



JÖNKÖPING UNIVERSITY
School of Engineering

Doctoral Thesis

Critical Operations Capabilities for Competitive Manufacturing: A High-Cost Environment Perspective

Cinzia Sansone

Jönköping University
School of Engineering
Dissertation Series No. 066 • 2021



JÖNKÖPING UNIVERSITY
School of Engineering

Doctoral Thesis

Critical Operations Capabilities for Competitive Manufacturing: A High-Cost Environment Perspective

Cinzia Sansone

Doctoral Thesis in Production Systems

Critical Operations Capabilities for Competitive Manufacturing:
A High-Cost Environment Perspective
Dissertation Series No. 066

© 2021 Cinzia Sansone

Published by
School of Engineering, Jönköping University
P.O. Box 1026
SE-551 11 Jönköping
Tel. +46 36 10 10 00
www.ju.se

Printed by Stema Specialtryck AB, year 2021

ISBN 978-91-87289-70-5



*“The only true wisdom is in
knowing you know nothing”*

Socrates

Abstract

Manufacturing companies operating in a high-cost environment are facing many challenges attempting to achieve a competitive advantage. These challenges have encouraged manufacturing companies to relocate their manufacturing operations from a high-cost to low-cost environment, creating issues for the western social welfare. Manufacturing companies located in a high-cost environment must be able to improve their overall competitiveness to maintain their manufacturing in such environment.

Research has shown that the competitive success of a company depends on its ability to identify, develop and improve those operations capabilities that have the highest impact on their competitiveness. However, the literature provides limited emphasis on critical operations capabilities for competitive manufacturing in a high-cost environment. Therefore, the purpose of this research is to investigate critical operations capabilities and how they contribute to a competitive advantage in a high-cost environment.

To fulfill the purpose, two research questions have been formulated. The first research question is: what are the critical operations capabilities for competitive manufacturing in a high-cost environment? The second research question is: How do critical operations capabilities contribute to competitive advantage in a high-cost environment? The research questions were answered through different studies and the implementation of different research strategies.

This thesis contributes with increased knowledge on critical operations capabilities in a high-cost environment and how they contribute to a competitive advantage. This research has provided an updated and modernized framework of critical operations capabilities in a high-cost environment. Furthermore, this research has also offered an overview on different strategies which are implemented in a high-cost environment for reaching a competitive advantage. Thus, it also included an analysis on challenges and solutions faced by competitive manufacturing in a high-cost environment.

Keywords: capabilities, priorities, high-cost environment, operations strategy

Sammanfattning

Tillverkningsföretag som arbetar i en högkostnadsmiljö står inför många utmaningar medan de försöker uppnå en högre konkurrenskraft. Dessa utmaningar har uppmuntrat tillverkningsföretag att flytta sin verksamhet från en högkostnadsmiljö till lågkostnadsmiljö, vilket har skapat problem för den västerländska välfärden. Tillverkningsföretag i en högkostnadsmiljö måste kunna förbättra sin totala konkurrenskraft för att behålla sin tillverkning i en sådan miljö.

Forskning har visat att ett företags konkurrenskraftiga framgångar beror på dess förmåga att identifiera, utveckla och förbättra de driftskapaciteter som har störst inverkan på deras konkurrenskraft. Litteraturen är begränsad när det gäller kritiska produktionsförmågor för konkurrenskraftig tillverkning i en högkostnadsmiljö. Syftet med denna forskning är att bidra med kunskap om kritiska driftskapaciteter och hur de bidrar till en högre konkurrenskraft i en högkostnadsmiljö.

För att uppfylla syftet har två forskningsfrågor formulerats. Den första forskningsfrågan är: Vilka är de kritiska driftskapaciteterna för konkurrenskraftig tillverkning i en högkostnadsmiljö? Den andra forskningsfrågan är: Hur bidrar kritiska driftskapaciteter till högre konkurrenskraft i en högkostnadsmiljö? Forskningsfrågorna besvarades genom olika studier och implementering av olika forskningsstrategier.

Denna avhandling bidrar med ökad kunskap om kritiska driftskapaciteter i en högkostnadsmiljö och hur de bidrar till en högre konkurrenskraft. Denna forskning har gett en uppdaterad och moderniserad ram för kritiska driftskapaciteter i en högkostnadsmiljö. Vidare har denna forskning också bidragit till en översikt över olika strategier som implementeras i en högkostnadsmiljö för att nå en högre konkurrenskraft. Således inkluderade den också en analys av utmaningar och lösningar som konkurrenskraftig tillverkning har i en högkostnadsmiljö.

Keywords: capabilities, priorities, high-cost environment, operations strategy

Acknowledgements

This thesis is written with the support and inspiration of many people. I would have not been able to write this thesis without you:

To Christian, my love, my husband, my best friend. Thank you for always being by my side, for your constant support and always believing in me. This thesis is also yours!

To my family, even in the distance you have always been my strength and motivation. To my dad, my great inspiration and idol, this thesis is for you! To my mum, my constant in life, the strongest woman I know. To my brother and sister, my lifetime best friends.

To my supervisors, Dr. Kerstin Johansen and Dr. Carin Rösiö. This thesis is a result of a journey including ups and downs, thanks to both of you I was able to turn those difficult moments into opportunities for growing on both academic and personal level. Kerstin, your contagious energy and positivity have been my inspiration and motivation for finalizing my thesis. Carin, your professionalism, focus and kindness have been an encouragement to always stay focus on my goals and finalize my thesis. I am deeply grateful to have met two such incredibly humble women as you during this journey. You have both given me courage and confidence!

To my present colleagues and the department of *Industrial Product Development, Production and Design* for providing a friendly work environment. To the production research group, I have been always looking forward to our meetings! I would also like to thank dean Ingrid Wadskog and the head of the department Olof Granath for the sincere support and constant availability.

Thanks also to all the people who participated in this research, all the case companies and all the co-authors.



List of appended papers

Paper 1

Sansone, C., Hilletoft, P., and Eriksson, D. (2017). “Critical operations capabilities for competitive manufacturing: a systematic review”, *Industrial Management and Data Systems*, Vol. 117 No. 5, pp. 801-837.

Contribution: Sansone and Hilletoft planned the theoretical study, which was carried out by Sansone. Sansone analyzed the data and wrote the paper. Hilletoft and Eriksson reviewed the paper and provided comments for improvements.

Paper 2

Sansone, C., Hilletoft, P., Eriksson, D., Pinna, C. (2017). “An analysis of critical operations capabilities in a high-cost environment: a multiple case study”, *24th European Operations Management Association (EurOMA) conference*, Edinburgh, Scotland.

Contribution: Sansone and Hilletoft planned the empirical study, which was carried out by Hilletoft. Sansone analyzed the data and wrote the paper. Eriksson and Pinna reviewed the paper and provided comments for improvements.

Paper 3

Sansone, C., Hilletoft, P., and Eriksson, D. (2020). “Evaluation of critical operations capabilities for competitive manufacturing in a high-cost environment”, *Journal of Global Operations and Strategic Sourcing*, Vol. 13 No. 3, pp. 229-250.

Contribution: Sansone and Hilletoft planned the empirical study. Sansone developed the questionnaire while Hilletoft took lead in the group discussion. Sansone analyzed the data and wrote the paper. Hilletoft and Eriksson reviewed the paper and provided comments for improvements.

Paper 4

Sansone, C., Hilletoft, P., and Eriksson, D. (2020). “Critical operations capabilities for competitive manufacturing in a high-cost environment:

a multiple case study”, *Operations and Supply Chain Management*, Vol. 13 No. 1, pp. 96-109.

Contribution: Sansone and Hilletoft planned the empirical study, which was carried out by Hilletoft. Sansone analyzed the data and wrote the paper. Eriksson reviewed the paper and provided comments for improvements.

Paper 5

Sansone, C., Johansen, K., Rösiö, C (2021). “Manufacturing competitively in a high-cost environment: a SME’s perspective”, *28th European Operations Management Association (EurOMA) conference*, Berlin, Germany.

Contribution: Sansone, Johansen and Rösiö planned the empirical study, which was carried out by Sansone. Sansone analyzed the data and initiated the paper. Johansen and Rösiö reviewed the paper and provided comments for improvements.

Paper 6

Sansone, C., (2021). “Toward a competitive advantage in a high-cost environment: challenges and solutions”, *28th European Operations Management Association (EurOMA) conference*, Berlin, Germany.

Contribution: Sansone initiated and wrote the paper. Part of the empirical data included was carried out by Sansone and other co-authors from a previous study. Sansone re-analyzed the collected data for this paper and integrated it with additional data, which was collected and analyzed by Sansone.

Additional publications

Conference papers

Sansone, C., Hilletoft, P., Eriksson, D. (2018). Critical operations capabilities in high cost environment: a multiple case study. *1st International Conference on Industrial and Systems Engineering, (IConISE)*, Bali, Indonesia.

Sansone, C., Hilletoft, P., Eriksson, D. (2018). “Critical operations capabilities in a high cost environment”, *International Conference on Operations and Supply Chain Management (OSCM)*, Cranfield, UK.

Reitsma, E., Sansone, C., Hilletoft, P. (2017). “Critical operations capabilities in high cost environment: a grey relational analysis”, *MakeLearn and TIIM Joint International Conference*, Lublin, Poland.

Sansone, C., Eriksson, D., Hilletoft, P. (2016). “Framework of operations capabilities: a literature review with new insights”, *23rd European Operations Management Association (EurOMA) conference*, Trondheim, Norway.

Sansone, C., Hilletoft, P. (2016). “Critical operations capabilities in high cost environment: a case study”, *23rd European Operations Management Association (EurOMA) conference*, Trondheim, Norway.

Edh Mirzaei, N., Wlazlak, P., Sansone, C., Hilletoft, P. (2016). “Challenges with competitive manufacturing in high cost environment”, *23rd European Operations Management Association (EurOMA) conference*, Trondheim, Norway.

Sansone, C., Hilletoft, P., Eriksson, D. (2016). “Critical operations capabilities in high cost environment: a focus group study”, *International Conference on Operations and Supply Chain Management (OSCM)*, Phuket, Thailand.

Licentiate thesis

Sansone, C. (2018). “*Critical operations capabilities in a high cost environment*”, Licentiate Thesis, Jönköping University, Sweden.

Table of contents

1	Introduction.....	1
1.1	Background of the research.....	1
1.2	Motivation of the research	4
1.3	Purpose of the research	6
1.4	Scope and delimitations of the research.....	8
1.5	Outline of the thesis	9
2	Frame of reference	11
2.1	Introduction to the frame of reference	11
2.2	Competitive manufacturing in a high-cost environment.....	13
2.3	Operations strategy	14
2.4	Operations capabilities	16
2.5	Competitive advantage.....	21
3	Research methodology.....	25
3.1	Research process	25
3.2	Research strategies	27
3.2.1	Study I.....	29
3.2.2	Study II	30
3.2.3	Study III.....	33
3.3	Research quality	35
3.4	Motives for research strategies selected.....	36
4	Summary of appended papers	39
4.1	Introduction to the appended papers	39
4.2	Paper 1.....	41
4.3	Paper 2.....	42
4.4	Paper 3.....	43
4.5	Paper 4.....	45
4.6	Paper 5.....	47
4.7	Paper 6.....	49
4.8	Summary of the papers' contributions	52
5	Discussion	55
5.1	General discussion	55
5.2	Critical operations capabilities in a high-cost environment.....	56
5.2.1	Framework of critical operations capabilities in a high-cost environment.....	57
5.2.2	Critical operations capabilities in a high-cost environment from LMEs and SMEs perspectives.....	61
5.3	Contribution of critical operations capabilities to competitive advantage in a high-cost environment.....	65

5.4	Discussion of method	68
6	Conclusion.....	71
6.1	Answering the research questions.....	71
6.2	Theory contributions.....	72
6.3	Managerial implications	73
6.4	Limitations and further research.....	74
	References	77
	Appendices	91
	Appendix 1	91
	Appendix 2	93
	Appendix 3	97

List of figures

Figure 1 Introduction to the research..... 2

Figure 2 Scope of the research (highlighted in grey) 8

Figure 3 Components of the frame of reference..... 12

Figure 4 Operations strategy models spectrum (adapted from Singh et al.,
2015)..... 20

Figure 5 Competitive advantage (adapted from Porter, 2020 p.12) 23

Figure 6 Competitive advantage, “Three Cs” (adapted from Christopher,
2016 p.4)..... 24

Figure 7 Purpose, research questions and studies conducted 26

Figure 8 Research process 27

Figure 9 Connection of the appended papers to the research questions..... 39

List of tables

Table 1 Operations capabilities (Frohlich and Dixon, 2001; Miller and Roth, 1994)..... 19

Table 2 Characteristics of systematic literature reviews.....29

Table 3 Characteristics of the multiple case study A.....30

Table 4 Overview of companies selected for multiple case study A (from Paper 3 and Paper 4).....31

Table 5 Characteristics of the multiple case study B32

Table 6 Overview of companies selected for multiple case study B (from Paper 6)33

Table 7 Characteristics of the multiple case study C34

Table 8 Overview of companies selected for multiple case study C (from Paper 5 and Paper 6)..... 34

Table 9 Quality criteria in relation to the research strategies.....35

Table 10 Evaluation of the operations capabilities from Paper 344

Table 11 Critical operations capabilities based on empirical findings from Paper 4.....46

Table 12 Case companies characteristics from Paper 548

Table 13 Challenges and solutions in relation to the six dimensions of operations capabilities summarized from Paper 6.....50

Table 14 Main contributions from the appended papers, in relation to the research questions (Paper 1 – 6).....52

Table 15 Critical operations capabilities in a high-cost environment (based on findings from Studies I, II, III).....59

Table 16 Critical operations capabilities for LMEs and SMEs in a high-cost environment (based on findings from Studies II and III).....62

List of definitions

Business strategy: The business strategy defines the scope and boundaries of each business, specifying the basis on which that business unit will achieve and maintain a competitive advantage; in other words, it specifies the targeted competitive advantage that the organization wants to achieve (Hayes and Wheelwright, 1984).

Capacity: Capacity is the power to hold, receive something (Vincent, 2008); it can refer to, among other things, manufacturing capacity or inventory capacity.

Competence: Competencies as well as resources are requisites that an organization needs to own to be able to develop capabilities. Examples of competencies are collective learning in an organization; communication, involvement and commitment to working across the organization (Hamel and Prahalad, 1990)

Competitive advantage: A company is said to have a competitive advantage when it is implementing a value creating strategy desired by customers and not simultaneously being implemented by any current or potential competitors (Barney, 1991).

Competitive priority: These are objectives which guide the management actions towards the building of operations capabilities (Koufteros et al., 2002). In other terms, they are desired capabilities, i.e., those that a firm wants to have in the future or on which emphasis should be placed (Größler and Grübner, 2006).

Corporate strategy: The corporate strategy defines the business in which the organization wants to participate, including the acquisition and allocation of resources for those businesses (Hayes and Wheelwright, 1984).

Cost-leadership strategy: In a cost leadership strategy, a company is planning to become the low-cost leader in its industry sector (Porter, 2020).

Cumulative (or sand-cone) model: In the cumulative or sand-cone model, operations capabilities are built on each other in a cumulative manner and developed simultaneously (Größler and Grübner, 2006; Schoenherr et al., 2012).

Differentiation strategy: In a differentiation strategy, a company is planning to become unique in its industry by selecting different dimensions other than cost (e.g., quality) that many customers in an industry perceive as important, and uniquely attempt to differentiate itself along these dimensions; hence, it is rewarded for its uniqueness with a premium price (Porter, 2020).

Dynamic capability: The term ‘dynamic’ refers to the shifting character of the environment [in which capabilities are developed and generated]; [...] the term ‘capabilities’ emphasizes the key role of strategic management [management actions] in appropriately adapting, integrating, and re-configuring internal and external organizational skills, resources and functional competencies to change in environment (Teece and Pisano, 1994, p. 538).

Functional strategy: The functional strategy specifies how that function will support the desired or targeted competitive advantage; to be effective, each functional strategy must support the competitive advantage being sought by the business strategy (Hayes and Wheelwright, 1984; Slack and Lewis, 2020).

High-cost environment: In line with Ketokivi et al., (2017), as GDP per capita, which correlates with factors such as wages as distinctions between high-cost and low-cost environments are implicitly based on wage levels. Based on this distinction between high-cost and low-cost environments, Sweden can be considered as a high-cost environment. Swedish manufacturing companies are facing high costs related to the high wages provided in the country.

Knowledge-based school: The knowledge-based school suggests that competitive advantage results from the creation and development of new knowledge through a process of organizational learning (Grant and Baden-Fuller, 2004).

Operational: Operational is the opposite of strategic, it is detailed, localized, short term and day to day while operations constitute the parts of the organization that satisfy customer needs and includes the resources that create products and services (Slack, 2005)

Operations capability: A plant's contribution to a company's success factors in competition, i.e., the strengths of a plant with which it wants to support corporate and marketing strategy, and which help it to succeed in the marketplace (Größler and Grübner, 2006, p. 459).

Operations strategy: Operations strategy is the total pattern of decisions that shape the long-term capabilities of any type of operation and their contribution to overall strategy, through the reconciliation of market requirements with operations resources (Slack and Lewis, 2020).

Operations: Operations are the part of an organization that creates and/or delivers its products or services. Operations involves the transformation of inputs into outputs to satisfy the customers' needs (referred to as 'input-transformation-output' model of operations) (Slack and Lewis, 2020).

Resource-based school: The resource-based school is based on the idea that the competitive advantage results from the development and exploitation of internal resources and competencies that a company owns (Wernerfelt, 1984).

Resources: Resources are those inputs that will be changed or transformed in the operations. These resources can be tangible or intangible, and refers to for example: materials, information, knowledge, equipment, buildings (Slack, 2005; Slack and Lewis, 2020)

Trade-off model: In this model, some operations capabilities are strategically more important than others. In the trade-off model, operations capabilities are distinct and developed in isolation, one at a time (Sum et al., 2012).

1 Introduction

This chapter introduces the research topic. First, it presents the background of the research, addressing the role of competitive manufacturing in a high-cost environment and the importance of operations capabilities to achieve a competitive advantage. Second, it introduces the motivation of the research, with a focus on critical operations capabilities for competitive manufacturing in a high-cost environment. Third, it presents the purpose and the research questions. Finally, it includes an explanation of the scope and limitations of the research as well as the outline of the thesis.

1.1 Background of the research

Manufacturing plays a fundamental role in the development of the economy in which it is carried out (de Treville *et al.*, 2017). Manufacturing companies operating in a high-cost environment face many difficulties in attempting to achieve a competitive advantage (Roos, 2014). In this research, a high-cost environment is defined in line with Ketokivi *et al.*, (2017), as Gross Domestic Product (GDP) per capita, which correlates with factors such as wages, as distinctions between high-cost and low-cost environments are implicitly based on wage levels. High labor costs, coupled with high rates of technological and competitive change, presents challenges for manufacturing companies in high-cost environments (Yin *et al.*, 2017). Manufacturing operating in a high-cost environment must pay its own way, as governments and shareholders are not willing to cover the costs for unprofitable activities (de Treville *et al.*, 2017). These challenges have encouraged manufacturing companies to move their facilities to low-cost environments, which has caused several issues in high-cost environments, such as: rising of unemployment rates, loss of innovation potential and intellectual property issues (Fratocchi *et al.*, 2016). These issues have strengthened the debate on the importance of having manufacturing companies in a high-cost environments and, more specifically, on how these manufacturing companies can compete from a high-cost environment without having to move their facilities to low-cost environments; see for example the special issue in *Journal of Operations Management*, (de Treville *et al.*, 2017).

Academic researchers have highlighted the importance of developing operations capabilities to increase the competitiveness of manufacturing companies (Größler and Grübner, 2006). The competitive success of a manufacturing company depends on its ability to identify, develop and continuously improve *critical* operations capabilities that contribute to its competitive advantage in the specific environment in which it operates (Koufteros *et al.*, 2002a). Here, *critical* is used as an adjective that wants to emphasize the trait of these capabilities in contributing to a competitive advantage. An overview to the research and the main elements is provided in Figure 1.

