonious minimal formula.

Parsimonious solution → **PROGRESS**

Solution (Parsimonious)	OI	+	VI	→	PROGRESS
Single case coverage	7,9; 16,21		1,6,19		
Multiple case coverage	3,12,13,14,22,28,30,32		3,12,13,14,22,28,30,32		
Consistency	1.0		1.0		
Raw coverage	0.8		0.73		
Unique coverage	0.27		0.2		
					Solution consistency 1.0 *Solution coverage 1.0*

Sufficient conditions for progress beyond exploration of services-led strategies to begin servitization

Parsimonious solution → **no progress**

Solution (Parsimonious)	vi * oi	→	no progress
Single case coverage	2,4,8,10,11,15,17, 20,23,29,31,35,36; 18,24,25,26,27,33,34; 5		
Consistency	1.0		
Raw coverage	1.0		
Unique coverage	-		
			Solution consistency 1.0 *Solution coverage 1.0*

Sufficient conditions for failure to progress beyond the initial exploration of services-led strategies

Strategic dynamic capability	Operational capability (activity or resource)	Evidence of operational capability	Scores	Scoring Criteria for assessing the intensity of operational capability
Vision Innovation **(Sense)** Total score 5/10	**Sense** opportunities for advanced service	"Our print business is declining, for example NHS is going paperless and we recognised the need to diversify to ensure sustainability."	1	0 - No 1 - Partially 2 - Yes
	Customer, market and competitor data	"We 'had a session with our sales team' to explore what this could look like for the business." "We want to get in at the front end."	1	0 - No 1 - Limited 2 - Extensive
	Seize by evaluating opportunities and developing a new vision	"You want print to communicate, so we want to go down the route of marketing and logistics, splitting the medium between digital and print, rather then just ink on paper."	1	0 - No 1 - Underdeveloped 2 - Clear and compelling
	Influential champion to gain stakeholder support	"Lack of buy in from the sales team who were nervous of hindering print sales and their changing roles. Business as usual gets in the way. Marketing person found it harder than expected to get customers to recognise value of a set monthly figure and left. Twelve months of investment down the drain." "Owner wants to do it, but we need to start again".	1	0 - No support 1 - Partial support 2 - Full support
	Reconfigure existing vision and create a roadmap for implementation	"We need to change our business model and we need to understand which is best model for us as a company." "We've got lots of activities going on and we sort of scattergun it."	1	0 - No plan 1 - Plan without targets/milestones 2 - Plan with targets/milestones
Service Innovation **(Seize)** Total score 6/10	**Sense** potentially receptive customers for advanced service	"We asked our salespeople to test the idea with customers. We did it intuitively."	2	0 - No 1 - Partially 2 - Yes
	Customer relationship management system to segment and target based on needs	"An NHS Trust wanted a storage, pick and ship solution we made a proposal and they accepted."	2	0 - No 1 - Broad overview of application 2 - Understand customer pains
	Seize by collaborating with customers to explore problems and design advanced service	"One customer gave us all their logistics business. We moved their warehouse into ours, which was too much."	1	0 - Very little collaboration 1 - Consider customer feedback 2 - Co-create solutions with customers
	Devices to collect and analyse data on problems solved to demonstrate the value of advanced service	"We proposed our logistics to one customer and they declined. We proposed a deal to another one, the NHS and they accepted. It was a cost plus quotation." "A stumbling block is getting customers to recognise the value of a set monthly figure to create their marketing content."	0	0 - No 1 - Developing 2 - Remote condition monitoring
	Reconfigure product-service offerings to include advanced service	"We haven't developed the customer value proposition enough. You've got to run a pilot, we didn't. We've had skills and capability issues."	1	0 - No processes 1 - Adhoc processes 2 - Formalised routines