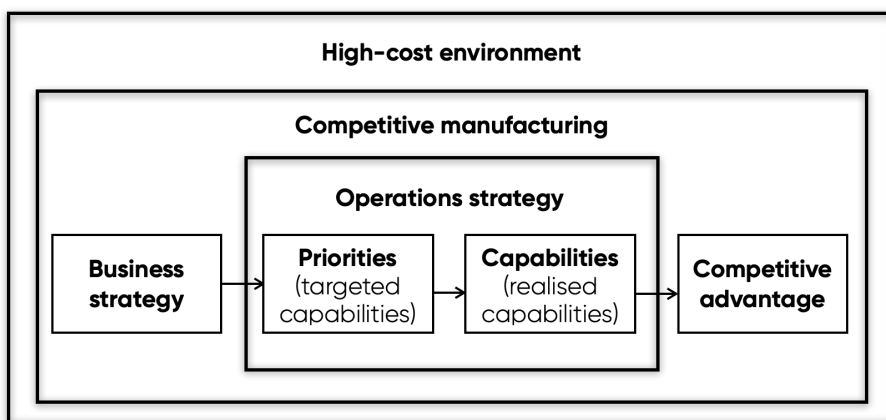


Figure 1 Introduction to the research

The development of operations capabilities can help to achieve a high level of performance along different dimensions or priorities such as cost, quality, time and flexibility (Boyer and Lewis, 2002; Rosenzweig *et al.*, 2003). Cost and quality are important dimensions in the global competition (Alsmadi *et al.*, 2011; Krause *et al.*, 2001). When manufacturing companies do not pay sufficient attention to these dimensions, they can run a higher risk of losing the market share and drastically reducing profit (Alsmadi *et al.*, 2011; Zhao *et al.*, 2010). Quality has become an essential dimension for manufacturing companies (Alsmadi *et al.*, 2011). However, the current market competition not only requires reduced costs and improved quality but also fast and reliable deliveries plus multiple types of flexibilities (Badri *et al.*, 2000; Dangayach, G.S.; Deshmukh *et al.*, 2001). Manufacturing companies that cannot offer products with low prices or with excellent quality can instead focus on developing their responsiveness. In this

case, on-time and fast delivery are important capabilities for achieving a competitive advantage that can help manufacturing companies win orders in the competitive environment (Alsmadi *et al.*, 2011).

The development, nurturing and abandonment of operations capabilities are major tasks of any operations strategy (Figure 1) (Größler and Grübner, 2006). An operations strategy includes the identification of competitive priorities, and the development of capabilities (Dangayach and Deshmukh, 2001; Luz Martín Peña *et al.*, 2008; Platts *et al.*, 1998). Competitive priorities consist of a set of objectives or goals pursued by an operations function (Luz Martín Peña and Díaz Garrido, 2008) and can be defined as the capabilities that the operations unit should have to be competitive, given its overall business strategy (Hayes and Wheelwright, 1984; Miller and Roth, 1994; Platts *et al.*, 1998). In other words, these are the targeted capabilities that future emphasis should be placed on (Größler and Grübner, 2006). Companies make operational decisions based on specified priorities and the available knowledge and resources (Größler and Grübner, 2006). Depending on the defined priorities, different operations capabilities are developed (Anderson *et al.*, 1989; Größler and Grübner, 2006). The operations capabilities form the basis for organizational (e.g., revenue, profit, and asset turnover) and operational (e.g., lead-time, unit cost, and setup cost) performance. The notion that top-down alignment of business strategy and operations capabilities drives performance is well established in the literature (see e.g., Frohlich and Dixon, (2001)). The strategic alignment between business strategy and operations strategy is fundamental for achieving a competitive advantage (Skinner, 1969).

Competitive advantage is planned in the business strategy and is achieved through pursuing a value-creation strategy that is desired by customers but has not been implemented by any current or potential competitor (Grant, 2016; Porter, 2020). The implemented strategy needs to exploit the internal strengths of the company by responding to external opportunities, while at the same time neutralizing threats and avoiding internal weaknesses (Porter, 2020). An advantage can be created by offering customers superior value, either by providing the same benefits as competitors at a lower cost (cost advantage), or by providing benefits that exceed those of the competing offerings (value advantage) or both (Barney, 1991; Porter, 2020). The fundamental

strategies for creating a competitive advantage are usually referred to as a cost-leadership and differentiation strategy (Galbreath *et al.*, 2020; Lorenzo *et al.*, 2018). The source of the advantage is found in the ability to differentiate from the competition regarding products and customer service, and in the ability to operate at a lower cost with fewer resources (Christopher, 2016). Depending on the nature of the competitive advantage pursued, the manufacturing company may focus either on the value-creation or value-delivery processes, or both (Galbreath *et al.*, 2020; Newton *et al.*, 2015).

1.2 Motivation of the research

An important shift of manufacturing facilities from high-cost to low-cost environments has occurred in recent decades (Ketokivi *et al.*, 2017; Yin *et al.*, 2017). This has led to an intensified competition for both small-medium enterprises (SMEs¹) and large manufacturing companies operating in high-cost environments (Spring *et al.*, 2017; Yin *et al.*, 2017). Many manufacturing companies driven by the need to decrease the manufacturing cost, or more specifically the labor cost, have decided to move their facilities to low-cost environments (Canham and Hamilton, 2013; Ellram, 2013; Gylling *et al.*, 2015). In most cases, a cost reduction is achieved as planned, but in some situations, it is evident that the decision to compete from a low-cost environment had been based on insufficient information regarding items such as overhead costs (see e.g., Eriksson *et al.*, (2018)). Competitive threats from low-cost countries and the movement of manufacturing to low-cost environments has been a serious concern for companies in high-cost environments (Spring *et al.*, 2017). Yet, a heightened emphasis on sustainability by reducing distances within the supply chains; increasing customer expectations for flexibility; and improved cost performance are merely some of the reasons that have led a few manufacturing companies to move their manufacturing to a high-cost environment (Tate *et al.*, 2014). This movement emphasizes the opportunity for manufacturing companies to be able to compete from a

¹ *Small-Medium Enterprises (SMEs)* are companies with less than 250 employees. SMEs are further divided into micro enterprises (fewer than 10 employees), small enterprises (10 to 40 employees), medium-sized enterprises (50 to 249 employees), following a recommendation of the European Union Commission (2003/361/EC).

high-cost environment; even though it is still not considered a mass trend, its relevance is steadily increasing (Fratocchi *et al.*, 2016).

Companies compete in different ways based on the environment in which they operate. They must respond to the particular limitations of the context in which they compete and still register higher performance than their competitors. The goal of manufacturing companies is to maximize their competitiveness and profitability (de Treville *et al.*, 2017). However, this should be done through new paths and alternatives (Garo *et al.*, 2018), for example by developing operations capabilities that will increase manufacturing competitiveness. There is an intense debate about how manufacturing in a high-cost environment can achieve a competitive advantage (Ketokivi, 2017; Ketokivi *et al.*, 2017; de Treville *et al.*, 2017; Yin *et al.*, 2017). It is acknowledged that the competition in this context cannot be based only on cost (Ketokivi *et al.*, 2017) but needs to take into consideration also other competitive priorities or dimensions, which in turn support the development of specific operations capabilities. To improve their overall competitiveness, manufacturing companies should develop operations capabilities that support the strengths of the company against its competitors (Koufteros *et al.*, 2002a; Teece and Pisano, 2003). Consequently, they should be able to outperform competitors by developing capabilities that will create a competitive advantage (Hallgren *et al.*, 2011).

Many researchers in the operations management field have conducted studies in which they examine and identify critical operations capabilities (Frohlich and Dixon, 2001; Größler and Grübner, 2006). Existing literature is rich with both conceptual and empirical research about competitive priorities, operations capabilities and operations strategy (e.g., Miller and Roth, (1994); Frohlich and Dixon, (2001)). However, there is a limited emphasis on the critical operations capabilities in a high-cost environment. Moreover, these operations capabilities are dynamic by nature (Größler and Grübner, 2006), which means that they change over time to allow manufacturing companies to adapt to the changes of the environment in which they operate. A comprehensive understanding of critical operations capabilities in high-cost environments and their contribution to competitive advantage is limited in the literature. An updated understanding of critical operations capabilities can support manufacturing companies in gaining an

overview of those capabilities that need to be developed in a high-cost environment. This is relevant to be able to achieve a competitive advantage. Thus, the development of critical operations capabilities can support the realization of elevated levels of performance along distinctive dimensions (Boyer and Lewis, 2002; Rosenzweig *et al.*, 2003). A failure in the assessment of critical operations capabilities may drastically decrease a company's competitiveness (Phusavat and Kanchana, 2007).

To summarize, it is essential for manufacturing companies in a high-cost environment to implement successful operations strategy and achieve a competitive advantage. The implementation of an operations strategy includes the identification of those critical operations capabilities that can offset the limitations of a high-cost environment. Understanding the critical operations capabilities in a high-cost environment would provide a framework on which capabilities are more relevant in a specific context, such as a high-cost environment. Once the most important capabilities in a high-cost environment are identified, strategies can be updated and improved for achieving better performance (Bulak *et al.*, 2014) that better respond to customer requirements. In addition, to maintain constant improvements within the organization, companies need to identify the important operations capabilities, evaluate their current performance and identify where changes and improvement are required (Carpinetti and Martins, 2001).

1.3 Purpose of the research

In section 1.2, the research gap has been identified and discussed. Specifically, competitive threats from low-cost countries and the movement of manufacturing to low-cost environments have been a serious concern for companies in high-cost environments. Thus, manufacturing companies in high-cost environments are required to improve their operations strategies to a greater extent to achieve a competitive advantage. Hence, manufacturing companies in high-cost environments need to develop those critical operations capabilities that will contribute to a competitive advantage in this specific context.

The current literature requires an updated understanding on operations capabilities from a high-cost environment perspective. There is a need to consider the level of importance of those operations capabilities in

the specific high-cost context; in addition, it is important to gain more knowledge on how those critical operations capabilities can contribute to a competitive advantage in a high-cost environment. Therefore, the purpose of the research is to:

Investigate critical operations capabilities and how they contribute to a competitive advantage in a high-cost environment.

To fulfil the purpose, two research questions have been formulated. The first research question aims to investigate the operations capabilities on two levels. First, the literature will be reviewed to gain a base of knowledge on critical operations capabilities to better reflect the current level of competition. Second, analyzing those operations capabilities in a specific context (high-cost environment) will add a practical and real-world perspective. These two aspects will contribute to an improved understanding of the critical operations capabilities in a high-cost environment. The first research question is:

RQ1: What are the critical operations capabilities for competitive manufacturing in a high-cost environment?

The second research question will investigate the keys for competitive advantage in a high-cost environment. It will build on the critical operations capabilities identified and analyzed in the first research question. It will focus on understanding how manufacturing companies implement the critical operations capabilities in their production processes, including challenges and solutions. Moreover, it will contribute to gaining knowledge on the operations strategies implemented in a high-cost environment, whether they are cost leadership strategies or differentiation strategies. Hence, the second research question is:

RQ2: How do critical operations capabilities contribute to competitive advantage in a high-cost environment?

The two research questions will enrich current understanding about critical operations capabilities in a high-cost environment. The first research question will provide an overview on operations capabilities in a high-cost environment, understanding and studying their different

attributes and characteristics. The second research question will give an overview of how critical operations capabilities are implemented in a high-cost environment and how they contribute to competitive advantage. The research questions will be answered through different studies and the implementation of different research strategies. The combination of the two answers will contribute to the fulfilment of the purpose of the research.

1.4 Scope and delimitations of the research

The scope of this thesis is the critical operations capabilities for competitive manufacturing in a high-cost environment and how they contribute to a competitive advantage (Figure 2).

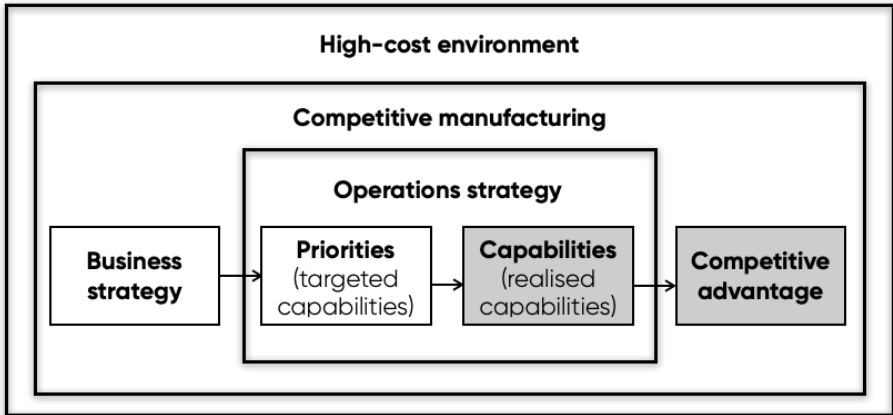


Figure 2 Scope of the research (highlighted in grey)

The research belongs to the operations management field and focuses on the manufacturing sector. Manufacturing plays an important role since it strengthens the economy in which it is carried out (de Treville *et al.*, 2017). Having a strong manufacturing sector can improve the economy through (among other things) job creation, innovation, intellectual property, high-value jobs, increased exports, strengthened research and development (Stentoft *et al.*, 2016). In this setting, this research is mainly limited to competitive manufacturing in a high-cost environment. It does not address the topic of location decisions, including an investigation of motives or drivers for moving manufacturing to a high-cost or low-cost environment. Thus, the

companies included in this research are only manufacturing companies currently operating and competing in a high-cost environment.

Moreover, this research belongs to the operations management field and focuses on the investigation of the realized operations capabilities within the operations strategy area (Figure 2). These capabilities are usually developed based on resources, knowledge and competencies that the company has, which creates the foundation for a resource-based view. However, the research does not investigate which resources and knowledge are needed to develop those capabilities.

The development of these capabilities affects the operational and organizational performances of the manufacturing companies. Here, the focus is limited to the realized capabilities without capturing performance outcomes, and therefore lacks the ability to evaluate these capabilities based on different performance measures. Instead, this research is limited to incorporating practitioners' views regarding the critical operations capabilities for competitive manufacturing in a high-cost environment. Hence, this research excludes any statistical attempt to evaluate or assess the critical capabilities identified and investigated.

1.5 Outline of the thesis

This doctoral thesis consists of six chapters and six appended papers. The remainder of this thesis is structured as follows:

In **Chapter 1**, the introduction of the research is presented, including the background, motivation, purpose and scope of the research.

In **Chapter 2**, the frame of reference is presented, including the concepts of competitive manufacturing in a high-cost environment: operations strategy, operations capabilities, and competitive advantage.

In **Chapter 3**, the research methodology of the study is presented, including the research process, research strategies, research quality and the motives for research strategies selected.

In **Chapter 4**, a summary of the appended papers is presented, including an outline of all appended papers in this thesis. It also includes

an overview of the connection between each paper and the research questions.

In **Chapter 5**, a discussion of the findings is presented, relating the thesis findings to prior literature and a discussion on the method.

In **Chapter 6**, the conclusions are presented, including contributions and implications, limitations and further research.

2 Frame of reference

In this chapter, previous research and theories related to the research topic under investigation are presented. The current understanding on competitive manufacturing in a high-cost environment, operations strategy, operations capabilities and competitive advantage is summarized.

2.1 Introduction to the frame of reference

Several research streams are relevant to the topic of *critical operations capabilities for competitive manufacturing in a high-cost environment* (highlighted in bold in Figure 3). Specifically, Figure 3 provides an overview on the theories related to this research topic, where the boxes represent the different theoretical fields and the arrows represent their connections.

The research focuses on competitive manufacturing in the specific context of a high-cost environment. Therefore, it was important to gain a better understanding on competitive manufacturing and the high-cost environment in which these companies operate. The external environment impacts the formulation of operations strategy and, consequently, the development of operations capabilities. Hence, the frame of reference begins with a discussion on competitive manufacturing in a high-cost environment, including a distinction between high-cost and low-cost environments.

Second, the research is linked to the theory of operations strategy. The formulation of an operations strategy begins from a business strategy, which sets the boundaries and specifies the basis of the operations strategy. However, the business strategy is not part of the scope of this research and for this reason will not have a dedicated section in this chapter; instead, it will be briefly introduced in the operations strategy section. The implementation of an operations strategy represents the pattern of decisions that shape the development of operations capabilities (Slack and Lewis, 2020) towards the achievement of a competitive advantage.

Third, the research focuses on operations capabilities for competitive manufacturing. More emphasis is therefore given to presenting theories related to operations capabilities, including an explanation of the different terms used in the literature and different models adopted in developing these capabilities.

Finally, the research is linked to the theory on competitive advantage, of which there are several schools of thought. Moreover, manufacturing companies achieve a competitive advantage in different ways, each of which requires its own strategy; these will be presented and explained in more detail later.

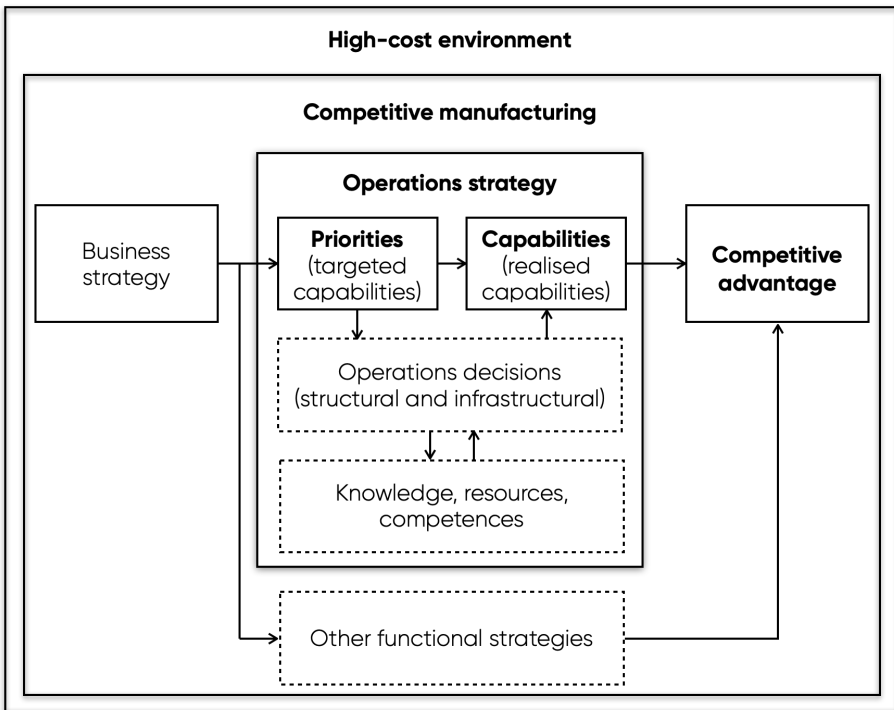


Figure 3 Components of the frame of reference

2.2 Competitive manufacturing in a high-cost environment

The external environment in which the company operates impacts the formulation of competitive advantage; this interplay between the events studied and their environment is fundamental for research (Sayer, 1992). There is an intense debate within the literature concerning the role of manufacturing in high-cost environments (de Treville *et al.*, 2017). High-cost production can remain competitive through factors such as flexibility, responsiveness, control, long-term relationships and supply chain sustainability (Harper, 2020). Indeed, keeping manufacturing close to product development, research and local markets has helped many manufacturing companies remain profitable even in a high-cost environment (Yin *et al.*, 2017). This approach has led competitive manufacturing to focus on responsiveness and innovation (Ketokivi *et al.*, 2017), as the literature shows that maximizing competitiveness and profitability can be achieved through remaining flexible and open to new ideas and customer needs (de Treville *et al.*, 2017). However, one of the major challenges for competitive manufacturing in a high-cost environment is to organize their production to be sufficiently responsive at a reasonable cost (de Treville *et al.*, 2017). To better understand how competitive manufacturing can compete in a high-cost environment, it is also important to understand what a high-cost environment is and distinguish it from a low-cost environment. Unfortunately, the literature does not provide a clear distinction between a high-cost and a low-cost environment. One way to determine whether a country is high or low-cost is to use a price parity index (Green and Roos, 2012). By using such indexes, it is possible to obtain an approximate distribution of relative cost levels and to identify countries that normally have a high or low-cost level (Green and Roos, 2012).

The *cost-of-living index* was introduced by Konüs (1939). This index compares prices in different countries. This is often done by comparing two baskets of goods (fixed basket approach), but here, the comparison is between the cost of maintaining the same standard of living in the comparison and reference periods (cost of living approach; National Research Council, 2002). Specifically, the cost-of-living index shows “the relative change occurring in the monetary cost of those consumers’ goods which are necessary for the maintenance of a certain standard of

living” (Konüs, 1939, p.10) . By dividing the cost of living at one period in time by the cost of living at another period, is it possible to obtain the “true index of the cost of living” (Konüs, 1939). Based on this index, the high-cost-environment category includes, for example, Sweden, Denmark, Iceland, Japan, Norway and Switzerland, while the low-cost environment category includes, for example, Egypt, India, Pakistan, Tunisia and Venezuela. Moreover, according to Ketokivi et al. (2017, p. 20), the distinction between high and low-cost environments has always implicitly been the difference between high and low wages. Based on this distinction between high-cost and low-cost environments, Sweden can be considered a high-cost environment. Swedish manufacturing companies are facing high costs related to the high wages provided in the country. In addition, based on the cost-of-living index, Sweden is also included in the high-cost environment category.

The differentiation between high and low-cost environments is not well defined nor clearly specified in the literature. As stated by Green and Roos (2012), another way to differentiate between these two environments is by looking at the different ways of competing. In a low-cost environment, the basis for success is to compete on price and to have the lowest cost. This means focusing on efficiency (doing what you do as well as possible), which often results in a focus on productivity meaning that companies are less likely to take the risk of introducing new things into the operations system (Roos and Kennedy, 2014). In a high-cost environment, on the other hand, the basis for success is to compete on superior value for money. This approach requires focusing on effectiveness (doing the right operations or activities), and often leads to a focus on innovation and the identification of smarter ways to do operations or activities (Roos and Kennedy, 2014). These operations are managed and planned through an operations strategy (Porter, 2020), which will be presented and introduced in more detail in the next section.

2.3 Operations strategy

There is a hierarchy of strategy, which includes three major levels: corporate, business and functional. These areas correspond to the organizational units charged with formulating and pursuing each level of strategy (Hayes and Wheelwright, 1984). The corporate strategy defines the business in which the organization wants to participate,

including the acquisition and allocation of resources for those businesses (Hayes and Wheelwright, 1984). The business strategy defines the scope and boundaries of each business, specifying the basis on which that business unit will achieve and maintain a competitive advantage; in other words, it specifies the targeted competitive advantage that the organization wants to achieve (Hayes and Wheelwright, 1984). The functional strategy specifies how that function will support the desired or targeted competitive advantage; to be effective, each functional strategy must support the competitive advantage being sought by the business strategy (Hayes and Wheelwright, 1984; Slack and Lewis, 2020). Typical functional strategies include marketing strategy, operations strategy, finance strategy and technology strategy (Hill and Hill, 2009; Slack and Lewis, 2020). As one of the functional strategies, the operations strategy is typically driven by the overall business strategy of an organization (Porter, 2020).

The foundations of operations strategy can be traced back to the 1940s and 1950s, but it received greater recognition through the important contribution of Skinner in 1969. Skinner is the pioneer in defining strategy; he (1969, p.139) defines *strategy* as a “set of plans and policies by which a company aims to gain advantages over its competitors”. After Skinner, more definitions of strategy have been proposed (e.g., Cox III and Blackstone Jr, 1998; Hayes and Wheelwright, 1984; Swamidass and Newell, 1987). However, five common elements can be identified in most of the definitions: establishing purpose, setting direction, developing plans, taking major actions and securing a competitive advantage (Hill and Hill, 2009). Numerous articles have been published dealing with the theory and practice of operations strategy, but the topic is still under considerable growth and discussion (Pooya and Faezrad, 2017). There is no generally-accepted definition of operations strategy (Alves Filho *et al.*, 2015; Dangayach, G.S.; Deshmukh *et al.*, 2001; Kim *et al.*, 2014). However, an updated and exhaustive definition of *operations strategy* is presented by Slack and Lewis (2020, p.28):

Operations strategy is the total pattern of decisions that shape the long-term **capabilities** of any type of operation and their contribution to overall **strategy**, through the

reconciliation of market requirements with operations **resources** (emphasis added).

This definition contains several key concepts: strategy, operations, resources and capabilities. While a definition of strategy is already presented in the text above, *operations* is the part of an organization that creates and/or delivers its products or services. Operations involves the transformation of inputs into outputs to satisfy the customers' needs (referred to as 'input-transformation-output' model of operations) (Slack and Lewis, 2020). Operations are detailed, complex and carried out by those at the lower levels of the organization (Slack, 2005). Operations can sometimes be confused or mixed with the term operational. Therefore, it is important to distinguish between the terms operations and operational. *Operational* is the opposite of strategic, it is detailed, localized, short-term and day-to-day while operations constitutes the parts of the organization that satisfy customer needs and includes the resources that create products and services (Slack, 2005).

Following the same line adopted in the definition of operations, *resources* are those inputs that will be changed or transformed. These resources can be tangible or intangible, and refers to aspects such as materials, information, knowledge, equipment, or buildings (Slack, 2005; Slack and Lewis, 2020). Hence, *resources* are internally measured factors of competition (Koufteros *et al.*, 2002b) and a *resource* refers to anything which could be thought of as a strength or weakness of a given company. More formally, a company's resources at a given time could be defined as those (tangible and intangible) assets which are tied semi-permanently to the company (Wernerfelt, 1984, p.172). While resources are something that a company possesses or has access to, *capabilities* refer to what a company can do (Größler and Grübner, 2006). The concept of capability and all the linked attributes will be discussed and explained in more detail in the next section.

2.4 Operations capabilities

Many authors have argued that capabilities are the results of resources deployment and organizational processes (Größler and Grübner, 2006; Hafeez *et al.*, 2002). When analyzing and investigating the term capability, there is substantial confusion and ambiguity in the literature. The concept of capability is sometimes related to the concept of

competence and the concept of capacity (Größler and Grübner, 2006; Hafeez *et al.*, 2002; Helfat and Winter, 2011). A common understanding of these terms has still not been achieved, and it remains ambiguous and controversial. A current understanding on different terms will follow.

Competence refers to being functionally adequate or having sufficient knowledge, strength and skills; it is an organization's know-how (Vincent, 2008). Competencies as well as resources are requisites that an organization needs to have in order to develop capabilities. Examples of competencies are: collective learning in an organization; and communication, involvement and commitment to working across the organization (Hamel and Prahalad, 1990).

Capacity, in contrast, is defined as the power to hold or receive something (Vincent, 2008); it can refer to, among other things, manufacturing capacity or inventory capacity.

Following this reasoning, it is possible to consider competencies and capacity as part of the resources and knowledge that an organization owns. Hence, it is important to distinguish between capabilities and resources. Capabilities are not part of resources because of their dynamic nature (Größler and Grübner, 2006). According to Teece *et al.*, (1997, p. 516), dynamic capabilities allow managers to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments. More specifically, *dynamic capabilities* emphasize two aspects (Teece and Pisano, 1994, p. 538). "Dynamic" refers to the shifting character of the environment (in which capabilities are developed and generated), and "capabilities" emphasizes the key role of strategic management (management actions) in appropriately adapting, integrating, and re-configuring internal and external organizational skills, resources and functional competencies to any change in environment.

In this research, operations capabilities are implicitly dynamic. At an overall level, *capabilities* are defined as:

A plant's contribution to a company's success factors in competition, i.e., the strengths of a plant with which it wants to support corporate and marketing strategy, and which help

it to succeed in the marketplace. (Größler and Grübner, 2006, p. 459).

Capabilities enable a company to exploit its resources to generate profits; these capabilities are generated after defining certain priorities or objectives and implementing certain operations decisions. Consequently, the generation of capabilities affects the performance of a company. On one hand, capabilities are developed to achieve specific priorities or objectives. On the other hand, once the capabilities have been developed, performance scores (or key performance indicators) can be adopted to measure the achievement of the company objectives (de Toni and Tonchia, 2001). For example, if the objective is to reduce the total cost, one way to measure the total cost is the sum of fixed costs and variable costs (Größler and Grübner, 2006; de Toni and Tonchia, 2001). An operations strategy implicates recognizing “ends” (performance outcomes) and “ways” (competitive priorities) and developing “means” (operations capabilities) by which the selected ends and ways can be reached (Hayes and Wheelwright, 1984; Peng *et al.*, 2011).

Several studies identified and discussed different capabilities (e.g., Frohlich and Dixon, 2001; de Meyer *et al.*, 1989; Miller and Roth, 1994). Commonly-used dimensions of operations capabilities are included in a taxonomy proposed by Miller and Roth, (1994) and later improved by other studies (e.g., Frohlich and Dixon, 2001). The taxonomy includes cost (price), quality, flexibility, delivery, and service. As can be seen in Table 1, each dimension includes one or more defined capability. Quality has undeniably become an essential factor in global competition (Alsmadi *et al.*, 2011). Companies that do not pay attention to this dimension run the risk of losing market share and seeing declining profits (Alsmadi *et al.*, 2011; Zhao *et al.*, 2002). Quality includes the capabilities of offering consistent quality (conformance) and providing high-performance products (performance). Flexibility is the firm’s ability to set up resources in response to environmental changes (Alsmadi *et al.*, 2011). This dimension includes the capabilities to make rapid design changes and/or introduce new products quickly (design flexibility), to respond to swings in demand (volume flexibility), and to deliver a broad product line. Delivery includes the capabilities to deliver products quickly (delivery speed), and to deliver on time (delivery dependability). On

time delivery is one of the requirements for fulfilling customer's needs, and fast delivery can also help a firm win orders in the current highly competitive environment (Alsmadi et al., 2011; Zhao et al., 2002). Service is growing in importance; in fact, providing more value-added services can help a firm to enrich the relationship with its customers (Zhao et al., 2002). In addition, the service dimension includes helping the customer after the product has been delivered with aspects such as repairs, installation, and so on (after sales service), reaching customers in dispersed geographic/national locations (broad distribution), and increasing sales through effective advertising and promotion. The price dimension includes the capability to compete on price (low price).

Table 1 Operations capabilities (Frohlich and Dixon, 2001; Miller and Roth, 1994)

Dimension	Capability	Intended outcome
<i>Price (Cost)</i>	1.Low price	Compete on price
<i>Flexibility</i>	2.Design flexibility	Make rapid design changes and/or introduce new product quickly
	3. Volume flexibility	Respond to swings in volume
	4. Broad product line	Deliver a broad product line
<i>Quality</i>	5. Conformance	Offer consistent quality
	6. Performance	Provide high performance products
<i>Delivery</i>	7. Delivery speed	Deliver products quickly
	8. Dependability	Deliver on time (as promised)
<i>Service</i>	9. After sale service	Provide after sale service
	10. Broad distribution	Distribute the product broadly
	11. Advertising	Advertise and promote the product

In the literature, many researchers have been trying to investigate and understand the relationship between these different capabilities. A major outcome is the development of two opposing models: the trade-off model and the cumulative model (Größler and Grübner, 2006; Schoenherr and Narasimhan, 2012; Singh *et al.*, 2015; Sum *et al.*, 2012). However, a study conducted by Singh *et al.*, (2015), questions the exactness of the statement being made about the two current models and finds empirical support for other four models: average model, thresholds model, multiple model and non-competitive model (Figure 4).

In the *non-competitive model*, organizations have a low level of performance on all capabilities. In other words, they do not excel in any of the capabilities; the reason behind this could be related to the same reasons presented in the average model (Singh *et al.*, 2015).

In the *trade-off model*, some operations capabilities are strategically more important than others, and they are distinct and developed in isolation one at a time (Sum *et al.*, 2012). However, in the literature, there has been a gradual change in how this model is discussed and treated (Singh *et al.*, 2015). The current understanding is more a literal interpretation of the term; organizations need to choose one capability on which they are aiming to achieve excellence while other capabilities will not receive the investment of resources (Avella *et al.*, 2011; Singh *et al.*, 2015; Sum *et al.*, 2012).

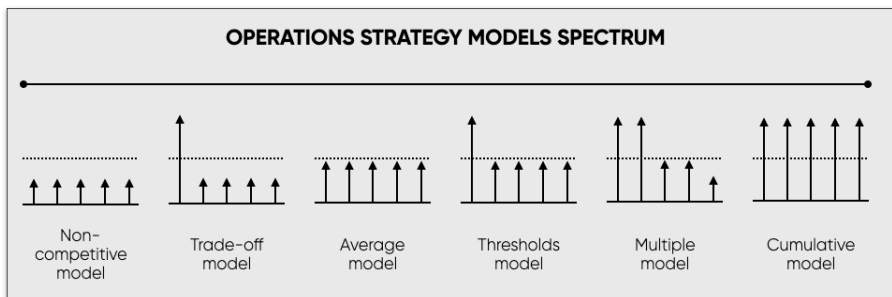


Figure 4 Operations strategy models spectrum (adapted from Singh *et al.*, 2015)

In the *average model*, all operations capabilities are developed and maintained on an average level. Singh *et al.*, (2015) suggest different reasons why organizations adopt this model: achieving a high level on some capabilities is neither required nor desirable for a specific context; organizations can settle for an average performance level because this situation meets expectations and is therefore acceptable; or organizations are only able to reach an average level despite their best efforts.

In the *thresholds model*, an organization would achieve excellence in one capability while maintaining an average level of competitiveness in the other capabilities (Singh *et al.*, 2015). This model is supported by the view of order winner and order qualifiers (Hill, 1995; Slack and Lewis, 2020). Organizations are therefore expected to be winners in at least one dimension, while being qualifiers in other dimensions (Singh *et al.*, 2015).

In the *multiple model*, the pattern of achievement is not clear and coherent. Singh et al. (2015) explain that this could be related to different reasons: first, the multiple model could be found in organizations that are in a transitory stage, which means that they are perhaps updating their strategies to better respond to the external environment; second, the multiple model could be found in organizations that have not yet developed a clear picture and overview on their goals and objectives; third, the multiple model could be found in organizations where, despite their best efforts, they are not able to follow a coherent strategy.

In the *cumulative model*, operations capabilities are built on each other cumulatively and developed simultaneously (Größler and Grübner, 2006; Schoenherr et al., 2012). With this perspective, manufacturing systems allow for simultaneous improvements in more than one capability (Größler and Grübner, 2006), instead of trading these capabilities off against each other (Ferdows and de Meyer, 1990; Singh et al., 2015). This model suggests that capabilities are mutually supportive and that organizations can develop strong capabilities along multiple dimensions, which in turn will support companies in achieving a competitive advantage. The concept of competitive advantage will be discussed and explained in more detail in the next section.

2.5 Competitive advantage

The concept of competitive advantage has been discussed over the last four decades (Barney, 1991; Christopher, 2016; Porter, 1980, 2020). When reflecting on the different sources for competitive advantage, the literature presents three main schools of thoughts: the competitive positioning (Porter, 2020), the resource-based school (Wernerfelt, 1984) and the knowledge-based school (Grant and Baden-Fuller, 2004). The competitive positioning is based on Porter's five forces and generic strategy (Porter, 2020). Once the industry sector in which a company wants to operate has been chosen, the company needs to determine which generic strategy to pursue, and then decide the optimal configuration of value-adding activities that support the generic strategy. This approach is mostly "outside-in". In comparison, the resource-based school is based on the idea that the competitive advantage results from the development and exploitation of internal resources and competencies that a company owns. Alsmadi et al. (2011)

explain that owning distinctive resources can lead to operational superiority or help create a superior market position, and consequently generate superior profits. This approach is mostly “inside-out”. Finally, the knowledge-based school suggests that competitive advantage results from the creation and development of new knowledge through a process of organizational learning (Grant and Baden-Fuller, 2004). These three schools of thought do not need to be considered as mutually exclusive (Campbell, et al., 2011). Knowledge is the basis for core competencies, resources and the implementation of generic strategies. In other words, the development of a strategy will inevitably draw upon some analysis of the company objectives, resources, competencies, and its competitive environment (Campbell, et al., 2011).

Competitive advantage is the result of the value a company can create for its customers that exceeds the company’s cost of creating it (Porter, 2020, p.3). In this definition, *value* is considered the price that customers are willing to pay, while *superior value* is originated when a company can offer equivalent benefits than its competitors for a lower price or when a company can provide unique benefits that compensates for premium prices (Barney, 1991; Porter, 2020). According to Barney, (1991), a company is said to have a competitive advantage when it is implementing a value-creating strategy desired by customers and not simultaneously being implemented by any current or potential competitors. A competitive advantage is said to be *sustained* when it continues to exist even after efforts of current or potential competitors to duplicate that advantage have ceased (Barney, 1991; Lippman and Rumelt, 1982). In other words, when current or potential competitors are unable to duplicate the benefits of a value-creating strategy implemented by a specific company, it means that this specific company is possessing a *sustained* competitive advantage over its competitors. A sustained competitive advantage can be achieved by implementing strategies that exploit the internal strengths of a company through responding to environmental opportunities, while at the same time neutralizing external threats and avoiding internal weaknesses (Barney, 1991, p.99).

A company can possess two basic types of competitive advantages: cost leadership and differentiation (Figure 5; (Porter, 2020)). These two types of competitive advantage led to three *generic strategies*: cost leadership, differentiation, and focus (Porter, 2020). In a cost leadership

strategy, a company is planning to become the low-cost leader in its industry sector. The logic behind a cost leadership strategy implies that a company should achieve a parity regarding differentiation relative to its competitors to be an above-average performer (Porter, 2020).

In a differentiation strategy, a company is planning to become unique in its industry by selecting dimensions other than cost (e.g., quality) that many customers in an industry perceive as important, and uniquely attempt to differentiate itself along these dimensions; hence, it is rewarded for its uniqueness with a premium price (Porter, 2020). In a focus strategy, a company is planning to focus on only one or a few segments within an industry sector. A focus strategy has two variants: cost focus or differentiation focus. In the first strategy, a company seeks a cost advantage in its target segment while in the second strategy, a company seeks differentiation in its target segment. Hence, a company can attempt to offer lower cost or differentiate itself in one or more specific segments (Porter, 2020). In all three generic strategies presented, the means for achieving them are specific to each industry sector.

		COMPETITIVE ADVANTAGE	
		Lower Cost	Differentiation
COMPETITIVE SCOPE	Broad Target	Cost Leadership Strategy	Differentiation Strategy
	Narrow Target	Cost Focus Strategy	Differentiation Focus Strategy

Figure 5 Competitive advantage (adapted from Porter, 2020 p.12)

Christopher (2016) states that the foundations for success can be easily explained through the “Three Cs” model (Figure 6). The model shows that the source of competitive advantage is found firstly in the ability of a company to differentiate itself positively from its competitors, and secondly by operating at a lower cost and at a greater profit (Christopher, 2016).

The source of the advantage is found in the ability to differentiate from the competition regarding products and customer service (value advantage), and in the ability to operate at a lower cost with fewer resources (cost advantage); the goal is therefore to achieve a superior customer value at a lower cost (Christopher, 2016). A cost advantage originates not only from volume and economies of scale, but also through decisions related to supply chain; logistic costs might represent for some industries a substantial percentage of the total cost, which allows a company to considerably reduce cost by essentially re-engineering logistic processes (Christopher, 2016). A value advantage can be orchestrated through service excellence; nowadays, customers are looking for superior responsiveness and reliability, which includes reduced lead-times, just-in-time (JIT) delivery and value-added services (Christopher, 2016; Jüttner *et al.*, 2007).

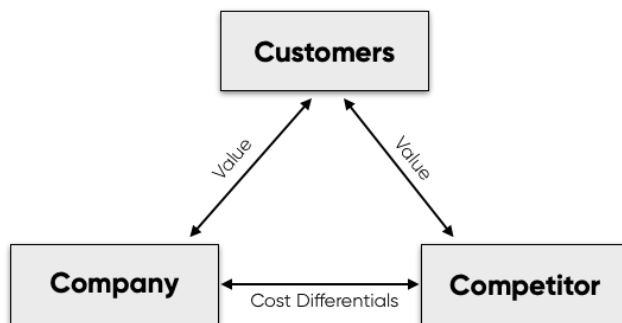


Figure 6 Competitive advantage, “Three Cs” (adapted from Christopher, 2016 p.4)

Successful companies will often seek to achieve a competitive advantage based upon both a cost advantage and a value advantage (Christopher, 2016; Porter, 1993). In conclusion, the competitive advantage implies the creation of an organization that has a unique advantage over the competitors (Barney, 1991).

3 Research methodology

In this chapter, the methodology of the research is presented. First, the research process is explained, including a clarification on the different studies conducted and their connection with the appended papers. Second, the different research strategies are described, including all information related to collecting and analyzing data. Finally, the assessment of quality related to all phases of the research process is presented, including all the quality criteria adopted and the motives for research strategies selected.

3.1 Research process

The research presented in this thesis has been carried out in two steps. The first part of the overall research process is summarized and presented in a licentiate thesis (Sansone, 2018). The second part is summarized and presented in this doctoral thesis. The purpose of this research is **to investigate critical operations capabilities and how they contribute to a competitive advantage in a high-cost environment**. Accordingly, two research questions were formulated (Figure 7). The answers to the research questions were obtained through three studies. The results of the three studies were presented in the six appended papers (Figure 7).

Study I aimed to derive critical operations capabilities for competitive manufacturing discussed in the literature. This study helped to answer the first research question and to give a state of the art of the critical operations capabilities presented in the literature. A systematic literature review was conducted and updated throughout the process to gain current knowledge on critical operations capabilities.

Study II aimed to investigate critical operations capabilities in a high-cost environment from the perspective of large and medium enterprises (LME) perspective. This study helped to answer the first and the second research questions. Two multiple case studies and a focus group were conducted with large manufacturing companies located in Sweden. This study helped shed light on the critical operations capabilities in a high-cost environment and on the competitive advantage reached by large manufacturing companies in this context.

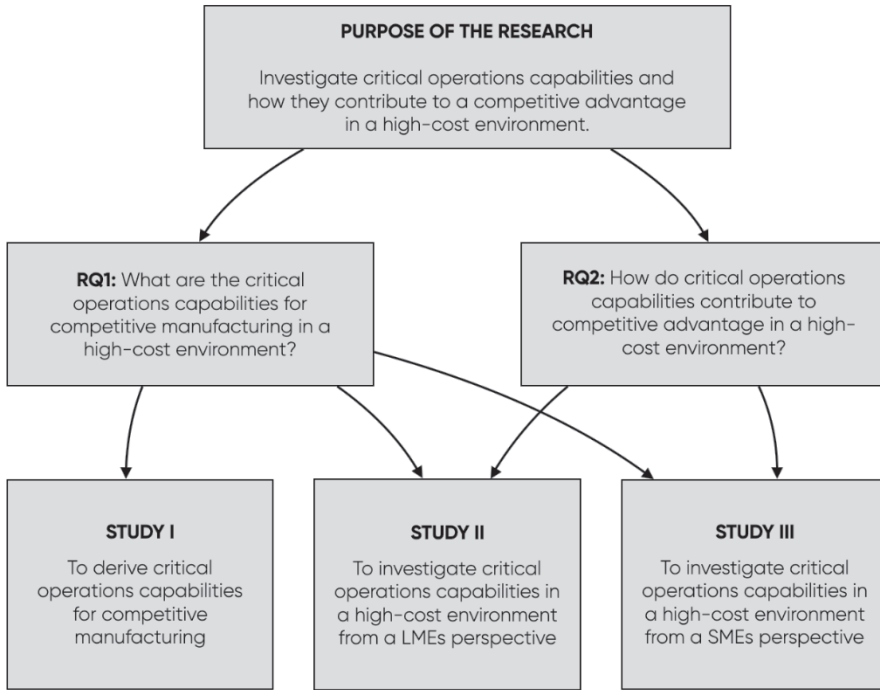


Figure 7 Purpose, research questions and studies conducted

Study III aimed to investigate critical operations capabilities in a high-cost environment from a small and medium enterprise (SME) perspective. This study helped to answer the first and second research questions. One multiple case study was conducted including small and medium manufacturing companies located in Sweden. This study helped gain a better perspective on small competitive manufacturing companies and how they compete in a high-cost environment, with a focus on the critical operations capabilities that they develop and the operations strategies implemented to reach a competitive advantage.