Strategic dynamic capability	Operational capability (activity or resource)	Evidence of operational capability	Scores	Scoring Criteria for assessing the intensity of operational capability
Product Innovation **(Seize)** Total score 1/10	**Sense** product development required to enable advanced service		N/A	0 - No 1 - Partially 2 - Yes
	Cross functional systems to understand product usage, customer problems and needs		1	0 - No 1 - Developing 2 - Yes
	Seize by designing new or adapted products		N/A	0 - No design influence 1 - Some design influence 2 - Design authority
	Research and development facilities		N/A	0 - No 1 - Developing 2 - Yes
	Reconfigure product range to combine with advanced service		N/A	0 - No processes 1 - Adhoc processes 2 - Formalised routines
Organisational Innovation **(Reconfigure)** Total score 6/10	**Sense** changes required to resources and activities for design and provision of advanced service	"We had to print patient information leaflets overnight and ship the next day." "We re-designed our website, marketing collateral and purchased databases." "We need to replace the marketing person who left."	2	0 - No 1 - Partially 2 - Yes
	Recruitment, training and incentives	Team meeting to cascade the idea to customer facing personnel.	1	0 - No processes 1 - Adhoc processes 2 - Formalised processes
	Seize by adapting resources and activities to build the required capabilities	"We refurbished our warehouse and installed new racking. We recruited a new warehouse operative and a marketing person." "Over 200 stored pallets with picking and shipping daily - cannot expand - haven't got room and therefore we cannot replicate."	1	0 - No 1 - Partially 2 - Yes
	Finance to fund investments	"We invested a lot of money in facilities and people and still need a new loading bay to accommodate container deliveries from Europe."	1	0 - Finance not explored 1 - Finance pending 2 - Finance available
	Reconfigure by integrating the adapted resources and activities		1	0 - Chaotic 1 - Reactive to priorities 2 - Pro-active

Populated code book for Company B and scores attributed

P.T. Jackson, DBA Thesis, Aston University 2021

Strategic dynamic capability	Operational capability (activity or resource)	Evidence of possession operational capability	Scores	Scoring Criteria for assessing the intensity of operational capability
Vision Innovation **(Sense)** Total score 7/10	**Sense** opportunities for advanced service	"Anyone can buy machines, we wanted to do something different which would be difficult for others to challenge. The penny dropped when we realised the real benefits and opportunities of machining by the hour (selling the mirror on the wall) not individual machined components but extension of customers factory."	2	0 - No 1 - Partially 2 - Yes
	Customer, market and competitor data	"Our service vision was not there, it came during storytelling in focus group 4." "We started to look outwards rather than inwards. There is nobody else doing this in our industry. We will conduct a customer questionnaire to understand the opportunities ."	1	0 - No 1 - Limited 2 - Extensive
	Seize by evaluating opportunities and developing a new vision	"Machining by the hour offers cost and capacity certainty. Customers pay whether they take them or not. Customers will be able to log in, book and prioritise their work and see where it is, what's happened, when they can have it. Real profit comes from selling underused hours at a premium."	2	0 - No 1 - Underdeveloped 2 - Clear and compelling
	Influential champion to gain stakeholder support	"One or two people in the factory believe we have a plan and know what we are doing."	1	0 - No support 1 - Partial support 2 - Full support
	Reconfigure existing vision and create a roadmap for implementation	"We started in four different places because each step takes a long time. Aiming to set up 3 cells and win our first contract within 12 months. We're figuring it out as we go along."	1	0 - No plan 1 - Plan without targets/milestones 2 - Plan with targets/milestones
Service Innovation **(Seize)** Total score 5/10	**Sense** potentially receptive customers for advanced service	"We are now starting to communicate the new concept to customers."	1	0 - No 1 - Partially 2 - Yes
	Customer relationship management system to segment and target based on needs	"Focus on customers where we have in-depth knowledge. We have developed KPIs for individual customers. All our people are closer to the customer."	1	0 - No 1 - Broad overview of application 2 - Understand customer pains
	Seize by collaborating with customers to explore problems and design advanced service	"We're focussing on groups of customers, where we can grow business and want more support going forward."	0	0 - Very little collaboration 1 - Consider customer feedback 2 - Co-create solutions with customers
	Devices to collect and analyse data on problems solved to demonstrate the value of advanced service	"Monthly fee covers our fixed costs, variable cost will depend on hours used providing 5% profit margin and re-selling surplus hours will give us 20% profit margin."	2	0 - No 1 - Developing 2 - Remote condition monitoring
	Reconfigure product-service offerings to include advanced service	"We have been shouting about our advanced service in our PR for about a year, just generally out in the marketplace to build our brand. Started talking with customers to get the concept over to them which has not been easy trying to change the game, We have had some positive reactions from customers, but others looked at us as if we were crazy."	1	0 - No processes 1 - Adhoc processes 2 - Formalised routines

Strategic dynamic capability	Operational capability (activity or resource)	Evidence of possession operational capability	Scores	Scoring Criteria for assessing the intensity of operational capability
Product Innovation (Seize) Total score 8 /10	**Sense** product development required to enable advanced service	"Customer cell configurations enable us to do things quicker, which gives us more capacity, which then means we can sell that additional capacity somewhere else."	2	0 - No 1 - Partially 2 - Yes
	Cross functional systems to understand product usage, customer problems and needs	"What we've got to do is get very good at what we do. We're better than most in our industry, but not good enough to put the advanced service into place. We need almost seamless flow of products and information through the factory, without problems and without issues."	1	0 - No 1 - Developing 2 - Yes
	Seize by designing new or adapted products	"We then went further by designing our advanced service concept."	2	0 - No design influence 1 - Some design influence 2 - Design authority
	Research and development facilities	"Next step is for customers to see into our ERP system, to see where their product is and final steps will be to influence where their parts are and control cells themselves."	1	0 - No 1 - Developing 2 - Yes
	Reconfigure product range to combine with advanced service	"To create these customer focussed cells has taken 3 years and 2 site moves. Not individual customers but small groups of customers."	2	0 - No processes 1 - Adhoc processes 2 - Formalised routines
Organisational Innovation (Reconfigure) Total score 7/10	**Sense** changes required to resources and activities for design and provision of advanced service	"We have designed our on-line portal for customer access. Re-organised shop floor into customer cells to reduce machining time, costs and lead times. We need seamless flow through the factory."	2	0 - No 1 - Partially 2 - Yes
	Recruitment, training and incentives	"We have transformed attitudes internally and most people now believe that the company can be much more than just a machine to print business."	1	0 - No processes 1 - Adhoc processes 2 - Formalised processes
	Seize by adapting resources and activities to build the required capabilities	"We have installed a new ERP system for in-house planning to support customer focussed approach. Not enough of the right people, necessary skills and experience in correct roles. We've got a company director running a cell at the moment, which is not good. Developing younger, junior people to take over these roles."	1	0 - No 1 - Partially 2 - Yes
	Finance to fund investments	"Think nothing of 3 year lease/purchase a new 400K machine. Received European grant funding to help with move to new factory."	2	0 - Finance not explored 1 - Finance pending 2 - Finance available
	Reconfigure by integrating the adapted resources and activities	"We're putting in new digital management, but since we moved there seems to have been a collective brain fade of what they are supposed to be doing, which is very frustrating."	1	0 - Chaotic 1 - Reactive to priorities 2 - Pro-active