The combination of the three different studies provided knowledge on competitive manufacturing companies in a high-cost environment and the critical operations capabilities in this specific environment, answering the two research questions and fulfilling the purpose of the research.

3.2 Research strategies

The three studies were conducted through different steps. Each step corresponds to each paper appended. The connections between the studies and papers are shown in Figure 8.

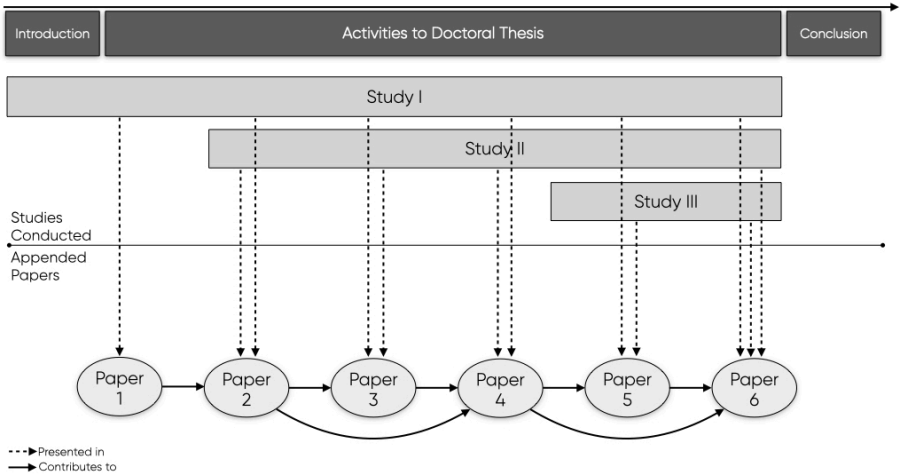


Figure 8 Research process

The first step of the research process is presented in Paper 1. To gain an overview on the research topic, a systematic literature review was conducted. The goal of the systematic literature review was to generate a conceptual framework of critical operations capabilities. The core idea of conducting a systematic literature review rested on the belief of establishing a procedure for identifying, selecting, and reviewing literature that is relevant to the research purpose and research topic (Ashby *et al.*, 2012).

The second step of the research process is presented in Paper 2. After the critical operations capabilities were identified in the literature and presented in Paper 1, the critical operations capabilities were investigated further in a high-cost environment. Hence, a multiple case study including large Swedish manufacturing companies was conducted.

The third step of the research process is presented in Paper 3. Between Paper 1, Paper 2 and Paper 3, there is a time frame of three years in

which the research was continuously shaped and refined. The systematic literature review conducted during 2015 and accepted for publication during 2016 (see Paper 1) needed to be updated and revised. A continuous update on operations capabilities was required to embrace the fast-changing competitive environment faced by manufacturing companies. The literature review was therefore revised in 2018/2019 and used as a starting point for Paper 3. It was then fundamental to contextualize the findings and evaluate them in the specific high-cost environment. Hence, the relevance of the operations capabilities derived from the literature were evaluated through a focus group. The output of Paper 3 became the input for the fourth step (Paper 4) of the research process.

The fourth step of the research process is presented in Paper 4. In the fourth step, there was the need to investigate the research topic more in-depth through the involvement of different manufacturing companies that could give further insights on the research topic. Hence, the framework proposed in Paper 3 was used as an input for the multiple case study conducted and presented in Paper 4. Through the implementation of this multiple case study, it was possible to focus on different cases within the same high-cost context by identifying similarities and differences across the cases.

The fifth step of the research process is presented in Paper 5. The idea was to investigate the research topic through the multiple case study, as done in Paper 4. However, since previous multiple case studies solely involved large companies, it was important to reach a broader perspective and include small and medium manufacturing companies. This allowed for the investigation of the same research topic by adopting different perspectives. Indeed, Paper 5 focused on understanding critical operations capabilities in high-cost environments and how small manufacturing companies reach a competitive advantage in this specific context.

The sixth step of the research process is presented in Paper 6. The idea was to include data collected from both small and large manufacturing companies and to identify challenges and solutions for competitive manufacturing in a high-cost environment. Overall, this step generated more knowledge and understanding concerning how manufacturing companies achieve a competitive advantage by comparing

manufacturing companies with different sizes and operating in different industries. Moreover, it allowed for the identification of the challenges faced by these companies and the solutions implemented to meet those challenges.

3.2.1 Study I

3.2.1.1 Systematic literature review

The core purpose of the systematic literature review was to establish a protocol for identifying, selecting, and reviewing literature that is relevant to the specific purpose (Ashby *et al.*, 2012). The search of papers was conducted during two timeframes (Table 2). The first timeframe included all articles published until 2015, with the results presented in Paper 1. The second timeframe included all articles published until 2019; the results were used to build the theoretical framework in Papers 2, 3, 4, 5, and 6.

Table 2 Characteristics of systematic literature reviews

	Operations capabilities 1.0	Operations capabilities 2.0
<i>Presented in</i>	Paper 1	Paper 2, Paper 3, Paper 4, Paper 5, Paper 6
<i>Goal</i>	To derive critical operations capabilities for competitive manufacturing	To derive critical operations capabilities for competitive manufacturing
<i>Search concepts</i>	'operations strategy', 'competitive priorities' and 'competitive capabilities'	'operations strategy', 'competitive priorities' and 'competitive capabilities'
<i>Database</i>	Scopus	Scopus
<i>Search date</i>	2015-02-15	2019-01-31
<i>Search period</i>	Until 2015	Until 2019
<i>Initial sample</i>	2089	2520
<i>Inclusion criteria</i>	English language journal papers that address critical capabilities for competitive manufacturing	English language journal papers that address critical capabilities for competitive manufacturing
<i>Final sample</i>	157	187
<i>Analysis included</i>	Dimensions, Capabilities	Dimensions, Capabilities, Environment

The database used to search the papers was Scopus. The papers were searched based on different keywords which were combined through a Boolean logic. For the review on operations capabilities, the three main concept terms were: “operations strategy”, “competitive priorities” and “competitive capabilities”. Two screening processes were implemented to narrow down the sample of papers. The first screening process

consisted in the revision of the abstract of the paper. The second screening process consisted in the revision of the entire paper. The papers included in the final sample were analyzed through a descriptive analysis and content analysis. The descriptive analysis gave an overview of the patterns and characteristics of the final sample, including distribution of papers across time and main journals, and distribution of applied research methodologies. The content analysis examined the content of the papers, including the interpretation of underlying meaning of terms and arguments. In the review named “operations capabilities 1.0”, the papers were categorized according to the operations capabilities derived from the material under examination. In the review named “operations capabilities 2.0”, the papers were also categorized based on the two different environments of high-cost and low-cost, depending on which environment was taken into consideration in the different papers. All relevant information was inserted into a spreadsheet, yielding an extensive outline of operations capabilities as extrapolated from the literature.

3.2.2 Study II

3.2.2.1 Multiple case study A

An overview on the multiple case study conducted in Study II is presented in Table 3. The benefits of multiple case study research are related to the possibility of focusing on different cases, retaining a holistic and real-world perspective, and identifying similarities and differences across the cases (Yin, 2017).

Table 3 Characteristics of the multiple case study A

Multiple case study A	
<i>Presented in</i>	Paper 2, Paper 3, Paper 4
<i>Unit of analysis</i>	Realized operations capabilities
<i>Companies selected</i>	Five Swedish manufacturing companies (Company A, B, C, D, E)
<i>Sampling</i>	Theoretical sampling
<i>Data Collection</i>	Semi-structured interviews, Workshops, observations, documents
<i>Data Analysis</i>	Qualitative data analysis

In multiple case study A, the data collection included 51 semi-structured interviews and four workshops. The interviews were conducted with representatives from the top and middle management at

each company included in the research. The focus of the interviews was on operations strategy, operations capabilities, and improvement strategies and work in the company (see Appendix 1). The workshops were used as tools to present the research but also to give an overview on different topics throughout the research. An overview on manufacturing companies selected for multiple case study A is provided in Table 4.

Table 4 Overview of companies selected for multiple case study A (from Paper 3 and Paper 4)

	Company A	Company B	Company C	Company D	Company E
<i>Location</i>	Sweden	Sweden	Sweden	Sweden	Sweden
<i>Market</i>	Global	Global	Global	Global	Global
<i>Product</i>	Telecom	Laundry	Vehicle	Packaging	Office
<i>Turnover (approx.)</i>	100.000MSEK	1.500 MSEK	1.000 MSEK	1.500 MSEK	500 MSEK
<i>Employees (approx.) (Sweden – 2020)</i>	15.000	500	500	300	200

The data analysis was based on the link between data collected and the operations capabilities identified in the literature. It included a within-case analysis and a cross-case analysis. The interviews were recorded and transcribed, and relevant information was extracted and included in a case study description. The information was also categorized based on the different dimensions and capabilities identified in the literature; this approach helped gain an overview for each case company. The cross-case analysis helped to identify patterns, commonalities and differences between the theory and the empirical data. The analysis of the data was conducted during different time frames as it was guided by feedback from researchers and practitioners over more than two years. In parallel, the literature review was also updated and a new analysis of the data was made, allowing for updates to the operations capabilities and findings of the multiple case study.

3.2.2.2 Focus group

The objective of the focus group was to explicitly use a group interaction to gather data and insights that would otherwise be less accessible without the element of collaboration enabled in a group (Marshall and Rossman, 2014). In the focus group, the data was collected through a questionnaire and a group discussion. Five Swedish

manufacturing companies were involved with a total of 14 participants in the focus group session. During the session, a questionnaire was used to evaluate the operations capabilities derived from the systematic literature review. The questionnaire included 21 questions, which were linked to the 21 operations capabilities included in the framework. Each participant ranked the operations capabilities using an interval scale from 1 to 5. After the questionnaire was collected, a group discussion was led by two moderators around the 21 operations capabilities.

In the focus group, the data analysis included two phases. The first phase concerned a quantitative analysis of the data collected through the questionnaire. The data was recorded into a spreadsheet that helped to calculate the mean values and standard deviations for each dimension and operations capability. The second phase involved a qualitative analysis of the group discussion. One of the two moderators of the discussion took notes during the discussion. The notes were then analyzed, and relevant information were categorized within the main categories (referring to dimensions) and subcategories (referring to capabilities). The findings were analyzed to gain a better understanding and overview on the operations capabilities, and additional follow-up meetings were implemented with the participants to present the findings.

3.2.2.3 Multiple case study B

An overview on the multiple case study B is presented in Table 5.

Table 5 Characteristics of the multiple case study B

Multiple case study B	
<i>Presented in</i>	Paper 6
<i>Unit of analysis</i>	Realized operations capabilities from the perspective of importance, performance and improvement
<i>Companies selected</i>	Four Swedish manufacturing companies (Company L, M, N)
<i>Sampling</i>	Theoretical sampling
<i>Data Collection</i>	Questionnaire, Workshops
<i>Data Analysis</i>	Quantitative data analysis, Qualitative data analysis

In multiple case study B, the data collection included workshops and a questionnaire. In total, two workshops were conducted. The first one introduced the research to some representatives of the companies selected, while the second one presented the results of the

questionnaire. The questionnaire was emailed to 115 representatives within three Swedish manufacturing companies. The respondents to the questionnaire included managers from the senior management in each company. The questionnaire included three sections (see Appendix 2). The first section concerned the evaluation of the perceived importance for each operations capability; the second section concerned the evaluation of the perceived performance for each operations capability; and the third section included the evaluation of the perceived improvement areas. An overview on manufacturing companies selected for multiple case study B is provided in Table 6.

Table 6 Overview of companies selected for multiple case study B (from Paper 6)

	Company L	Company M	Company N
<i>Location</i>	Sweden	Sweden	Sweden
<i>Market</i>	Europe	North America, Europe	Europe
<i>Product</i>	Textile	Aerospace	Energy
<i>Turnover (approx.)</i>	500 MSEK	12.000 MSEK	10.000 MSEK
<i>Employees (approx.) (Sweden – 2020)</i>	200	2000	2500

Among 115 representatives, 89 representatives responded to the questionnaire. After the cleaning process, 81 effective questionnaires were analyzed. Two types of data analysis were conducted: context analysis and descriptive analysis. The context analysis gave an overview on each company, investigating their manufacturing strategies, manufacturing mode, supplier base, product range and product complexity. The descriptive analysis gave an overview on the results from the questionnaire, focusing on importance, performance and improvement areas for each company.

3.2.3 Study III

3.2.3.1 Multiple case study C

An overview on the multiple case study C is presented in Table 7. In multiple case study C, the data collection included 13 semi-structured interviews and additional documents provided by the companies. The interviews were conducted with managers from the top and middle management at each company included in the multiple case study. The topics discussed during the interviews touched on different areas such

as competitive advantage, operations strategy, operations capabilities, challenges in manufacturing, performance and improvement areas (see Appendix 3).

Table 7 Characteristics of the multiple case study C

Multiple case study C	
<i>Presented in</i>	Paper 5, Paper 6
<i>Unit of analysis</i>	Realized operations capabilities
<i>Companies selected</i>	Four Swedish manufacturing companies (Company F, G, H, I)
<i>Sampling</i>	Theoretical sampling
<i>Data Collection</i>	Semi-structured interviews, Documents
<i>Data Analysis</i>	Qualitative data analysis

As the data was collected during the Covid-19 pandemic, the interviews were conducted online. The companies also provided also extra documents such as pictures and videos about the production systems. For some companies selected, virtual meetings were organized to gain a better understanding of the production process. The workshops were conducted online and used as tools to present the research but also to give an overview on the findings of the research. An overview on manufacturing companies selected for multiple case study C is provided in Table 8.

Table 8 Overview of companies selected for multiple case study C (from Paper 5 and Paper 6)

	Company F	Company G	Company H	Company I
<i>Location</i>	Sweden	Sweden	Sweden	Sweden
<i>Market</i>	Europe	Europe	Global	Europe
<i>Industry</i>	Wood	Wood	Plastic	Medical
<i>Turnover (approx.)</i>	70 MSEK	35 MSEK	300 MSEK	300 MSEK
<i>Employees (approx.) (Sweden – 2020)</i>	40	20	45	85

The interviews were recorded and transcribed, and relevant information was extracted and included in a case study description. Moreover, the data analysis was based on the different topics discussed and the information collected was categorized into five main sections: competitive advantage and strategy, priorities and capabilities, performance, production system, and challenges and improvements. Finally, a cross-case analysis was conducted. The cross-case analysis

helped to identified patterns, commonalities and differences between the theory and the empirical data.

3.3 Research quality

Validity and reliability are important criteria in establishing and assessing the quality of research (Bell *et al.*, 2018). In Table 9, these criteria are related to the research strategies adopted. *Internal validity* refers to the conclusiveness of the results (Williamson, 2002). *External validity* refers to the generalizability of the research findings (Williamson, 2002), meaning that the results are valid in a similar setting beyond the studied objects (Karlsson, 2009). *Reliability* refers to obtaining consistent, stable research results with the ability to replicate them (Williamson, 2002). It is important to ensure the replication of the research by providing the reader with all information regarding how the research was conducted. In Table 9, the quality criteria selected (internal validity, external validity, and reliability) are related to the research strategies adopted. Several techniques have been applied to ensure research quality; in Table 9, they are summarized based on the research strategies implemented.

Table 9 Quality criteria in relation to the research strategies

Research strategies	Internal validity	External validity	Reliability
<i>Systematic literature review</i>	Bias reduction, investigator triangulation, pre-study on the context,	Conclusions based on the initial selection of more than 2000 papers within the operations strategy area.	Structured process, detailed methodological description, explanation of different phases in planning and implementing the study.
<i>Multiple case study A</i>	Bias reduction, source triangulation, investigator triangulation	Validation with updated and relevant literature, presentation of results to companies and international conferences, follow-up findings, details about number of respondents, locations, date, position, details documents reviewed, and data collection and analysis methods incorporated	Structured process, case study description, guideline for the semi-structure interviews.

<i>Focus group</i>	Bias reduction, source triangulation, investigator triangulation, method triangulation, anonymizing responses, presenting analysis and discussion for feedback	Validation with updated and relevant literature, presentation of results to companies and international conferences, follow-up findings, details about number of respondents, locations, date, position, details documents reviewed, and data collection and analysis methods incorporated	Structured process, case study description, guideline for the semi-structure interviews,
<i>Multiple case study B</i>	Bias reduction, source triangulation, investigator triangulation, method triangulation, questionnaire based on literature review, anonymizing responses, sending final analysis and discussion for feedbacks	Validation with updated and relevant literature, presentation of results to companies and international conferences, follow-up findings, details about number of respondents, locations, date, position, details documents reviewed, and data collection and analysis methods incorporated	Structured process, case study description, guideline for the semi-structure interviews,
<i>Multiple case study C</i>	Bias reduction, source triangulation, investigator triangulation, method triangulation, interview guide based on literature review, tailoring interview guide per respondent, providing summary of interviews for feedbacks, sending final analysis and discussion for feedbacks	Validation with updated and relevant literature, presentation of results to companies and international conferences, follow-up findings, details about number of respondents, locations, date, position, details documents reviewed, and data collection and analysis methods incorporated.	Structured process, case study description, guideline for the semi-structure interviews,

3.4 Motives for research strategies selected

This research is based on different research strategies that include a systematic literature review, a focus group, and multiple case studies. These different research strategies have been selected to answer the two research questions and fulfill the purpose of the research. The reason for adopting different research strategies is to achieve both method and source triangulations (Karlsson, 2009), which strengthen the internal validity of the research and the consistency of the findings.

The systematic literature review was selected to answer the first research question and build a framework of operations capabilities derived from the literature. The topic of operations capabilities within the field of operations strategy and operations management has a robust foundation in the literature, as many researchers have contributed to the field of operations capabilities and operations strategy. Adopting a systematic literature review as the first strategy in this research allowed for the analysis of the work conducted by previous researchers and the use of it as a starting point for this research. To manage the extensive number of articles included in the initial sample, different inclusion and exclusion criteria were adopted, which helped identify, select, and review literature relevant to answering the research questions (Ashby *et al.*, 2012). Moreover, the literature review was conducted in a systematic way to ensure transparency and reproducibility of its procedure, as suggested by Crossan and Apaydin, (2009). The three main concept terms used in the systematic literature review were: “operations strategy”, “competitive priorities” and “competitive capabilities”. To include all the relevant papers in the sample, different synonyms were identified and used as search terms that were combined through Boolean logic. The synonyms were identified through a prior review of the most influential papers in the field and a continuous discussion between different investigators, allowing for the definition of the most suitable search terms for this research.

The focus group strategy was selected to gain a practical and managerial perspective on the operations capabilities identified through the systematic literature review. The data was collected through a questionnaire and a group discussion. Combining both qualitative and quantitative data collection and analysis added value and credibility to the results (Barbour and Kitzinger, 1998). The goal of adopting a focus group strategy was based on using group interaction to obtain perceptions on a defined topic and to gather data and insights that would be less accessible without the collaboration in a group (Marshall and Rossman, 2014). The operations capabilities identified through the systematic literature review were evaluated and discussed through the focus group. The creation of a small group in which to evaluate and discuss the operations capabilities previously identified allowed for substantial interaction and a high response rate concerning the questionnaire.

The multiple case study was selected to offset the limitations of the other chosen research strategies (systematic literature review and focus group). The multiple case study allowed for a more in-depth investigation into the operations capabilities in the specific context of a high-cost environment. In total, three multiple case studies were conducted that included twelve Swedish manufacturing companies with varying characteristics such as size and product. The multiple case study provided rich data concerning operations capabilities in a high-cost environment, their implementation, plus the challenges and solutions required to develop those capabilities. To manage the extensive amount of data, the data collection was thoroughly prepared by developing an interview guide for each multiple case study, in alignment with the recommendations by Karlsson (2009). The multiple case studies added to previous knowledge from the field of operations management by investigating operations capabilities within the Swedish manufacturing context. To ensure data sources triangulation (Williamson, 2002), a variety of techniques were used to collect data. In multiple case study A, the data collection was based on semi-structured interviews, documents, workshops and observation. In multiple case study B, the data collection was based on questionnaires and workshops. In multiple case study C, the data collection was based on semi-structured interviews and documents provided by the case companies.

4 Summary of appended papers

In this chapter, the appended papers in this thesis are introduced and a summary of the papers' findings is given. Additionally, an overview of the connection between each publication and the research questions is presented. The combination of the appended papers helps to reach the answer to the research questions discussed.

4.1 Introduction to the appended papers

As described in the previous chapter, the six appended papers represent the six steps taken during the overall research process. The combination of all six papers provides answers to the two research questions and contributes to fulfilling the research purpose through different emphases (Figure 9).

		APPENDED PAPERS					
		PAPER 1	PAPER 2	PAPER 3	PAPER 4	PAPER 5	PAPER 6
RESEARCH QUESTIONS	RQ1	✓	✓	✓	✓	✓	✓
	RQ2	✓	✓	✓	✓	✓	✓

Figure 9 Connection of the appended papers to the research questions

The first research question mainly focuses on understanding the critical operations capabilities in a high-cost environment. All six papers combined to answer the question; however, Papers 1-4 had a higher contribution to RQ1 (marked with darker grey in Figure 8). The second research question mainly focused on understanding how manufacturing companies achieve a competitive advantage in a high-cost environment. This was achieved through the combination of all six papers attached. However, Papers 3-6 had a higher contribution to RQ2 (marked with darker grey in Figure 8).

A combination of the findings from all six papers attached contributed to an understanding of operations capabilities, operations strategy, and competitive manufacturing in a high-cost environment.

Paper 1 provides an overview on operations capabilities; it contributes to current knowledge by building a framework of operations capabilities including seven dimensions and twenty-one capabilities.

Paper 2 investigates the capabilities identified in Paper 1, looking at them within a high-cost environment context and from the perspective of two manufacturing companies. Paper 2 confirmed the validity of the framework of operations capabilities in a high-cost environment and identifies new capabilities such as flow efficiency and employee flexibility.

Paper 3 provides an updated version of the literature review presented in Paper 1 and evaluates the operations capabilities in a high-cost environment through a focus group. The findings revealed that all dimensions and capabilities identified in the literature are critical in a high-cost environment with different emphasis. Quality-related capabilities are the most important in a high-cost environment, followed by time and cost.

Paper 4 is built on the literature review presented in Paper 3 and it investigates the operations capabilities in-depth in a high-cost environment, including five manufacturing companies. The findings reveal that all dimensions and capabilities included in the framework are considered critical, and additional capabilities can be identified: service quality, supplier dependability, supplier flexibility, supply chain innovation and supply chain sustainability.

Paper 5 provides an understanding on operations capabilities in a high-cost environment from a SME's perspective. Paper 5 highlights how manufacturing SMEs in a high-cost environment develop critical operations capabilities in their productions. SMEs emphasize the development of operations capabilities related to innovation, flexibility and sustainability.

Paper 6 provides an understanding of the challenges faced by both large and small manufacturing companies in a high-cost environment, and reviews the solutions implemented to meet those challenges. The challenges and solutions are categorized based on the six dimensions of operations capabilities as identified, evaluated and investigated in the previous papers.

4.2 Paper 1

The purpose of this paper was to investigate systematically the topic of operations capabilities within the operations strategy area. Many researchers in the operations management field have examined the concept of operations strategy, competitive priorities and operations capabilities. However, there is a lack of consensus on competitive priorities and operations capabilities (Koufteros *et al.*, 2002a). This paper responds to the call for more updated knowledge on operations capabilities and presents a framework on operations capabilities through a systematic literature review. The systematic literature review was conducted during March 2015, and the final sample included papers published between 1991 and 2015. The basic body of identified literature comprised 157 papers.

The descriptive analysis revealed that there is a connection between the unpredictable, fast-changing environment and companies' interest in overcoming dramatic changes in the global economy through the identification and development of operations capabilities. Focusing on implementing critical operations capabilities might be considered a way out for companies to manage an economic crisis such as the 1990-91 or the 2000s recession. Among the 157 papers, there are many papers that adopt surveys as the main research strategy, which highlights a more explanatory rather than explorative research approach. As stated by Alsmadi *et al.* (2011), competitive priorities and operations capabilities evolve over time, implying a strong need to continuously update the knowledge on the research topic. This paper aimed to analyze the current literature and reconsider theories and concepts that would better reflect the current business environment. Moreover, the descriptive analysis revealed that, despite the differences in terminology, there is consensus in the literature that the main dimensions are: cost, quality, delivery, flexibility, service, innovation and environment. Among these, five (cost, quality, delivery, flexibility, service) have long been recognized in the literature, while two (innovation, environment) are merely beginning to gain recognition (Paper 1). In total, twenty-one critical operations capabilities were identified. The identification of innovation and environment as additional competitive dimensions resulted in the inclusion of six more operations capabilities. Innovation included the capabilities of "new product", "new technology", "new service", and "new market". Environment included "environmentally

friendly processes” and “environmentally friendly products” (Paper 1). The content analysis revealed that there is a lack of consensus among researchers about definitions and terminologies used when describing operations capabilities. One example is given by the capability of “dependability”, which is sometimes defined as part of quality, and other times is defined as part of delivery or time dimension. The delivery dimension can also be defined as time dimension; many terms are used interchangeably.

4.3 Paper 2

The purpose of this paper was to analyze critical operations capabilities in a high-cost environment. The purpose was operationalized in two research questions that aimed to identify the critical operations capabilities in a high-cost environment and their dimensions. To maintain a long-term competitive advantage, companies need to develop operations capabilities (Ward *et al.*, 1998). This development supports the achievement of the highest level of performance along dimensions such as cost, quality, delivery, and flexibility (Sarmiento *et al.*, 2007). Considering the manufacturing relocation process from high to low-cost environments that has been taking place during the previous decades (Jensen and Pedersen, 2011), it is of particular interest to conduct studies regarding the formulation of winning operations strategy in a high-cost environment.

The findings confirmed the validity of the framework of operations capabilities proposed in Paper 1 and its contribution in a high-cost environment. The main dimensions of operations capabilities discussed were cost, quality, delivery, flexibility, service, innovation and environment (Paper 2) (Sansone *et al.*, 2017b). These dimensions included one or more capabilities each, for a total of twenty-one operations capabilities. The findings also revealed that two additional operations capabilities were present in the case studies but not in the initial framework. The first capability was called “flow efficiency” and it was included in the cost dimension. During the interviews, this capability was mentioned and discussed by the interviewers and related to the concept of resource efficiency and productivity in the lean practice. The second capability was called “employee flexibility” and it was included in the flexibility dimension. During the interviews, this capability was mentioned and discussed by the interviewers and related

to the concept of high skilled employees as part of an effective learning organization. The main pillar of this study was the framework of operations capabilities proposed by Sansone *et al.* (2017a) (Paper 1). Thus, the focus of the research process was the analysis of this framework in the specific context of a high-cost environment.

4.4 Paper 3

The purpose of this paper was to evaluate critical operations capabilities in a high-cost environment. In the literature, there is limited theoretical and empirical support regarding how companies located in a high-cost environment should compete, and what the winning operations strategies are (Brandon-Jones *et al.*, 2017; Ketokivi *et al.*, 2017). To understand how companies in this specific environment reach a competitive advantage, it is first necessary to understand the critical operations capabilities for companies located in this specific environment (Sansone *et al.*, 2017a) (Paper 1). This paper aimed to assess, rank and analyze the critical operations capabilities in a high-cost environment.

This research topic is dynamic and changes over time. Compared to Paper 1 and Paper 2, the starting point of Paper 3 was an updated version of the literature review on operations capabilities, which was updated and modified based on feedbacks from researchers and practitioners gathered over three years. This explains the different terminologies used in the framework of operations capabilities adopted in Paper 3 (Sansone *et al.*, 2020a). The findings revealed that all the dimensions received a mean value higher than 3, as shown in Table 10. However, the results of Paper 3 also showed that different emphasis was placed on the various dimensions and capabilities. The research showed that the most important dimension is quality, which received the highest score of all the dimensions presented. Companies in a high-cost environment focus on producing high-quality products before addressing cost issues. Manufacturing companies located in high-cost environments tend to emphasize process quality, product quality and delivery dependability (Paper 3). An additional capability was introduced and discussed by the participants in the discussion session ('process efficiency'), which was not identified in the literature review (Paper 3). Tay (2016) defined it as the ability to optimize the movement of products through all processes and operations. Hence, process

efficiency measures how well a flow unit moves through all the processes across operations and the supply chain. In the traditional way of looking at the flexibility dimension, the emphasis is often placed upon capabilities such as volume flexibility, production-mix flexibility or customization (Bolivar Cruz and Espino Rodríguez, 2008).

Table 10 Evaluation of the operations capabilities from Paper 3

Dimension	Capability	Mean (\bar{x})	Standard deviation (σ)
Quality	Process quality	4,64	0,50
Quality	Product quality	4,36	0,84
Quality	Delivery dependability	4,29	0,99
Cost	Cost efficiency	4,29	0,99
Time	Time to market	4,07	0,83
Innovation	Product innovation	4,07	0,83
Time	Delivery time	3,93	0,83
Flexibility	Labor flexibility	3,79	0,80
Innovation	Technology innovation	3,79	1,19
Flexibility	Product flexibility	3,71	0,83
Flexibility	Product line flexibility	3,71	0,73
Flexibility	Production mix flexibility	3,71	0,73
Innovation	Process innovation	3,71	0,73
Cost	Resource efficiency	3,64	1,08
Innovation	Service innovation	3,57	0,94
Quality	Brand quality	3,50	1,09
Flexibility	Delivery flexibility	3,36	1,08
Innovation	Market innovation	3,36	0,84
Flexibility	Volume flexibility	3,29	0,83
Sustainability	Product sustainability	3,29	0,99
Sustainability	Process sustainability	3,00	0,55

In Paper 3, labor flexibility is also emphasized. Labor flexibility as part of effective organizational learning has been considered fundamental to successfully dealing with environmental turbulence (Camps *et al.*, 2016). In a high-cost environment, manufacturing companies tend to emphasize the development of capabilities related to innovation. Significant attention has been paid to product and technology innovation. Innovation is a market qualifier and is considered essential for achieving a competitive advantage (Ferrer *et al.*, 2011) even if not typically included among the four basic dimensions (Avella *et al.*, 2010; Hallgren, 2007). Leading companies in a high-cost environment need to continuously improve and identify new products and technologies that allow them to be innovative (Ferrer *et al.*, 2011). From a high-cost-environment perspective, there is an interest in developing operations capabilities related to sustainability. Companies in such environments tend to focus on manufacturing sustainable products. However, the literature presents a gap concerning the development of these

capabilities in a high-cost environment. This could be related to the extreme complexity of these capabilities and perhaps to the scarcity of resources available (Longoni and Cagliano, 2015).

4.5 Paper 4

This paper aims to investigate critical operations capabilities in a high-cost environment. As identified in Paper 1, a limited amount of research has implemented case study research to further investigate operations capabilities. Manufacturing companies in a high-cost environment have been facing great difficulties managing competition from companies locating in low-cost environments, especially considering the important shift of manufacturing from high-cost to low-cost environments that characterizes the current business market (Gurtu *et al.*, 2019; Kerkhoff *et al.*, 2017). This paper aimed to fill these research gaps by presenting an in-depth investigation of operations capabilities from a high-cost environment perspective. The research was built on the framework developed and presented in Paper 3, which gave different shape to the findings presented as compared to Paper 2. After an updated literature review was conducted, the data collected in Paper 2 was also updated, re-analyzed and then presented in Paper 4.

The findings in Paper 4 revealed that, despite the four basic dimensions discussed in the literature of cost, quality, time, and flexibility (Avella *et al.*, 2001; Bolivar Cruz and Espino Rodríguez, 2008; Hallgren, 2007), companies in a high-cost environment also develop capabilities related to innovation and sustainability. Table 11 provides a framework of operations capabilities investigated in Paper 4; the capabilities in bold are those additional capabilities identified from the empirical findings. Regarding the flexibility dimension, it appears that companies in a high-cost environment aim to have flexible employees who perform better under conditions of high turbulence. There is a strong emphasis on labor flexibility. Concerning the quality dimension, a new capability was identified within the case studies, “service quality”. One path to differentiation, identified in the empirical data, is to be service-minded. Offering a good service to the customer can be considered as a competitive advantage to the company (Bolivar Cruz and Espino Rodríguez, 2008).

Table 11 Critical operations capabilities based on empirical findings from Paper 4

Dimension	Capability	Definition
<i>Cost</i>	Cost efficiency	The ability to provide products at low cost
	Resource efficiency	The ability to maximize the utilization of process resources (machinery and human)
	Process efficiency	The ability to maximize the process output
<i>Quality</i>	Product quality	The ability to provide durable, high-performance products
	Service quality	The ability to provide high-performance services
	Process quality	The ability to provide products/ services with consistent quality
	Delivery dependability	The ability to deliver on time
	Brand quality	The ability to build a strong and positive company image
	Supplier dependability	The ability to select and develop reliable suppliers
	<i>Time</i>	Delivery time
	Time to market	The ability to have short time frame from product development to market introduction
<i>Flexibility</i>	Product flexibility	The ability to customize products based on customer requirements
	Product line flexibility	The ability to provide a wide range of products with different features
	Volume flexibility	The ability to respond to changes in market demand
	Production mix flexibility	The ability to change the manufacturing product mix
	Labor flexibility	The ability of employees to perform different types of tasks
	Delivery flexibility	The ability to change delivery times and quantities within the agreed upon delivery time
	Supplier flexibility	The ability to select and develop responsive suppliers
<i>Innovation</i>	Product innovation	The ability to develop and introduce new products
	Service innovation	The ability to develop and introduce new services
	Process innovation	The ability to develop and implement new processes
	Technology innovation	The ability to develop and implement new technologies
	Market innovation	The ability to find and exploit new markets and opportunities
	Supply chain innovation	The ability to develop and implement new supply chain solutions
<i>Sustainability</i>	Product sustainability	The ability to provide sustainable products
	Process sustainability	The ability to manufacture products in a sustainable manner
	Supply chain sustainability	The ability to source and deliver products in a sustainable manner

Companies in a high-cost environment seem to have a strong focus on the supply chain perspective. Four new capabilities have been identified in the case study: supplier dependability, supplier flexibility, supply chain innovation and supply chain sustainability (in bold in Table 11). The empirical data also emphasized the increased need for cooperation among partnering companies in the supply chain. The most successful companies seem to be those that have carefully linked their internal processes to external suppliers and customers in unique supply chains (Frohlich and Westbrook, 2001; Seuring and Müller, 2008). This study provides empirical evidence on critical operations capabilities in a high-cost environment and on the notion that there is an undeniable advantage in locating manufacturing in this specific context. The research stresses that issues other than cost are becoming increasingly important to creating a competitive advantage. This could also be linked to the ongoing movement of manufacturing to high-cost environments, where most of the drivers are found outside of the cost dimension, including quality, flexibility and time issues (Engström *et al.*, 2018).

4.6 Paper 5

Based on the findings of Paper 4, there are several critical capabilities to consider when manufacturing competitively and profitably in a high-cost environment, which are related to cost, quality, time, flexibility, innovation and sustainability. The findings of Paper 2, Paper 3 and Paper 4 represent mainly large manufacturing companies. However, an important challenge for manufacturing companies in high-cost environment is to organize their production systems to be sufficiently responsive at a reasonable cost (de Treville *et al.*, 2017). The literature presents several examples of how manufacturing companies organize their production systems in a high-cost environment. Improving the competitiveness of manufacturing SMEs is fundamental as they are important engines for economic growth (Thürer *et al.*, 2014). It is essential to investigate how manufacturing SMEs in a high-cost environment organize their productions to specifically develop those critical capabilities that have the highest impact on their performances (Sansone *et al.*, 2021) (Paper 5). Therefore, the purpose of this research is to investigate how manufacturing SMEs in a high-cost environment implement the critical capabilities in their production systems.

Manufacturing SMEs in a high-cost environment need to face increased costs related to the environment in which they operate. As they need to respond to high demand volatility and a short product life cycle, these companies need to be highly responsive and achieve a smooth flow of a broad range of products. Manufacturing SMEs in a high-cost environment emphasize the development of capabilities related to innovation, flexibility and sustainability (Table 12).

Table 12 Case companies characteristics from Paper 5

	Company F	Company G	Company H	Company I
<i>Dimensions of capabilities implemented</i>	Innovation, Flexibility, Sustainability	Flexibility, Sustainability, Quality	Innovation, Flexibility, Sustainability	Flexibility, Quality, Time
<i>Dimensions of most important capabilities</i>	Innovation	Quality	Innovation	Flexibility
<i>Dimensions of capabilities to improve in the future</i>	Sustainability	Sustainability	Cost	Sustainability
<i>Manufacturing processes</i>	Process and assembly operations	Process and assembly operations	Process operations	Assembly operations
<i>Human participations in the manufacturing processes</i>	Manual-Machine system	Manual - Machine system	Manual-Machine system	Manual-Machine system

These capabilities (See Table 12) allow the manufacturing SMEs to differentiate themselves from their competitors. Therefore, they invest in innovative solutions such as advanced manufacturing technologies, multipurpose equipment and information systems that improve the performances of their production systems (Paper 5). Innovation capabilities are combined with capabilities related to sustainability and flexibility to achieve better quality and optimize the production. The manufacturing processes are a combination of automated and manual operations and different digital tools, and technologies are adopted. Digitalization in the manufacturing processes allowed the case companies to reduce paperwork through the internet of things and cloud manufacturing for their internal communication, and to improve operator performance by allowing heavy tasks to be performed by machines. Moreover, the manufacturing process is improved through

the adoption of hybrid and fully electric machines that use sustainable energy. However, the findings presented in Paper 5 also revealed that those capabilities related to sustainability and cost still need to be improved in the future and they represent an important challenge for these manufacturing companies.

4.7 Paper 6

After investigating critical operations capabilities in a high-cost environment for large manufacturing companies (Paper 2, Paper 3, Paper 4) and for manufacturing SMEs (Paper 5), and the realization of these capabilities in the production systems (Paper 5), the next step was to understand the challenges faced by manufacturing companies in developing those critical operations capabilities. Hence, Paper 6 (Sansone, 2021) combines data collected from both large and SMEs companies and investigates the challenges and solutions for developing those critical operations capabilities to reach a competitive advantage. The purpose of Paper 6 is two-fold. First, this research investigates challenges for competitive manufacturing in a high-cost environment. Second, this research reviews the solutions implemented to meet those challenges.

Manufacturing companies in high-cost environments have been faced with various challenges related to volatile demand (Baines *et al.*, 2009; Demartini *et al.*, 2018), servitization (Baines *et al.*, 2009), increased automation and increased skills required from employees (Westkämper, 2014). This research derives challenges related to the six dimensions (cost, quality, time, flexibility, innovation, sustainability) for manufacturing in a high-cost environment and operations strategies for meeting those challenges. The challenges are extracted from the manufacturing companies selected and their strategy implementation, and they are classified based on the six dimensions identified by Sansone *et al.*, (2020b). Manufacturing companies in a high-cost environments face increased costs related to the environment in which they operate. Table 13 provides an overview on the challenges and solutions identified in the empirical findings.