Populated code book for Company C and scores attributed

Strategic dynamic capability	Operational capability (activity or resource)	Evidence of operational capability	Scores	Scoring Criteria for assessing the intensity of operational capability
Vision Innovation **(Sense)** Total score 10/10	**Sense** opportunities for advanced service	"After 16 years in the business we had a eureka moment and recognised an opportunity to grow the business through regular payments from service contracts, rather than time and materials for a break fix service on a one off basis."	2	0 - No 1 - Partially 2 - Yes
	Customer, market and competitor data	"The problem with the manufacturers is that you don't get personalised service when you ring, you're speaking to someone who is somewhere else in the world."	2	0 - No 1 - Limited 2 - Extensive
	Seize by evaluating opportunities and developing a new vision	"We have 1000 customers and aim to have 30-50% on service contracts within 3 years. 50% will give us up to 1.4m per year."	2	0 - No 1 - Underdeveloped 2 - Clear and compelling
	Influential champion to gain stakeholder support	"We unanimously decided that we wanted to grow the business and give this a go." "We developed our service offering with friendly customers."	2	0 - No support 1 - Partial support 2 - Full support
	Reconfigure existing vision and create a roadmap for implementation	"We have created a 3-5 year plan with sales forecasts."	2	0 - No plan 1 - Plan without targets/milestones 2 - Plan with targets/milestones
Service Innovation **(Seize)** Total score 9/10	**Sense** potentially receptive customers for advanced service	"We offer personalised service, where our customers can ring someone they know and not a person in another country going through a trouble shooting list. We proposed - you invest in us and you're investing in a better future"	2	0 - No 1 - Partially 2 - Yes
	Customer relationship management system to segment and target based on needs	"Customers segmented based on users of large format printers."	2	0 - No 1 - Broad overview of application 2 - Understand customer pains
	Seize by collaborating with customers to explore problems and design advanced service	"We discussed and developed ideas with friendly customers." "We understand that when a printer breaks down there's a lot of pains, a lot of unexpected cost maybe and downtime is the biggest pain."	2	0 - Very little collaboration 1 - Consider customer feedback 2 - Co-create solutions with customers
	Devices to collect and analyse data on problems solved to demonstrate the value of advanced service	"Average price £60/month. Perhaps we could have gone slightly higher on our prices, we don't have 2-3 years contracts, just keep it open, rolling payments which rolls over to new equipment."	2	0 - No 1 - Developing 2 - Remote condition monitoring
	Reconfigure product-service offerings to include advanced service	"We have registered with a company called GoCardless, which has made it easier to set up direct debits and sign up customers, we signed up 15 printers in the first month."	1	0 - No processes 1 - Adhoc processes 2 - Formalised routines

Strategic dynamic capability	Operational capability (activity or resource)	Evidence of operational capability	Scores	Scoring Criteria for assessing the intensity of operational capability
Product Innovation **(Seize)** Total score 7/10	**Sense** product development required to enable advanced service	"Product innovation is done by our suppliers."	2	0 - No 1 - Partially 2 - Yes
	Cross functional systems to understand product usage, customer problems and needs	"We use third party software for remote access to printer information, which costs us £3 per month for each printer and is added on to the customers contract."	2	0 - No 1 - Developing 2 - Yes
	Seize by designing new or adapted products	"We feedback our experiences of working on the printers and maybe have some minor influence on product development."	1	0 - No design influence 1 - Some design influence 2 - Design authority
	Research and development facilities		0	0 - No 1 - Developing 2 - Yes
	Reconfigure product range to combine with advanced service		2	0 - No processes 1 - Adhoc processes 2 - Formalised routines
Organisational Innovation **(Reconfigure)** Total score 9/10	**Sense** changes required to resources and activities for design and provision of advanced service	"We're not wating for business to come in, we are mailing customers about our new service."	2	0 - No 1 - Partially 2 - Yes
	Recruitment, training and incentives	"Our processes work well for now, but will have to grow with the company."	2	0 - No processes 1 - Adhoc processes 2 - Formalised processes
	Seize by adapting resources and activities to build the required capabilities	"Additional maintenance engineers will be required as service contracts increase, in the meantime I'm juggling a lot of stuff around trying to grow the business and run the business. Developed sales script based on mutual benefits."	1	0 - No 1 - Partially 2 - Yes
	Finance to fund investments	"I'm getting the money up front, I'm getting a pool of money where I can invest in other staff, which makes me more responsive and allows me to stock more parts, so I can fix the machine first time and the customer has got less downtime."	2	0 - Finance not explored 1 - Finance pending 2 - Finance available
	Reconfigure by integrating the adapted resources and activities	"I have a small team, but all buy-in to our vision."	2	0 - Chaotic 1 - Reactive to priorities 2 - Pro-active