Table 13 Challenges and solutions in relation to the six dimensions of operations capabilities summarized from Paper 6

Dimensions	Challenges for competitive manufacturing in a high-cost environment	Solutions adopted to meet the challenges
<i>Cost</i>	<p>High cost of employees;</p> <p>High energy cost;</p> <p>High transportation cost;</p> <p>High material cost;</p> <p>Optimize use of resources available;</p> <p>Improve production performances</p>	<p>Lean techniques and methods</p> <p>Continuous improvement</p>
<i>Quality</i>	<p>Ensure high quality in production process;</p> <p>Ensure employees involvement for identifying improvement areas in production;</p> <p>Ensure employees high competencies and skills;</p> <p>Produce high quality products by re-using scrap material;</p> <p>Comply with increased regulatory constraints for ensuring job safety and employees wellbeing;</p> <p>Increase life-cycle of products;</p> <p>Ensure product quality without affecting product flexibility;</p>	<p>Employees training and education</p> <p>Creating more engagement to build stronger bonds within the company and supply chain</p> <p>Build strong brand quality</p> <p>Adopting more homogenous and reliable KPIs in all the company</p> <p>Investing in technologies which reduce human errors</p> <p>Monitor manufacturing equipment performances through manufacturing intelligence solutions</p> <p>Ensure efficiency operator guidance in all production line</p>
<i>Time</i>	<p>Enable smooth collaboration within the company and throughout all the supply chain;</p> <p>Ensure fast delivery, reduce time to market;</p> <p>Automate production to ensure faster and reliable delivery;</p> <p>Logistic and transportation challenges due to manufacturing location in Sweden;</p> <p>Enable cross-functional teams to ensure higher flexibility and shorten delivery time</p>	<p>Design products with higher level of modularity</p> <p>Ensuring data visibility in all levels</p> <p>Strategic design location of warehouses and facilities</p>
<i>Flexibility</i>	<p>Enable cross-functional teams to ensure higher flexibility and shorten delivery time;</p> <p>Maintain high production mix flexibility and high volume flexibility</p>	<p>Investing in robotics and flexible automated solutions</p> <p>Design products with higher level of modularity</p> <p>Create standardized assembly line</p>

<i>Innovation</i>	<p>Identify more reliable and faster ways to communicate within the company and supply chain;</p> <p>Identify new technologies which better collaborate and interact with operators in the production line;</p> <p>Identify new ways of reuse scrap material in production;</p> <p>Identify new product designs solutions to reduce transportation cost and production cost;</p> <p>Ensure that new technologies are support by right infrastructure inside the company;</p> <p>Identify new market opportunities;</p> <p>Identify new services to improve customers experience</p>	<p>Investing in R&D and developing organization around new technologies and machines</p> <p>Strong collaboration with suppliers of robotic and automation solutions</p> <p>Create awareness on new trends and competitors</p> <p>Strong collaboration with customers to further develop the product range</p> <p>Strong collaboration with academia and research institutions</p>
<i>Sustainability</i>	<p>Increase life-cycle of products;</p> <p>Minimize scraps in production;</p> <p>Ensure sustainability in the choice of raw material, in the production process, and in the overall supply chain;</p> <p>Comply with increased demand on sustainable products and sustainable process from both government and customers;</p> <p>Ensure sustainability as part of brand quality</p>	<p>Strong collaboration with suppliers and customers</p> <p>Create awareness on new regulations and policies</p> <p>Implementing lean methods to increase resources efficiency</p> <p>Implementation of automated solutions to minimize paperwork</p> <p>Implementing digital solutions to improve sourcing decisions and implement circular economy</p>

Based on the analysis from the studied manufacturing companies, it is identified a need to justify the premium prices of their products by offering improved quality, a high level of technology, and improved innovation, while still ensuring excellent time-related capabilities by having greater control over their processes and keeping manufacturing in-house. Therefore, some of the challenges currently faced by manufacturing companies in a high-cost environment are frequently related to savings costs, shortening lead times, and increasing flexibility. Another challenge identified is related to innovation. To create extra value that will differentiate their products from their competitors, manufacturing companies in a high-cost environments depend on the development of innovative solutions and technologies that will smooth their processes and boost their competitiveness. To meet these challenges, manufacturing companies in a high-cost

environment implement differentiation strategies, focusing on higher levels of quality, innovation and time to differentiate them from the competition and justify their premium prices.

4.8 Summary of the papers' contributions

An overview of the main contributions from the appended papers, in relation to the two research questions, is provided in Table 14.

Table 14 Main contributions from the appended papers, in relation to the research questions (Paper 1 – 6)

Appended Papers	RQ1: What are the critical operations capabilities in a high-cost environment?	RQ2: How do critical operations capabilities contribute to competitive advantage in a high-cost environment?
<i>Paper 1</i>	The literature review revealed that, despite differences in terminology, there is consensus that the main dimensions can be expressed in terms of cost, quality, delivery, flexibility, service, innovation, and environment. In total, 21 operations capabilities were identified, which were categorized into the dimensions identified.	The framework presented in this paper provides a summary of operations capabilities and it sets the basis for managers and practitioners concerning the formulation of successful operations strategies. Manufacturing companies achieve a competitive advantage through the development of operations capabilities. They might develop these capabilities in a trade-off or cumulative way, they can emphasize different capabilities based on the environment and/or industry in which they operate.
<i>Paper 2</i>	The findings confirmed the validity of the framework of operations capabilities in a high-cost environment, previously developed in Paper 1. The investigation of these capabilities in a high-cost environment through a multiple case study, revealed the importance of two new capabilities: flow efficiency and employee flexibility.	Manufacturing companies in a high-cost environment achieve a competitive advantage through the development of operations capabilities related to cost, quality, delivery, flexibility, service, innovation and environment, with different emphasis. The case companies develop these capabilities in a cumulative way. Reducing the total cost in the production, while improving flow efficiency and productivity seem quite important for these companies. At the same time, a lot of emphasis is put on quality related capabilities such as performance, conformance and durability. The case companies also emphasize employee flexibility, as an ability to which employees develop skills which enable the company to pursue strategic decisions.

<i>Paper 3</i>	<p>The literature review is updated, so the framework of operations capabilities and the terms previously adopted are also updated. The 21 operations capabilities are categorized into 6 dimensions which are cost, quality, time, flexibility, innovation and sustainability. The capabilities and their dimensions are evaluated in a high-cost environment. The findings revealed that all capabilities were considered critical in a high-cost environment (all received a value of criticality higher or equal than 3). The most critical capabilities are related to quality, while the least critical are related to sustainability.</p>	<p>Manufacturing companies included in the focus group, seem to emphasize capabilities related quality, time and flexibility. In a high-cost environment, quality seems to be quite important for achieving a competitive advantage. Companies need to develop innovative products with high-quality and to deliver it faster than their competitors. Hence, manufacturing companies in a high-cost environment seem to focus on differentiation strategies, rather than cost leadership strategies.</p>
<i>Paper 4</i>	<p>The framework of operations capabilities is further investigated in a high-cost environment through a multiple case study including five Swedish manufacturing companies. The findings revealed that all dimensions and their capabilities are considered critical in a high-cost environment, however with different emphasis. Additional operations capabilities could be identified: service quality, supplier dependability, supplier flexibility, supply chain innovation, supply chain sustainability.</p>	<p>Manufacturing companies in a high-cost environment achieve a competitive advantage through an emphasis on service and supply chain perspective. Companies in a high-cost environment seem to work with supply chain integration to both improve performance and build sustainable supply chains. This also confirms previous findings sustaining that manufacturing companies in a high-cost environment implement differentiation strategies which are based on creation of a value advantage through tailored services, reliability, and high responsiveness.</p>
<i>Paper 5</i>	<p>The findings confirm the criticality of the dimensions and operations capabilities (identified and investigated in previous appended papers) from a SME's perspective. However, it is revealed that SME's put different emphasis on these capabilities. The most emphasized capabilities are those related to innovation, flexibility and quality. The companies also agree that sustainability related capabilities need to be further develop and improved in the future.</p>	<p>SME's need to respond to a customer demand which is characterized by high variety of product in small batch sizes. To win the competition and achieve a competitive advantage, these companies seem to develop innovation-related capabilities. they invest on innovation solutions such as advanced manufacturing technologies, multipurpose equipment and information systems that improve the performance of their production systems.</p>
<i>Paper 6</i>	<p>The findings contribute to an understanding on the challenges faced by both large and SMEs in developing critical operations capabilities in a high-cost environment (identified and investigated in previous appended papers). It also categorizes the challenges and solutions to meet those challenges based on the</p>	<p>Manufacturing companies in a high-cost environment seem to face several challenges related to the six dimensions identified: cost, quality, time, flexibility, innovation and sustainability. The most common challenges seem to be related to the development of quality and innovation capabilities. Manufacturing companies in a high-cost environment seem to</p>

dimensions of cost, quality, time, flexibility, innovation and sustainability.

deal with these challenges through different practices; however, the most common solution is related to automation and digitalization in manufacturing. Innovation seems to have a strategic importance for achieving a competitive advantage in a high-cost environment. The findings not only confirm the cumulative nature of the capabilities developed, but also the implementation of differentiation strategies in a high-cost environment for achieving a competitive advantage.

5 Discussion

In this chapter, the findings from the papers are combined to discuss the answer to the research questions and reflect on the theoretical streams previously presented. The chapter begins with a general discussion, followed by two sections, each one dealing with one of the two research questions. Finally, the chapter is concluded with a discussion of methods used.

5.1 General discussion

Shifts in the global competitive landscape have driven many companies to consider a change in their manufacturing footprints (Tate *et al.*, 2014). Customer location, natural disasters, currency valuation, labor cost, transportation cost, and availability have pushed competitive manufacturing to revise their decisions about their preferred manufacturing locations (Ellram, 2013; Tate *et al.*, 2014). All these various changes related to market, industry and country contexts have led companies to move their manufacturing from low to high-cost environments (Harper, 2020). These changes in the environment in which a company competes affects the formulation of the operations strategy including the development of different operations capabilities, which in turn affects the company's competitive advantage (Boyer and Lewis, 2002). The topic of competitive manufacturing in a high-cost environment has been gaining increased attention among researchers and practitioners. In this geographical reconfiguration of global value chains, it is vital to understand how companies located in high-cost environments should compete and what the winning operations strategies in this specific context are (Brandon-Jones *et al.*, 2017; Ketokivi *et al.*, 2017). The competitive advantage, which is the distinctive edge of every company (Barney, 1991; Robbins and Coulter, 2013), can be drawn from those capabilities that the company has developed and that represent the company's actual or realized competitive strength relative to primary competitors in its target markets (Robbins and Coulter, 2013; Rosenzweig *et al.*, 2003). It is worth underlining that the competitive success of a company depends on its ability to identify, develop and continuously improve those capabilities that offer superior value to the customers compared to their

competitors (Koufteros *et al.*, 2002a). The development of operations capabilities can support the achievement of a high level of performance along different dimensions such as cost, quality, time and flexibility (Boyer and Lewis, 2002; Rosenzweig *et al.*, 2003). While there are notable exceptions (e.g., Größler and Grübner, 2006), little emphasis has been put on critical operations capabilities for competitive manufacturing in high-cost environments (Ketokivi *et al.*, 2017), and there is a limited number of studies that present up-to-date research on operations capabilities that more accurately reflect the current market situation. Several studies have been conducted in the operations management field concerning the investigation of operations strategy theories, identifying critical priorities and capabilities (Frohlich and Dixon, 2001; Größler and Grübner, 2006; Hallgren, 2007). However, companies located in high-cost environments still face great difficulties in managing the competition against companies located in low-cost environments. In a high-cost environment, it is vital to understand what these capabilities are, and how and if they can be leveraged despite the cost disadvantages inherent to the environment. Therefore, the research underlying this thesis investigates critical operations capabilities in a high-cost environment and how they contribute to a competitive advantage by presenting a framework of operations capabilities suitable for a high-cost environment.

5.2 Critical operations capabilities in a high-cost environment

This section aims to discuss the findings in relation to the first research question:

RQ1: What are the critical operations capabilities for competitive manufacturing in a high-cost environment?

The discussion is based on the findings from Study I, II and III presented in Papers 1-6. The combination of the findings revealed that manufacturing companies in a high-cost environment develop various critical operations capabilities that are related to six dimensions: cost, quality, time, flexibility, innovation and sustainability. Each dimension includes two or more capabilities for a total of twenty-seven operations capabilities, which are summarized in Table 15. These dimensions and

capabilities were identified through Study I with a systematic literature review; thereafter, they were investigated further from a high-cost environment perspective through Study II and III. The investigation in a high-cost environment, through the implementation of a focus group and multiple case studies, identified additional capabilities that were not previously noted in the systematic literature review (Table 15). Moreover, Study II and Study III analyzed the critical operations capabilities in a high-cost environment from both LMEs and SMEs perspectives.

5.2.1 Framework of critical operations capabilities in a high-cost environment

To begin with, in the systematic literature review, the final sample of articles was categorized based on the two main environments (high-cost and low-cost). This descriptive analysis conducted during the systematic literature review 2.0 in Study I revealed that there is a weaker emphasis on operations capabilities from a high-cost environment perspective than a low-cost environment. Indeed, 62% of articles were investigating capabilities and operations strategies in low-cost environments, while 38% were investigating the same research topic in a high-cost environment. These findings support the motivation of this research and highlights a need to investigate these operations capabilities in a high-cost environment to strengthen the literature. As also suggested by Ketokivi et al., (2017), it is fundamental to develop additional understanding of the research topic in the high-cost environment.

The framework of operations capabilities built throughout Study I, Study II and Study III (presented in Paper 4) represents a considerable extension to frameworks in the previous literature (e.g., Frohlich and Dixon, 2001; Miller and Roth, 1994). While previous research has shown that there are usually only four dimensions of operations capabilities, namely cost (price), quality, delivery and flexibility (Avella *et al.*, 2010; Hallgren, 2007), Papers 1-6 includes two additional dimensions: innovation and sustainability.

By comparing the final framework of critical operations capabilities in a high-cost environment, as presented in Paper 4, to previous frameworks proposed in the literature (Frohlich and Dixon, 2001;

Miller and Roth, 1994), the dynamic nature of these capabilities becomes clear (Größler and Grübner, 2006). As the environment constantly changes, so do the capabilities need to be updated and modernized, as concluded in Papers 1-5. These capabilities emphasize the role of managers in integrating, adapting resources and knowledge to changes in the environment (Teece, 2019). This approach also finds support in the theory concerning the resource-based view (Wernerfelt, 1984). This view is based on the idea that the competitive advantage results from the exploitation of internal resources and competencies that a company owns.

Through Study II and Study III (presented in Papers 2-6), all six dimensions find support in a high-cost environment. Hence, the proposed framework adds sixteen more capabilities identified through the combination of theoretical (Study I) and empirical findings (Study II and Study III) of the different studies conducted (Table 15).

The first group of capabilities is organized into a *cost dimension*. These capabilities focus on achieving cost-efficiency in various ways. Cost reductions require involvement from all functional areas within the company; however, most of the costs are linked to manufacturing (Bolívar Cruz and Espino Rodríguez, 2008). In the manufacturing area, cost-efficiency is linked to achieving or maintaining low raw-material, labor, and manufacturing costs (Chi, 2010; Kaipia and Turkulainen, 2017; Ward *et al.*, 1995). Companies that develop cost-related capabilities usually adopt lean strategies. Still, it is no longer enough for companies located in high-cost environments to compete only based on cost. To stay competitive in fast changing and unstable markets, is important for companies to develop other capabilities that reach beyond the scope of lean strategies (Chi, 2010; Yusuf and Adeleye, 2005).

The second group of capabilities is organized into a *quality dimension*. These capabilities focus on the provision of high-performance products (Christiansen *et al.*, 2003; Ward *et al.*, 1995) and reliable products (Größler and Grübner, 2006; Hong *et al.*, 2010). The provision of high-quality products also helps companies to improve their brand value and image, which is another important quality-related capability (Christiansen *et al.*, 2003; Frohlich and Dixon, 2001; Longoni and Cagliano, 2015). A final capability is the ability to deliver on time. In the literature, quality is considered as the most critical dimension in high-cost contexts (Kaipia and Turkulainen, 2017; Gelders *et al.*, 1994).

Companies located in such contexts must first develop and constantly improve quality-related capabilities and later put more emphasis on other types of capabilities (Corbett, 1996).

Table 15 Critical operations capabilities in a high-cost environment (based on findings from Studies I, II, III)

Dimension	Capability	Definition	Study I	Study II- Study III
<i>Cost</i>	Cost efficiency	The ability to provide products at low cost	✓	✓
	Resource efficiency	The ability to maximize the utilization of process resources (machinery and human)	✓	✓
	Process efficiency	The ability to maximize the process output		✓
<i>Quality</i>	Product quality	The ability to provide durable, high-performance products	✓	✓
	Service quality	The ability to provide high-performance services		✓
	Process quality	The ability to provide products/services with consistent quality	✓	✓
	Delivery dependability	The ability to deliver on time	✓	✓
	Brand quality	The ability to build a strong and positive company image	✓	✓
	Supplier dependability	The ability to select and develop reliable suppliers		✓
	<i>Time</i>	Delivery time	The ability to deliver in a short time frame	✓
Time to market		The ability to have short time frame from product development to market introduction	✓	✓
<i>Flexibility</i>	Product flexibility	The ability to customize products based on customer requirements	✓	✓
	Product line flexibility	The ability to provide a wide range of products with different features	✓	✓
	Volume flexibility	The ability to respond to changes in market demand	✓	✓
	Production mix flexibility	The ability to change the manufacturing product mix	✓	✓
	Labor flexibility	The ability of employees to perform different types of tasks	✓	✓
	Delivery flexibility	The ability to change delivery times and quantities within the agreed upon delivery time	✓	✓
	Supplier flexibility	The ability to select and develop responsive suppliers		✓
<i>Innovation</i>	Product innovation	The ability to develop and introduce new products	✓	✓
	Service innovation	The ability to develop and introduce new services	✓	✓
	Process innovation	The ability to develop and implement new processes	✓	✓
	Technology innovation	The ability to develop and implement new technologies	✓	✓
	Market innovation	The ability to find and exploit new markets and opportunities	✓	✓

	Supply chain innovation	The ability to develop and implement new supply chain solutions	✓	
<i>Sustainability</i>	Product sustainability	The ability to provide sustainable products	✓	✓
	Process sustainability	The ability to manufacture products in a sustainable manner	✓	✓
	Supply chain sustainability	The ability to source and deliver products in a sustainable manner		✓

The third group of capabilities is organized into a *time dimension*. These capabilities focus on providing products to the customers in a rapid manner. This involves both fast product delivery (Chung and Swink, 2009; Da Silveira, 2005) and short time to market (Al Serhan, 2015; Gao and Tian, 2014). Companies that compete based on time may not have the most cost-efficient operations nor the highest performing products but are able to compete based on rapid product delivery and development (Chi, 2010). This means that successful companies in high-cost contexts respond to the current competition through differentiation strategies that emphasize capabilities such as delivery time and time to market (Ward et al., 1995). Shorter time to market has many benefits including a higher market share, increasing profits and quicker break-even times (Jayaram and Narasimhan, 2007). The rapid technological development and reduced product life cycles that characterize high-cost environments push companies to constantly improve time to market and product delivery times (Szász and Demeter, 2014; Gelders et al., 1994).

The fourth group of capabilities is organized into a *flexibility dimension*. These capabilities focus on responding to market changes by quickly adjusting the operations and hence reducing the negative impact on time and cost (Ferrer et al., 2011). Companies work on improving the flexibility in many ways including product (Bouranta and Psomas, 2017), product line (Pooya and Faezrad, 2017), volume (Garo and Guimarães, 2018), production mix (Ho et al., 2016), labor (Chi, 2010) and delivery flexibility (Ho et al., 2016). The high market volatility and complex industrial dynamics inherent in high-cost environments force companies located in such contexts to be more flexible (Chi et al., 2009). This mean that high-performing companies in high-cost contexts develop capabilities linked to flexibility (Chi et al., 2009; Ward et al., 1995).

The fifth group of capabilities is organized into an *innovation dimension*. These capabilities focus on the introduction and development of new solutions including products, services, processes, supply chains and markets (Bulak and Turkyilmaz, 2014; Zhao et al., 2002). In high-cost environments, high innovation is considered as a necessity to sustain a competitive advantage (Ferrer et al., 2011). As mentioned above, successful companies in high-cost contexts respond to the current competition through differentiation strategies. Some companies differentiate themselves through quality-related capabilities (Koufteros et al., 2002), which allow them to provide high performing products while others differentiate themselves through time-related capabilities that allow them to rapidly satisfy customer needs (Ferrer et al., 2011). A third option is to differentiate based on innovation-related capabilities (Lau et al., 2013).

The sixth group of capabilities is organized into a *sustainability dimension*. These capabilities focus on increasing the sustainability of the operations in various ways. This means reducing the impact on the environment (Pooya and Faezrad, 2017), consuming fewer natural resources and generating limited emissions (Espino-Rodríguez, 2016). In the literature, it is not fully evident that these capabilities are critical for competitive manufacturing in a high-cost environment. This could be related to the high complexity of these capabilities, which require a mature approach and the availability of resources that not all companies seem to have (Longoni and Cagliano, 2015).

5.2.2 Critical operations capabilities in a high-cost environment from LMEs and SMEs perspectives

The combination of Study II and Study III and specifically the findings of Paper 2, Paper 3, Paper 4 and Paper 5 support an analysis of critical operations capabilities based on different companies' sizes. All case companies included in Study II and Study III have confirmed and supported the operations capabilities and their dimensions identified in Study I. All capabilities and dimensions identified in Study I were considered critical in a high-cost environment, although they had different emphases. The different industries in which the case companies operate do not seem to have revealed major differences in

the findings. Although small, the difference in the emphasis put on critical operations capabilities between LMEs and SMEs are shown in Table 16 (considering that all operations capabilities included in the framework are considered critical from the case companies selected, Table 16 shows the extra emphasis put on some of them from LME's and SME's perspectives).

Table 16 Critical operations capabilities for LMEs and SMEs in a high-cost environment (based on findings from Studies II and III)

Dimension	Capability	LMEs (Study II)	SMEs (Study III)
<i>Cost</i>	Cost efficiency	+	
	Resource efficiency	+	
	Process efficiency	+	
<i>Quality</i>	Product quality	+	+
	Service quality	+	+
	Process quality	+	+
	Delivery dependability	+	+
	Brand quality	+	+
	Supplier dependability	+	+
<i>Time</i>	Delivery time	+	
	Time to market	+	
<i>Flexibility</i>	Product flexibility		+
	Product line flexibility		+
	Volume flexibility		+
	Production mix flexibility		+
	Labor flexibility		+
	Delivery flexibility		+
	Supplier flexibility	+	+
<i>Innovation</i>	Product innovation	+	+
	Service innovation	+	+
	Process innovation	+	+
	Technology innovation	+	+
	Market innovation	+	+
	Supply chain innovation	+	+
<i>Sustainability</i>	Product sustainability		
	Process sustainability		
	Supply chain sustainability		

On an overall level, both manufacturing LMEs and SMEs emphasize capabilities related to quality. Independent of their sizes, all case companies included in Study II and Study III focus on producing high quality products before addressing cost issues.