Populated code book for Company D and scores attributed

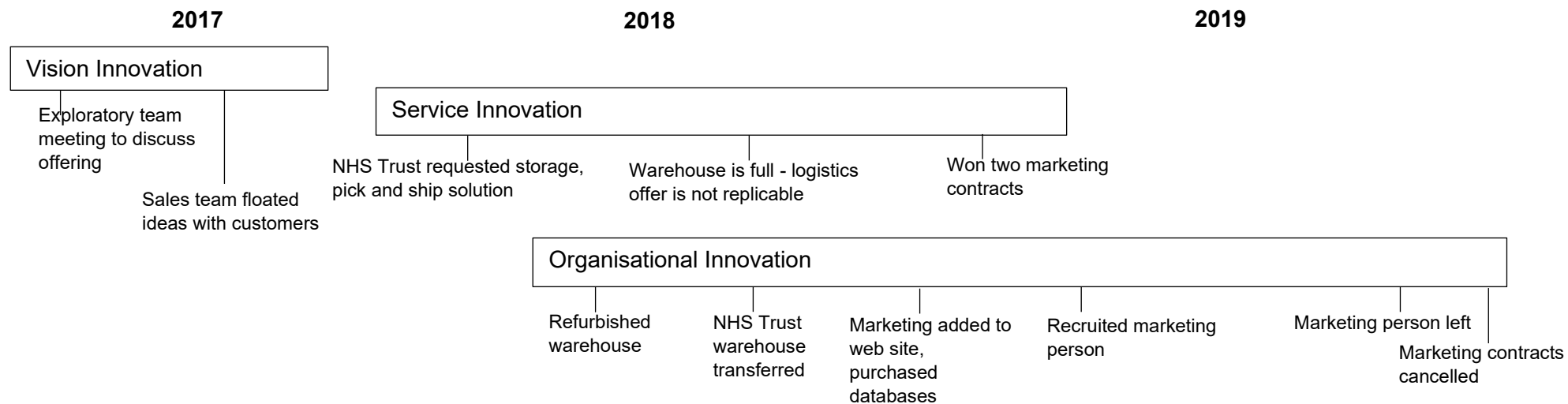| Strategic dynamic capability	Operational capability (activity or resource)	Evidence of operational capability	Scores	Scoring Criteria for assessing the intensity of operational capability
Vision Innovation **(Sense)** Total score 9/10	**Sense** opportunities for advanced service	"We recognised an opportunity for getting paid for services we have always supplied free of charge."	2	0 - No 1 - Partially 2 - Yes
	Customer, market and competitor data	"We think we can disrupt the market by offering new technology with lower life-cycle costs and business improvement opportunities."	2	0 - No 1 - Limited 2 - Extensive
	Seize by evaluating opportunities and developing a new vision	"Food processing by the hour will bring our customers from the stone age to the digital age and change the way we feed the world.	1	0 - No 1 - Underdeveloped 2 - Clear and compelling
	Influential champion to gain stakeholder support	"We have full internal support and a passionate champion. We expect to receive further European Grant funding.	2	0 - No support 1 - Partial support 2 - Full support
	Reconfigure existing vision and create a roadmap for implementation	"We have only validated part of the process and now need to validate a whole facility, with say, 10 machines."	2	0 - No plan 1 - Plan without targets/milestones 2 - Plan with targets/milestones
Service Innovation **(Seize)** Total score 6/10	**Sense** potentially receptive customers for advanced service	"Because of the nature of the business, you have to be in the factory to do the development, so you are working very closely with the customer."	1	0 - No 1 - Partially 2 - Yes
	Customer relationship management system to segment and target based on needs	"We are targeting lower volume facilities which represent lower risks and are less demanding." "Customers can buy cost certainty."	2	0 - No 1 - Broad overview of application 2 - Understand customer pains
	Seize by collaborating with customers to explore problems and design advanced service	"Pilot studies ongoing in India, China and Greece to demonstrate functionality through data and establish shared value." "Potential customers are fixated on capacity, not quality and waste. There is a perceived higher cost and technology risk."	1	0 - Very little collaboration 1 - Consider customer feedback 2 - Co-create solutions with customers
	Devices to collect and analyse data on problems solved to demonstrate the value of advanced service	"Part of the pilot is to establish the value proposition and how is the value appropriately distributed between customers and us. Pricing is such a fundamental part of it - you're not buying the machine, you're buying certainty of cost for ten years."	1	0 - No 1 - Developing 2 - Remote condition monitoring
	Reconfigure product-service offerings to include advanced service	"No problem in the customers eyes to solve and we are struggling to convince customers that we can change their business by reducing their running costs and improving quality."	1	0 - No processes 1 - Adhoc processes 2 - Formalised routines

Strategic dynamic capability	Operational capability (activity or resource)	Evidence of operational capability	Scores	Scoring Criteria for assessing the intensity of operational capability
Product Innovation **(Seize)** Total score 9/10	**Sense** product development required to enable advanced service	"We've had great results with our new machine. We've expanded the range from 2 chambers to 12 chambers."	1	0 - No 1 - Partially 2 - Yes
	Cross functional systems to understand product usage, customer problems and needs	Paradox – "If it's too good to be true, then it probably is".	2	0 - No 1 - Developing 2 - Yes
	Seize by designing new or adapted products	"We are developing the ability to process different foods."	2	0 - No design influence 1 - Some design influence 2 - Design authority
	Research and development facilities	"We are gathering large amounts of data to validate our offering."	2	0 - No 1 - Developing 2 - Yes
	Reconfigure product range to combine with advanced service	"Innovate UK funding has enabled us to produce a proven machine."	2	0 - No processes 1 - Adhoc processes 2 - Formalised routines
Organisational Innovation **(Reconfigure)** Total score 7/10	**Sense** changes required to resources and activities for design and provision of advanced service	"We have to work around the seasons in India and missed our opportunity this year."	1	0 - No 1 - Partially 2 - Yes
	Recruitment, training and incentives	"We've had some issues on trust, interpretation of collaboration agreements and what they mean. It's a worry they will try to copy our technology in India. Innovate UK are keen to get something going in India and this could unlock extra funding for outreach projects, like a food processing school.	2	0 - No processes 1 - Adhoc processes 2 - Formalised processes
	Seize by adapting resources and activities to build the required capabilities	"We are developing remote monitoring and fixes to support our overseas installations in India."	2	0 - No 1 - Partially 2 - Yes
	Finance to fund investments	"We are still exploring finance options for overseas installations. We need asset finance suppliers in the local country."	0	0 - Finance not explored 1 - Finance pending 2 - Finance available
	Reconfigure by integrating the adapted resources and activities	"We have a new strategic alliance with a UK company to build our machines."	2	0 - Chaotic 1 - Reactive to priorities 2 - Pro-active