Previous research has suggested that quality-related capabilities are the most critical in high-cost environments (Gelders *et al.*, 1994; Kaipia and Turkulainen, 2017). The empirical findings show that, despite the different industries of the companies selected, there is a general agreement that providing durable, high-performance products and products/services with consistent quality are critical operations capabilities for manufacturing companies located in high-cost environments. The rule “quality before cost” presented by Hay and Williamson (1991) appears to be valid. The strategic importance of quality-related capabilities in high-cost environments is further supported in the manufacturing relocation literature, which highlights the idea that many of the motives for moving manufacturing back to high-cost environments are related to improving quality (Arbjørn and Mikkelsen, 2014; Engström *et al.*, 2018; Johansson *et al.*, 2019).

Moreover, another similarity between manufacturing LMEs and SMEs in the empirical studies revealed that capabilities related to sustainability are considered critical; however, both LMEs and SMEs believe that they need to be further strengthened and improved in the future. This could be related to the high complexity of these capabilities (Longoni and Cagliano, 2015) and to the development of sustainable supply chains. One major challenge of sustainability for manufacturing LMEs and SMEs and their supply chains is the broader set of economic, environmental and social norms and criteria that needs to be met (Elkington, 2002; Seuring and Müller, 2008). However, both manufacturing LMEs and SMEs have revealed a robust awareness of sustainability issues and the strong need for improvements in the future; however, they were not a priority focus at the time the data was collected.

In Paper 3, manufacturing LMEs also emphasized capabilities related to time and cost, which are ranked higher than all the other dimensions (based on the questionnaire results presented in Paper 3). The findings of Paper 3 are also supported in the multiple case study presented in Paper 4. Cost is considered in a broader perspective rather than just reducing the total cost; instead, these manufacturing companies focus on improving process and resource efficiency as well. Both cost and time related capabilities are strictly linked to the implementation of lean methods. Usually, the focus is on increasing productivity by increasing

output or/and reducing inputs to improve overall profitability (Tay, 2016). Moreover, when analyzing the capabilities in-depth in Paper 4, new capabilities were identified that emphasized a service perspective (service quality) and a supply chain perspective (supplier dependability, supplier flexibility, supply chain innovation and supply chain sustainability). On one side, it is important to emphasize the appropriate treatment of customers, making products easily obtainable to customers and providing them with effective after-sales services (Bolivar Cruz and Espino Rodríguez, 2008). On the other side, it is important to adopt a holistic approach to the supply chain (Christopher, 2016) and when developing specific operations capabilities. These aspects are both important because the most successful manufacturing companies appear to be those that have carefully linked their internal processes to external suppliers and customers in unique and agile supply chains (Christopher, 2016; Seuring and Müller, 2008).

In Paper 5, manufacturing SMEs confirm and support the operations capabilities and the dimensions proposed but with different emphasis compared to manufacturing LMEs in Paper 2, Paper 3 and Paper 4. Manufacturing SMEs in high-cost environments seem to emphasize capabilities related to innovation and flexibility. Innovation-related capabilities may also be the foundation for the development of other capabilities such as those related to flexibility, quality and sustainability. Innovation is therefore considered in a broader sense: it is about finding new combinations of products and services that can help manufacturing companies to adapt to different industries (Nair and Boulton, 2008). In this sense, identifying and exploiting new markets creates essential benefits and opportunities for SMEs located in high-cost environments. The strategic importance of innovation-related capabilities in high-cost environments is further supported in the manufacturing relocation literature, which emphasizes that one important driver for relocating manufacturing to high-cost environments is better access to technology, IT, and stronger protection of know-how (Sequeira and Sansone, 2021; Tate *et al.*, 2014). Moreover, manufacturing SMEs usually need to respond to a customer demand that requires a higher variety of products and customization, but the quantity required is usually smaller than LMEs (Zheng *et al.*, 2019). These differences in demands might be a way for manufacturing SMEs to develop and emphasize flexibility-related capabilities. These capabilities are also reflected in the way that these companies organize

their production, which is usually characterized by a combination of both automated and manual operations to take advantage of their relative strengths and attributes (Groover, 2016).

5.3 Contribution of critical operations capabilities to competitive advantage in a high-cost environment

This section aims to discuss the findings in relation to the second research question:

RQ2: How do critical operations capabilities contribute to competitive advantage in a high-cost environment?

The discussion is based on the findings from Study II and III presented in Papers 2-6. The combination of the findings revealed that manufacturing companies in a high-cost environment achieve a competitive advantage by implementing different strategies. These strategies are usually based on the development of critical operations capabilities. Study II provided understanding on how critical operations capabilities contribute to competitive advantage from LME's perspective. Study III gained further knowledge on how critical operations capabilities contribute to competitive advantage from SME's perspective. The combination of data collected in Study II and Study III (presented in Paper 6) first identified different challenges that are faced by both manufacturing LMEs and SMEs in a high-cost environment and, second, identified different solutions adopted to meet those challenges.

A major stream of research in the operations management field concerns how companies use their operations capabilities to compete with others (Hayes and Wheelwright, 1984; Skinner, 1969, Nand et al., 2013). The relationship between operations capabilities is an important element of operations strategy (Flynn and Flynn, 2004). Study II and Study III and the investigation of operations capabilities in a high-cost environment showed how manufacturing companies develop operations capabilities in a cumulative way, which means that these capabilities usually exist simultaneously in a mutually reinforcing way, rather than being a trade-off (Sansone and Sequeira, 2021; Flynn and Flynn, 2004). The findings presented in Paper 5 show how

manufacturing SMEs implement innovation-based strategies, which support the development of quality and flexibility capabilities. At the same time, the development of flexibility-related capabilities can support the improvement of time-related capabilities such as delivery time and time to market. As deduced from the empirical findings in Paper 2 and Paper 4, manufacturing LMEs emphasize the development of capabilities related to the quality dimension such as process quality, product quality and delivery dependability. Once the development of quality-related capabilities is satisfied, companies in a high-cost environment focus on the development of other capabilities. Operations capabilities are cumulative by nature, and to achieve a successful strategy, these capabilities need to be built on one another (Größler and Grübner, 2006). Paper 2 and Paper 4 provide several examples for LMEs that support the cumulative theory of capabilities (Avella *et al.*, 2011; Größler and Grübner, 2006; Schoenherr *et al.*, 2012). For example, by adopting cost-reduction strategies like lean, manufacturing LMEs in a high-cost environment not only increase their cost efficiency and flow efficiency, but also improve product and process quality. Some companies focus on developing process quality, which in turn helps them to reduce the time to market. It is therefore apparent that the complex nature of interrelationship between the different capabilities and case companies can provide insights into alternative paths to high performance.

Based on the findings of this research, the manufacturing companies involved in the different studies appear to implement strategies that allow them to differentiate themselves from their competitors. These manufacturing companies are facing high costs due to the environment in which they operate. As such, these companies need to differentiate their products from the low-cost competition. To do this, they implement differentiation strategies based on the development of capabilities that are not related to cost. They instead implement capabilities such as quality, innovation, flexibility, time and sustainability. Because of the high labor costs that these manufacturing companies are facing, low-cost manufacturing is not viewed as a strength, especially in manufacturing SMEs (as shown in Paper 5). To better adapt to the market conditions, manufacturing companies aim to excel in developing innovations and flexibility capabilities as demanded by the market. Moreover, their quality management has a strong emphasis on customer satisfaction and continuous improvement,

which also highlights the important role of service (as shown in Paper 4). In Paper 3, the evaluation of operations capabilities in a high-cost environment shows that companies in such a context differentiate themselves from their competitors in different ways. The first option concerns a differentiation through the development of quality-related capabilities, which allows them to provide high-performing products (Ferrer *et al.*, 2011). The second option concerns a differentiation through the development of time-related capabilities, which allows them to rapidly satisfy customer needs (Ferrer *et al.*, 2011). The third option concerns a differentiation through the development of innovation-related capabilities, which allows them to offer innovative products and solutions that are hard to imitate (Ferrer *et al.*, 2011; Lau *et al.*, 2013). The findings of this research also give insights into sustainability-related capabilities. These capabilities are not strongly supported in the literature for competitive manufacturing in high-cost environments (Longoni and Cagliano, 2015). However, the investigation of these capabilities in the studies revealed that even though, on the overall level, they received lower emphasis than other capabilities, they are still considered critical by the companies included in this research. Study II and Study III also show that sustainability aspects are part of continuous improvement programs that companies in a high-cost context implement for increasing the quality of products and processes. However, this also must be considered from a supply chain perspective, as companies in a high-cost environment do not compete as single entities, but instead as part of supply chains (Christopher, 2016).

To achieve a competitive advantage in a high-cost environment, manufacturing companies face several challenges. Paper 6 presents an investigation of these challenges. The challenges were identified then summarized and categorized in six dimensions: cost, quality, time, flexibility, innovation and sustainability. The challenges identified are also consistent to the findings of Paper 2, Paper 3, Paper 4 and Paper 5. Quality and innovation dimensions included a higher number of challenges, which can be related to the strong focus on developing quality and innovation capabilities to achieve a competitive advantage. In a low-cost environment, a common route to success in manufacturing is through imitation, whereas in a high-cost environment, innovation is what often brings about success (Roos and Kennedy, 2014). This view is partly supported by the findings of the research, as case companies in

Study II and Study III highlighted the key role of innovation. Hence, innovation is considered as the secret key for implementing solutions that are able to meet current challenges. As supported in Paper 6, common solutions are related to process improvements and associated technologies such as industrial internet of things (IIoT), cloud manufacturing, big data analytics, and additive manufacturing (Demartini *et al.*, 2018). In line with findings from Paper 4 and Paper 5, digitalization and smart manufacturing are considered as innovative solutions that are implemented to also improve the organization of the supply chains. The physical flow of products is continuously mapped on digital platforms; this results not only in improving flexibility and product customization but also in creating highly transparent and integrated supply chains. However, manufacturing companies in high-cost environments must either protect their innovative knowledge from becoming globally accessible, or be able to create and utilize codified knowledge quicker than manufacturing companies located in more favorable cost locations (Roos and Kennedy, 2014). This is also strictly connected with building and maintaining strong relationships with external partners such as lead customers and suppliers. These abilities were also emphasized in Paper 4 and Paper 5. A strong collaboration between the different actors in the supply chain and an engaged working relationship with research providers and universities benefit manufacturing companies in improving their innovation-related capabilities and their growth.

5.4 Discussion of method

This research was conducted through the implementation of different research strategies: a systematic literature review, a focus group, and multiple case studies. The use of a mixed method approach that combines both quantitative and qualitative research enabled a more well-rounded and complete picture to be drawn (Bell *et al.*, 2018). The mixed method approach only enriched the findings, but it also increased the researcher's understanding of the different research methods. Adopting different methods and techniques made it possible to reach a further understanding of the different methods, including their advantages and disadvantages.

The systematic literature review created the foundation for the entire research process. However, it also revealed some challenges and

difficulties in analyzing and interpreting the rich amount of data collected. To manage the extensive amount of data, the papers included in the final sample were analyzed by following a clear protocol that made it possible to identify patterns, themes and issues, and conceptual content in the field (Seuring and Müller, 2008). The clear structure and transparency of the process allowed for the reproduction of its process and an update of the content during different time periods. One of the limitations of this research strategy is related to the dynamic nature of the topic of operations capabilities. As discussed in this thesis, these capabilities and the terms used may change over time. To address this limitation, the systematic literature review was updated during a second time period. On this occasion, an analysis of the environment discussed in the papers was also included.

The focus group analyzed the operations capabilities identified in the literature in a high-cost environment. In this research, the focus group was implemented to evaluate and investigate the findings from the literature review in a specific context. However, some researchers have suggested that focus groups are weaker than other methods, such as surveys (Bell et al., 2019). To allow triangulation and strengthen the findings, both quantitative and qualitative approaches were implemented. Hence, a questionnaire and a group discussion were included in the focus group session. This choice made it possible to enrich the findings and collect improved data. Although the focus group included fourteen managers from five different Swedish manufacturing companies, the evaluation of the operations capabilities did not attempt to draw statistical generalization for manufacturing companies in Sweden. In this sense, the results are valid and limited to those five manufacturing companies selected. Another limitation is related to the selection of the participants in the focus group, which could have an impact on the results of the focus group. Although the low number of participants might raise questions on the validity of the results, the use of multiple data collection techniques decreased the impact on the results' validity to an extent. The limitations of the focus group were met through the implementation of multiple case studies for a further and richer investigation of the operations capabilities evaluated and discussed in a high-cost environment.

The multiple case studies analyzed the research topic in-depth, adding a high-cost environment perspective to the topic under investigation.

Different data collections were used to create a triangulation, which would increase the validity of the research. Moreover, a within and cross-case analysis were conducted. It is important to first become familiar with each case as a stand-alone entity, and then allow the unique patterns across cases to emerge (Voss *et al.*, 2002). However, one limitation could be that all twelve case companies selected were manufacturing companies located in Sweden. Even though Sweden can be considered as part of a high-cost environment (see Section 2.2), the findings are still specific to the country, which makes their generalizability somewhat limited. Moreover, the data analysis in the multiple case studies can be considered as subjective and influenced by the researcher's interpretations of events as suggested by Williamson (2002). To avoid an early interpretation of the data and early conclusions, the data techniques and findings were constantly revised throughout the research process. Moreover, in some cases (i.e., multiple case study A), the data collection and data analysis were conducted by different researchers, thus minimizing the risk of subjectivity in the conclusions drawn. In all case studies, the raw data was always separated from the case study protocol and from possible notes and comments of the researcher. Additionally, to maintain traceability, all the data analysis and findings were linked back to the raw data such as interview, questionnaire or specific document.

6 Conclusion

This chapter presents the conclusions of this research. It outlines the theoretical contributions and practical implications. Finally, it concludes with the limitations of this research and presents some suggestions for further research.

6.1 Answering the research questions

The purpose of this research was to **investigate critical operations capabilities and how they contribute to a competitive advantage in a high-cost environment**. To fulfill the purpose, two research questions were formulated and three studies were conducted. The conclusions drawn in this thesis are presented in relation to the two research questions. The first research question was:

RQ1: What are the critical operations capabilities for competitive manufacturing in a high-cost environment?

Based on the findings presented in this thesis, it can be concluded that companies in a high-cost environment develop different operations capabilities to gain competitive advantage. Due to their dynamic nature, operations capabilities are exposed to change in terms of time, as evident from the findings of the literature review as well as the empirical investigation. The findings propose a framework including twenty-seven operations capabilities, which are organized into six dimensions: cost, quality, time, flexibility, innovation and sustainability. It can be concluded that, despite the different industries, manufacturing companies in a high-cost environment seem to emphasize a broad set of capabilities related to quality, time, flexibility, innovation and sustainability rather than only cost-related capabilities. Differences by company size were marginal.

RQ2: How do critical operations capabilities contribute to competitive advantage in a high-cost environment?

Based on the findings presented in this thesis, it can be concluded that companies in a high-cost environment achieve a competitive advantage through the implementation of differentiation strategies. The strategies

implemented are usually based on the development of non-cost related capabilities such as quality, time, flexibility, innovation and sustainability. Hence, competitive advantage is achieved by offering customers superior value than competitors, through tailored services, flexibility, and higher levels of quality and innovation.

6.2 Theory contributions

Critical operations capabilities have been studied mainly in low-cost environments. The research presented in this thesis overcomes the shortcomings of the previous studies by contributing knowledge on critical operations capabilities in a high-cost environment. The first contribution concerns a deeper understanding on what capabilities manufacturing companies need to develop to be competitive in a high-cost environment. This research enriches the current debate on operations strategy in a high-cost context, and it provides an overview on operations capabilities, which can be used by researchers as a starting point for further research and assessment. The capabilities investigated in this research can aid researchers in gaining a better understanding of the operations strategy through the clarification of critical operations capabilities. Hence, this research expands the existing knowledge on operations strategy.

The second contribution concerns the dynamic nature of operations capabilities. Hence, this study contributes to the ongoing process of gaining knowledge (Eriksson, 2015) on operations capabilities as part of the operations strategy, which are dynamic and based on the environment and circumstances in which they are developed (Frohlich and Dixon, 2001). Operations capabilities are dynamic and subject to change in terms of time. They are also subject to change in terms of the manufacturing environment, as evident from the empirical investigations. While the investigation of these capabilities is an important initial step for understanding how competitive advantage can be attained, researchers need be careful not to make blanket statements as to which operations capabilities companies need to develop, but instead evaluate the specific circumstances under which manufacturing takes place.

The third contribution concerns the in-depth investigation of these capabilities in a high-cost environment. The research also reveals the

importance of additional operations capabilities: service quality, supplier dependability, supplier flexibility, supply chain innovation, and supply chain sustainability. The identification of these new capabilities revealed a strong emphasis on service and the importance of a supply chain perspective in a high-cost environment. Moreover, it investigates critical operations capabilities in a high-cost environment from both LME's and SME's perspectives, which provides an overview of which capabilities are emphasized in different manufacturing companies. It contributes to the debate on how manufacturing companies with different sizes achieve a competitive advantage in a high-cost environment.

6.3 Managerial implications

Relevant implications for practice can be drawn from this research. The first implication is related to the extensive list of operations capabilities derived from the literature review, the analysis of secondary data, and the analysis through the focus group and multiple case studies, which can provide managers with a detailed overview of critical operations capabilities in a high-cost context. It becomes fundamental to consider these capabilities for implementing successful strategies that better fit high-cost contexts and help companies to achieve a sustainable competitive advantage. In relation to the manufacturing relocation process, which has been ongoing over the last few decades (Jensen and Pedersen, 2011), and the significant movement of manufacturing from high-cost to low-cost environments, companies located in high-cost environments are able to identify capabilities they need to develop to be able to compete with low-cost manufacturing markets.

The second implication is connected to the strong focus on quality-related capabilities in a high-cost environment. The findings of this thesis emphasize the importance of the development of quality-related capabilities in the specific high-cost environment. Companies that compete in this context need to carefully implement management actions that will strengthen capabilities such as product quality, process quality, delivery dependability and brand quality. This context provides strong incentives that can support companies in improving quality-related capabilities, such as the proximity to better resources, access to technology, innovative suppliers and a skilled labor force.

The third implication is related to the implementation of differentiation strategies in high-cost environments. The findings of this thesis reveal that companies in a high-cost environment achieve a competitive advantage through differentiation strategies that are based on the creation of a value advantage through tailored services, reliability and high responsiveness. The literature suggests that differentiation strategies can lead to sustainable performance compared to cost leadership strategies (Banker *et al.*, 2014). However, differentiation strategies can also lead to negative consequences. Managers that decide to implement these types of strategies need to consider that pursuing a differentiation strategy might lead to more risk and unstable earnings; they should understand if the advantages from sustainable performance compensate the additional risk that such a strategy imposes (Banker *et al.*, 2014).

The fourth implication is related to the cumulative nature of operations capabilities. The findings of this thesis reveal that to gain a competitive advantage, manufacturing companies in a high-cost environment need to develop critical operations capabilities in a cumulative way. Managers need to focus on developing the critical capabilities by developing capabilities on a cumulative way. This approach highlights an effort to develop different dimensions of operations capabilities in parallel. It is also fundamental to focus on developing those capabilities that are critical in the specific environment in which the company operates. This research provides an overview on the key capabilities that are critical to consider in a high-cost environment. Hence, capabilities related to quality, time, flexibility and innovation should be the initial focus for manufacturing companies that wish to compete in a high-cost environment.

6.4 Limitations and further research

As in any research, there are limitations on the findings generated. The findings of this thesis reveal that all the capabilities identified were considered critical in a high-cost environment. However, the investigation was limited to manufacturing companies located in Sweden; a large-scale investigation of operations capabilities in a high-cost environment is still needed to be able to generalize the findings. More survey-based studies can be implemented to reach a broader

sample of companies located in different countries within a high-cost environment.

Since manufacturing companies develop operations capabilities to achieve higher levels of performance (Schroeder *et al.*, 2002), future research should also investigate the relationship between operations capabilities and organizational and operational performance. To do this, it is important to first set a measurement and assessment tool for each operations capability and dimension. The second task would be to find a link between operations capabilities and the company's operational and organizational performances.

This research mainly focused on the investigation of operations capabilities in a high-cost environment. However, interesting insights can also be reached when comparing the findings from high-cost environments to those from low-cost environments. Future research could focus on the investigation of critical operations capabilities in a low-cost environment. The investigation of critical operations capabilities in a different context could help the understanding of its relevance and to find similarities and differences between low and high-cost environments. This would support companies in the formulation of a winning operations strategy or by guiding them through a hypothetical relocation process.