Populated code book for Company E and scores attributed

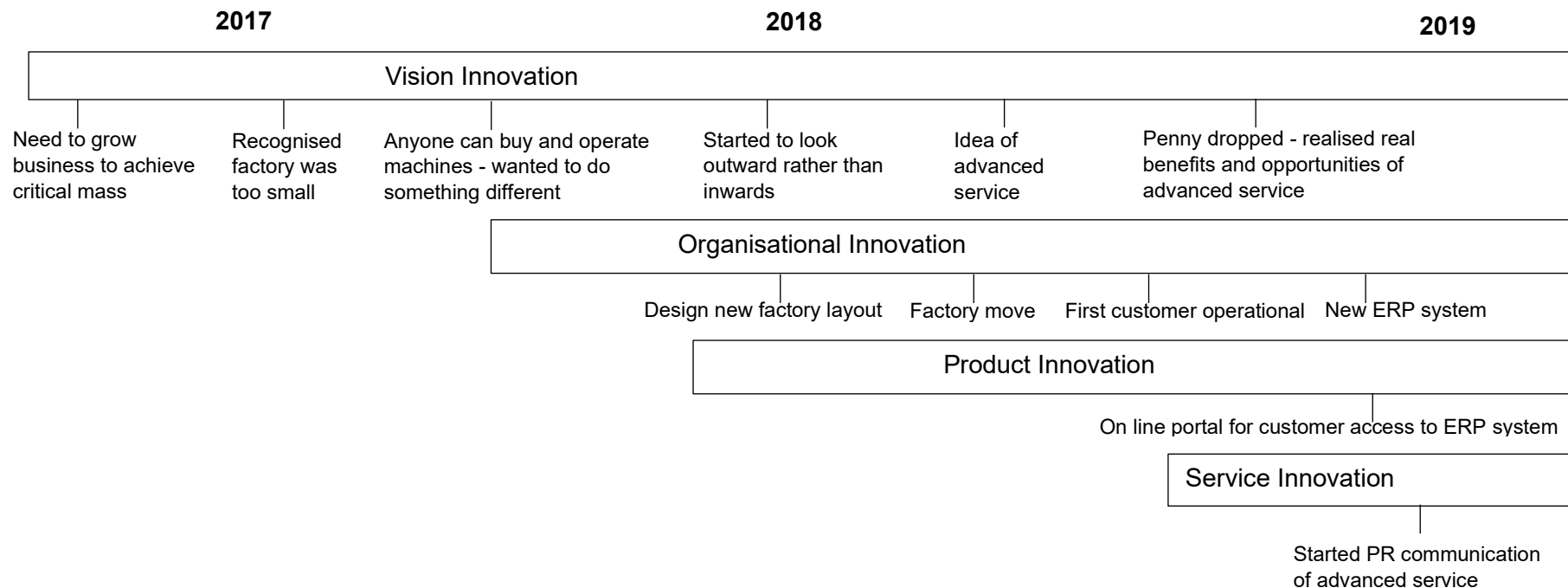| Strategic dynamic capability	Operational capability (activity or resource)	Evidence of operational capability	Scores	Scoring Criteria for assessing the intensity of operational capability
Vision Innovation (Sense) Total score 4/10	**Sense** opportunities for advanced service	"Our customers want to offload the management of their presses. We recognised an opportunity to get paid for a service we were already doing to a certain extent."	1	0 - No 1 - Partially 2 - Yes
	Customer, market and competitor data	"This approach has never been seen within our industry."	0	0 - No 1 - Limited 2 - Extensive
	Seize by evaluating opportunities and developing a new vision	"To have most of our customers connected remotely for us to see and prevent problems on presses before they happen to increase their uptime."	1	0 - No 1 - Underdeveloped 2 - Clear and compelling
	Influential champion to gain stakeholder support	"Other directors are on-board." "Large automotive manufactures want to spend their whole budget and smaller companies just want a finance package."	1	0 - No support 1 - Partial support 2 - Full support
	Reconfigure existing vision and create a roadmap for implementation	"We have a financial plan and projections for providing a complete install and aftermarket service." "I cannot just stand back and think about how I can make a plan work for the company like large businesses do, because we would go bust in the meantime."	1	0 - No plan 1 - Plan without targets/milestones 2 - Plan with targets/milestones
Service Innovation (Seize) Total score 6/10	**Sense** potentially receptive customers for advanced service	"We intend to leverage the support of our tier 1 customers to push the concept out to the rest of our customer base."	2	0 - No 1 - Partially 2 - Yes
	Customer relationship management system to segment and target based on needs	"We know what our customers want."	1	0 - No 1 - Broad overview of application 2 - Understand customer pains
	Seize by collaborating with customers to explore problems and design advanced service	"Engineer wants to offload management of their presses and we have been providing this service without charge in a limited way."	1	0 - Very little collaboration 1 - Consider customer feedback 2 - Co-create solutions with customers
	Devices to collect and analyse data on problems solved to demonstrate the value of advanced service	"The purchasing departments and engineering mangers of our customers are fixated on CapEx only, they don't want to forecast beyond the year, they know what they have got to spend this year and its all they want to commit to."	1	0 - No 1 - Developing 2 - Remote condition monitoring
	Reconfigure product-service offerings to include advanced service	"I'm speaking with engineers who want it, but cannot get to financial directors, it's a step too far."	1	0 - No processes 1 - Adhoc processes 2 - Formalised routines

Strategic dynamic capability	Operational capability (activity or resource)	Evidence of operational capability	Scores	Scoring Criteria for assessing the intensity of operational capability
Product Innovation **(Seize)** Total score 4/10	**Sense** product development required to enable advanced service	"We have not been able to recruit a new software engineer, which stalled our product development."	0	0 - No 1 - Partially 2 - Yes
	Cross functional systems to understand product usage, customer problems and needs	"We put computer equipment on presses for condition monitoring."	1	0 - No 1 - Developing 2 - Yes
	Seize by designing new or adapted products		2	0 - No design influence 1 - Some design influence 2 - Design authority
	Research and development facilities	"Cannot find a software engineer with the right skills."	1	0 - No 1 - Developing 2 - Yes
	Reconfigure product range to combine with advanced service	"We're very small and I don't think of step by step planning, I think, how can I make the most money in the next year. Bigger companies can plan it more."	0	0 - No processes 1 - Adhoc processes 2 - Formalised routines
Organisational Innovation **(Reconfigure)** Total score 4/10	**Sense** changes required to resources and activities for design and provision of advanced service	"We have created new sales and marketing material and updated our web site."	1	0 - No 1 - Partially 2 - Yes
	Recruitment, training and incentives	"We have appointed a new distributor in India, but they need to upskill their engineers for installation and servicing"	1	0 - No processes 1 - Adhoc processes 2 - Formalised processes
	Seize by adapting resources and activities to build the required capabilities	"Need to recruit a new software engineer and free up more time for sales, finding new distributors, recruitment and up skilling our distributors."	1	0 - No 1 - Partially 2 - Yes
	Finance to fund investments	"We've got no funding, its all out of our own pockets, so its on the back burner for now."	0	0 - Finance not explored 1 - Finance pending 2 - Finance available
	Reconfigure by integrating the adapted resources and activities	"We are a small team, but sometimes we don't communicate enough."	1	0 - Chaotic 1 - Reactive to priorities 2 - Pro-active

Populated code book for Company F and scores attributed

2017

2018

2019

Vision Innovation

Exploratory team
meeting to discuss
offering

Sales team floated
ideas with customers

Service Innovation

NHS Trust requested storage,
pick and ship solution

Warehouse is full - logistics
offer is not replicable

Won two marketing
contracts

Organisational Innovation

Refurbished
warehouse

NHS Trust
warehouse
transferred

Marketing added to
web site,
purchased
databases

Recruited marketing
person

Marketing person left

Marketing contracts
cancelled

Epilogue: The project has been abandoned due to replication problems and business as usual getting in the way.

Company B - Chronology of capability development and application

2017   **2018**   **2019**

Vision Innovation

Need to grow business to achieve critical mass

Recognised factory was too small

Anyone can buy and operate machines - wanted to do something different

Started to look outward rather than inwards

Idea of advanced service

Penny dropped - realised real benefits and opportunities of advanced service

Organisational Innovation

Design new factory layout   Factory move   First customer operational   New ERP system

Product Innovation

On line portal for customer access to ERP system

Service Innovation

Started PR communication of advanced service

Epilogue: The project is ongoing, however, the factory move and re-organisation along with rapidly increasing business as usual has slowed progress for now.

Company C - Chronology of capability development and application

2017   **2018**   **2019**

Vision Innovation

Growth plan developed

Eureka moment, regular recurring revenue from rolling service contracts

Service Innovation

Segmented customers based on need of large formal printers

Co-produced offering with friendly customers

Launched offering

Product Innovation

Third party software for remote access to printer information

Organisational Innovation

Developed revenue model

Mailing to customers

Registered with GoCardless

Epilogue: The project is a huge success and is currently scaling up.

Company D - Chronology of capability development and application

2017

2018

2019

Vision Innovation

Recognised an
opportunity to get
paid for services we
were already doing

Food processing
by the hour

Product Innovation

Expanded product range from
2 chambers to 12 chambers

Ability to process
different foods

Developing remote monitoring
and fixing capability

Service Innovation

Segmented based on low
volume production for piloting

Trials in India,
Greece and China

Developing the customer
value proposition

Organisational Innovation

Grant funding

Exploring asset
funding solutions

New strategic alliance
partner for machine building

Developing the
revenue model

Epilogue: The project is ongoing, however, consistent resistance over a prolonged period from customers is cause for concern about commercial viability.

Company E - Chronology of capability development and application

2017   **2018**   **2019**

| Vision Innovation |

Customers want to offload the management of their presses

Recognised an opportunity to get paid for service already doing

| Product Innovation |

Started recruitment of new software engineer

Abandoned search for new software engineer

| Organisational Innovation |

Developed revenue model

New sales and marketing material

Updated web site

Launched

Appointed new distributor in India

| Service Innovation |

We know what our customers want (engineers)

Procurement people not interested

Epilogue: The project is abandoned and the champion has left the company.

Company F - Chronology of capability development and application