References

- Alsmadi, M., Khan, Z. and McTavish, A.M. (2011), “Evaluating competitive advantage priorities of SMEs in Jordan”, *International Journal of Networking and Virtual Organisations*, Vol. 9 No. 1, pp. 25–43.
- Alves Filho, A.G., Nogueira, E. and Gomes Bento, P.E. (2015), “Operations strategies of engine assembly plants in the Brazilian automotive industry”, *International Journal of Operations & Production Management*, Vol. 35 No. 5, pp. 817–838.
- Anderson, J.C., Cleveland, G. and Schroeder, R.G. (1989), “Operations strategy: a literature review”, *Journal of Operations Management*, Vol. 8 No. 2, pp. 133–158.
- Arlbjørn, J.S. and Mikkelsen, O.S. (2014), “Backshoring manufacturing_ Notes on an important but under-researched theme”, *Journal of Purchasing and Supply Management*, Vol. 20 No. 1, pp. 60–62.
- Ashby, A., Leat, M. and Hudson Smith, M. (2012), “Making connections: a review of supply chain management and sustainability literature”, edited by Wilding, R. *Supply Chain Management: An International Journal*, Vol. 17 No. 5, pp. 497–516.
- Avella, L., Fernández, E. and Vázquez, C.J. (2001), “Analysis of manufacturing strategy as an explanatory factor of competitiveness in the large Spanish industrial firm”, *International Journal of Production Economics*, Vol. 72 No. 2, pp. 1–19.
- Avella, L., Fernandez, E. and Vazquez, C.J. (2010), “Taxonomy of the manufacturing strategies of large Spanish industrial companies”, *International Journal of Production Research*, Vol. 36 No. 11, pp. 3113–3134.
- Avella, L., Vazquez-Bustelo, D. and Fernandez, E. (2011), “Cumulative manufacturing capabilities: an extended model and new empirical evidence”, *International Journal of Production Research*, Vol. 49 No. 3, pp. 707–729.

- Badri, M.A., Davis, D. and Davis, D. (2000), “Operations strategy, environmental uncertainty and performance: A path analytic model of industries in developing countries”, *Omega*, Vol. 28 No. 2, pp. 1–19.
- Baines, T.S., Lightfoot, H.W., Benedettini, O. and Kay, J.M. (2009), “The servitization of manufacturing: A review of literature and reflection on future challenges”, *Journal of Manufacturing Technology Management*, Vol. 20 No. 5, pp. 547–567.
- Banker, R.D., Mashruwala, R. and Tripathy, A. (2014), “Does a differentiation strategy lead to more sustainable financial performance than a cost leadership strategy?”, *Management Decision*, Vol. 52 No. 5, pp.872–896.
- Barbour, R. and Kitzinger, J. (1998), *Developing Focus Group Research: Politics, Theory and Practice*, Sage.
- Barney, J. (1991), “Firm Resources and Sustained Competitive Advantage”, *Journal of Management*, Vol. 17 No. 1, pp. 99–120.
- Bell, E., Bryman, A. and Harley, B. (2018), *Business Research Methods*, Oxford university press.
- Bolivar Cruz, A.M. and Espino Rodríguez, T.F. (2008), “An analysis of operations strategy in the food and beverage sector”, *International Journal of Services and Operations Management*, Vol. 4 No. 1, pp. 102–124.
- Boyer, K.K. and Lewis, M.W. (2002), “Competitive priorities: Investigating the need for trade-offs in operations strategy”, *Production and Operations Management*, Vol. 11 No. 1, pp. 9–20.
- Brandon-Jones, E., Dutordoir, M., Neto, J.Q.F. and Squire, B. (2017), “The impact of reshoring decisions on shareholder wealth”, *Journal of Operations Management*, Vol. 49–51, pp. 31–36.
- Bulak, M.E., Turkyilmaz, A., Enis Bulak, M. and Turkyilmaz, A. (2014), “Performance assessment of manufacturing SMEs: A frontier approach”, *Industrial Management & Data Systems*, Vol. 114 No. 5, pp. 797–816.
- Campbell, D.; Stonehouse, G; Houston, B. (2011), *Business Strategy*, Routledge, New York.

- Camps, J., Oltra, V., Aldás-Manzano, J., Buenaventura-Vera, G. and Torres-Carballo, F. (2016), “Individual performance in turbulent environments: The role of organizational learning capability and employee flexibility”, *Human Resource Management*, Vol. 55 No. 3, pp. 363–383.
- Canham, S. and Hamilton, R.T. (2013), “SME internationalisation: offshoring, ‘backshoring’, or staying at home in New Zealand”, *Strategic Outsourcing: An International Journal*, Vol. 6 No. 3, pp. 277–291.
- Carpinetti, L.C.R. and Martins, R.A. (2001), “Continuous improvement strategies and production competitive criteria: Some findings in Brazilian industries”, *Total Quality Management*, Vol. 12 No. 3, pp. 281–291.
- Chi, T. (2010), “Corporate competitive strategies in a transitional manufacturing industry: an empirical study”, *Management Decision*, Vol. 48 No. 6, pp. 976–995.
- Christiansen, T., Berry, W.L., Bruun, P. and Ward, P. (2003), “A mapping of competitive priorities, manufacturing practices, and operational performance in groups of Danish manufacturing companies”, *International Journal of Operations & Production Management*, Vol. 23 No. 10, pp. 1163–1183.
- Christopher, M. (2016), *Logistics & Supply Chain Management*, Pearson UK.
- Council, N.R. (2002), *At What Price?: Conceptualizing and Measuring Cost-of-Living and Price Indexes*, National Academies Press.
- Cox III, J.F. and Blackstone Jr, J.H. (1998), *APICS Dictionary (9th eds)*, Falls Church.
- Crossan, M.M. and Apaydin, M. (2009), “A Multi-Dimensional Framework of Organizational Innovation: A Systematic Review of the Literature”, *Journal of Management Studies*, Vol. 47 No. 6, pp. 1154–1191.
- Dangayach, G.S. and Deshmukh, S.G. (2001), “Manufacturing strategy: experiences from Indian manufacturing companies”, *Production Planning and Control*, Vol. 12 No. 8, pp. 775–786.

- Dangayach, G.S.; Deshmukh, S.G., Dangayach, G.S. and Deshmukh, S.G. (2001), “Manufacturing strategy”, *International Journal of Operations & Production Management*, Vol. 21 No. 7, pp. 884–932.
- Demartini, M., Pinna, C., Tonelli, F., Terzi, S., Sansone, C. and Testa, C. (2018), “Food industry digitalization: from challenges and trends to opportunities and solutions”, *IFAC-PapersOnLine*, Vol. 51 No. 11, pp. 1371–1378.
- Ellram, L.M. (2013), “Offshoring, reshoring and the manufacturing location decision”, *Journal of Supply Chain Management*, Vol. 49 No. 2, pp. 3–5.
- Engström, G., Hilletoft, P., Eriksson, D. and Sollander, K. (2018), “Drivers and barriers of reshoring in the Swedish manufacturing industry”, *World Review of Intermodal Transportation Research*, Vol. 7 No. 3, pp. 195–220.
- Eriksson, D. (2015), “Lessons on knowledge creation in supply chain management”, *European Business Review*, Vol. 27 No. 4, pp. 346–368.
- Eriksson, D., Hilletoft, P., Ellram, L.M. and Sansone, C. (2018), “To offshore or reshore: The battle of data points”, *Supply Chain Management Review*, Vol. 22 No. 3, pp. 42–46.
- Ferdows, K. and de Meyer, A. (1990), “Lasting improvements in manufacturing performance: in search of a new theory”, *Journal of Operations Management*, Vol. 9 No. 2, pp. 168–184.
- Ferrer, M., Santa, R., Storer, M. and Hyland, P. (2011), “Competences and capabilities for innovation in supply chain relationships”, *International Journal of Technology Management*, Vol. 56 No. 2–4, pp. 1–18.
- Flynn, B.B. and Flynn, E.J. (2004), “An exploratory study of the nature of cumulative capabilities”, *Journal of Operations Management*, Vol. 22 No. 5, pp. 439–457.
- Fratocchi, L., Ancarani, A., Barbieri, P., Mauro, C. di, Nassimbeni, G., Sartor, M., Vignoli, M., *et al.* (2016), “Motivations of manufacturing reshoring: an interpretative framework”, *International Journal of Physical Distribution & Logistics Management*, Vol. 46 No. 2, pp. 98–127.

- Frohlich, M.T. and Dixon, J.R. (2001), “A taxonomy of manufacturing strategies revisited”, *Journal of Operations Management*, Vol. 19 No. 5, pp. 1–18.
- Frohlich, M.T. and Westbrook, R. (2001), “Arcs of integration: an international study of supply chain strategies”, *Journal of Operations Management*, Vol. 19 No. 2, pp. 185–200.
- Galbreath, J., Lucianetti, L., Thomas, B. and Tisch, D. (2020), “Entrepreneurial orientation and firm performance in Italian firms”, *International Journal of Entrepreneurial Behavior & Research*, Vol. 26 No. 4, pp. 629–646.
- Garo, W.R.J., Guimarães, M.R.N., Garo Jr., W.R. and Guimarães, M.R.N. (2018), “Competitive priorities and strategic alignment as mediators in the relationship between companies in the Brazilian automotive supply chain”, *South African Journal of Industrial Engineering*, Vol. 29 No. 1, pp. 184–194.
- Gelders, L., Mannaerts, P. and Maes, J. (1994), “Manufacturing strategy, performance indicators and improvement programmes”, *International Journal of Production Research*, Vol. 32 No. 4, pp. 797–805.
- Grant, R.M. (2016), *Contemporary Strategy Analysis: Text and Cases Edition*, John Wiley & Sons.
- Grant, R.M. and Baden-Fuller, C. (2004), “A knowledge accessing theory of strategic alliances”, *Journal of Management Studies*, Vol. 41 No. 1, pp. 61–84.
- Green, R. and Roos, G. (2012), “Australia’s Manufacturing Future: Discussion paper prepared for the Prime Minister’s Manufacturing Taskforce”, No. April.
- Groover, M.P. (2016), *Automation, Production Systems, and Computer-Integrated Manufacturing*, Pearson Education.
- Größler, A. and Grübner, A. (2006), “An empirical model of the relationships between manufacturing capabilities”, *International Journal of Operations and Production Management*, Vol. 26 No. 5, pp. 458–485.
- Gurtu, A., Saxena, R. and Sah, N. (2019), “Offshoring Decisions: A Comprehensive and Conceptual Framework”, *Operations and*

- Supply Chain Management: An International Journal*, Vol. 12 No. 3, pp. 118–128.
- Gylling, M., Heikkilä, J., Jussila, K. and Saarinen, M. (2015), “Making decisions on offshore outsourcing and backshoring_ A case study in the bicycle industry”, *International Journal of Production Economics*, Vol. 162, pp. 92–100.
- Hafeez, K., Zhang, Y. and Malak, N. (2002), “Determining key capabilities of a firm using analytic hierarchy process”, *International Journal of Production Economics*, Vol. 76 No. 1, pp. 39–51.
- Hallgren, M. (2007), *Manufacturing Strategy, Capabilities and Performance*, Doctoral Thesis, Linköping University, Sweden.
- Hallgren, M., Olhager, J. and Schroeder, R.G. (2011), “A hybrid model of competitive capabilities”, edited by Demeter, K. *International Journal of Operations and Production Management*, Vol. 31 No. 5, pp. 511–526.
- Hamel, G. and Prahalad, C.K. (1990), “The core competence of the corporation”, *Harvard Business Review*, Vol. 68 No. 3, pp. 79–91.
- Harper, S. (2020), *Supply Network Configuration for Small Series , High- Cost Production: Exploring the European textile and apparel industry context*, Licentiate Thesis, University of Borås, Sweden.
- Hay, M. and Williamson, P. (1991), “Strategic staircases: planning the capabilities required for success”, *Long Range Planning*, Vol. 24 No. 4, pp. 36–43.
- Hayes, R.H. and Wheelwright, S.C. (1984), *Restoring Our Competitive Edge: Competing through Manufacturing*, Wiley New York.
- Helfat, C.E. and Winter, S.G. (2011), “Untangling dynamic and operational capabilities: Strategy for the (N) ever-changing world”, *Strategic Management Journal*, Vol. 32 No. 11, pp. 1243–1250.
- Hill, A. and Hill, T. (2009), *Manufacturing Operations Strategy*, Palgrave Macmillan.

- Hill, T. (1995), *Manufacturing Strategy: Text and Cases*, Macmillan International Higher Education.
- Hong, P., Tran, O. and Park, K. (2010), “Electronic commerce applications for supply chain integration and competitive capabilities: An empirical study”, edited by Mora Monge, C.A. *Benchmarking*, Vol. 17 No. 4, pp. 539–560.
- Jensen, P.D.Ø.Ø. and Pedersen, T. (2011), “Offshoring and international competitiveness: antecedents of offshoring advanced tasks”, *Journal of the Academy of Marketing Science*, Vol. 40 No. 2, pp. 313–328.
- Johansson, M., Olhager, J., Heikkilä, J. and Stentoft, J. (2019), “Offshoring versus backshoring: Empirically derived bundles of relocation drivers, and their relationship with benefits”, *Journal of Purchasing and Supply Management*, Vol. 25 No. 3, pp. 1–9.
- Jüttner, U., Christopher, M. and Baker, S. (2007), “Demand chain management-integrating marketing and supply chain management”, *Industrial Marketing Management*, Vol. 36 No. 3, pp. 377–392.
- Kaipia, R. and Turkulainen, V. (2017), “Managing integration in outsourcing relationships — The influence of cost and quality priorities”, *Industrial Marketing Management*, Vol. 61, pp. 114–129.
- Karlsson, C. (2009), *Researching Operations Management*, Routledge, New York.
- Kerkhoff, K., Kaul, K., Hilletoft, P. and Eriksson, D. (2017), “Sourcing from China: a literature review of motivations, outcomes, problems, and solutions”, *Operations and Supply Chain Management*, Vol. 10 No. 4, pp. 226–239.
- Ketokivi, M. (2017), “One more time, it is not about cost!”, *Journal of Operations Management*, Vol. 49–51, p. 82.
- Ketokivi, M., Turkulainen, V., Seppälä, T., Rouvinen, P. and Ali-Yrkkö, J. (2017), “Why locate manufacturing in a high-cost country? A case study of 35 production location decisions”, *Journal of Operations Management*, Vol. 49–51, pp. 20–30.

- Kim, Y.H., Sting, F.J. and Loch, C.H. (2014), “Top-down, bottom-up, or both? Toward an integrative perspective on operations strategy formation”, *Journal of Operations Management*, Vol. 32 No. 7–8, pp. 462–474.
- Konüs, A.A. (1939), “The problem of the true index of the cost of living”, *Econometrica: Journal of the Econometric Society*, Vol. 7 No. 1, pp. 10–29.
- Koufteros, X.A., Vonderembse, M.A. and Doll, W.J. (2002a), “Examining the competitive capabilities of manufacturing firms”, *Structural Equation Modeling*, Vol. 9 No. 2, pp. 256–282.
- Koufteros, X.A., Vonderembse, M.A. and Doll, W.J. (2002b), “Integrated product development practices and competitive capabilities: The effects of uncertainty, equivocality, and platform strategy”, *Journal of Operations Management*, Vol. 20 No. 4, pp. 331–355.
- Krause, D.R., Pagell, M. and Curkovic, S. (2001), “Toward a measure of competitive priorities for purchasing”, *Journal of Operations Management*, Vol. 19 No. 4, pp. 1–16.
- Lau, A.K.W., Baark, E., Lo, W.L.W. and Sharif, N. (2013), “The effects of innovation sources and capabilities on product competitiveness in Hong Kong and the Pearl River Delta”, *Asian Journal of Technology Innovation*, Vol. 21 No. 2, pp. 1–19.
- Lippman, S.A. and Rumelt, R.P. (1982), “Uncertain imitability: An analysis of interfirm differences in efficiency under competition”, *The Bell Journal of Economics*, Vol. 13 No. 2, pp. 418–438.
- Longoni, A. and Cagliano, R. (2015), “Environmental and social sustainability priorities”, *International Journal of Operations & Production Management*, Vol. 35 No. 2, pp. 216–245.
- Lorenzo, J.R.F., Rubio, M.T.M. and Garcés, S.A. (2018), “The competitive advantage in business, capabilities and strategy. What general performance factors are found in the Spanish wine industry?”, *Wine Economics and Policy*, Vol. 7 No. 2, pp. 94–108.
- Luz Martín Peña, M. and Díaz Garrido, E. (2008), “Typologies and taxonomies of operations strategy: a literature review”, *Management Research News*, Vol. 31 No. 3, pp. 200–218.

- Luz Martín Peña, M., Díaz Garrido, E., Peña, M.L.M., Garrido, E.D., (2008), “A taxonomy of manufacturing strategies in Spanish companies”, *International Journal of Operations & Production Management*, Vol. 28 No. 5, pp. 455–477.
- Marshall, C. and Rossman, G.B. (2014), *Designing Qualitative Research*, Sage publications.
- de Meyer, A., Nakane, J., Miller, J.G. and Ferdows, K. (1989), “Flexibility: the next competitive battle the manufacturing futures survey”, *Strategic Management Journal*, Vol. 10 No. 2, pp. 135–144.
- Miller, J.G. and Roth, A. V. (1994), “A Taxonomy of Manufacturing Strategies”, *Management Science*, Institute for Operations Research and the Management Sciences, Vol. 40 No. 3, pp. 285–304.
- Nair, A. and Boulton, W.R. (2008), “Innovation-oriented operations strategy typology and stage-based model”, *International Journal of Operations and Production Management*, Vol. 28 No. 8, pp. 748–771.
- Newton, S.K., Gilinsky Jr, A. and Jordan, D. (2015), “Differentiation strategies and winery financial performance: An empirical investigation”, *Wine Economics and Policy*, Vol. 4 No. 2, pp. 88–97.
- Peng, D.X., Schroeder, R.G. and Shah, R. (2011), “Competitive priorities, plant improvement and innovation capabilities, and operational performance: A test of two forms of fit”, *International Journal of Operations & Production Management*, Vol. 31 No. 5, pp. 484–510.
- Phusavat, K. and Kanchana, R. (2007), “Competitive priorities of manufacturing firms in Thailand”, *Industrial Management & Data Systems*, Vol. 107 No. 7, pp. 979–996.
- Platts, K.W., Mills, J.F., Bourne, M.C., Neely, A.D., Richards, A.H. and Gregory, M.J. (1998), “Testing manufacturing strategy formulation processes”, *International Journal of Production Economics*, Vol. 56–57, pp. 517–523.
- Pooya, A. and Faezirad, M. (2017), “A taxonomy of manufacturing strategies and production systems using self-organizing map”,

- Journal of Industrial and Production Engineering*, Vol. 34 No. 4, pp. 300–311.
- Porter, M.E. (1980), *Competitive strategy: Techniques for analyzing industries and competitors*, New York: The Free Press.
- Porter, M.E. (1993), *The Competitive Advantage of Nations*, Harvard business review.
- Porter, M.E. (2020), *Competitive Strategy: Creating and Sustaining Superior Performance*, The Free, New York.
- Robbins, S. and Coulter, M. (2013), *Management*, 12th ed., Harlow: Pearson.
- Roos, G. (2014), “Manufacturing in a high cost environment: Basis for success on the firm level”, in: *Global Perspectives on Achieving Success in High and Low Cost Operating Environments*, pp. 393–480.
- Roos, G. and Kennedy, N. (2014), *Global Perspectives on Achieving Success in High and Low Cost Operating Environments*, IGI Global, available at: <https://doi.org/10.4018/978-1-4666-5828-8>.
- Rosenzweig, E.D., Roth, A. v, Dean Jr., J.W. and Dean Jr, J.W. (2003), “The influence of an integration strategy on competitive capabilities and business performance: An exploratory study of consumer products manufacturers”, *Journal of Operations Management*, Vol. 21 No. 4, pp. 437–456.
- Sansone, C., Johansen, K. and Rösiö, C. (2021), “Competitive manufacturing in a high-cost environment: a SME’s perspective”, *28th EurOMA Conference*, Online.
- Sansone, C. (2021), “Towards a competitive advantage in a high-cost environment: challenges and solutions”, *28th EurOMA Conference*, Online.
- Sansone, C., and Sequeira, M. (2021), “Critical operations capabilities and reshoring drivers in a high-cost environment”, *28th ISTE International Conference on Transdisciplinary Engineering*, Online.
- Sequeira, M., and Sansone, C. (2021), “Relocation for production innovation capability: a bibliometric analysis”, *28th IPDMC*:

Innovation and Product Development Management Conference,
Milan, Italy.

- Sansone, C., Hilletoft, P., and Eriksson, D. (2020a), “Evaluation of critical operations capabilities for competitive manufacturing in a high-cost environment”, Vol. 13 No. 3, pp. 229–250.
- Sansone, C., Hilletoft, P., and Eriksson, D. (2020b), “Critical operations capabilities for competitive manufacturing in a high-cost environment: a multiple case study”, Vol. 13 No. 1, pp. 96–109.
- Sansone, C. (2018), *Critical operations capabilities in a high cost environment*, Licentiate thesis, Jönköping University, Sweden.
- Sansone, C., Hilletoft, P. and Eriksson, D. (2017a), “Critical operations capabilities for competitive manufacturing: a systematic review”, *Industrial Management & Data Systems*, Vol. 117 No. 5, pp. 801–837.
- Sansone, C., Hilletoft, P., Eriksson, D., Pinna, C. (2017b), “An analysis of critical operations capabilities in a high-cost environment: a multiple case study”, 24th EurOMA Conference, Edinburgh, Scotland.
- Sarmiento M.; Contreras, L.R.; Rich, N., R.; B., Sarmiento, R., Byrne, M., Rene Contreras, L. and Rich, N. (2007), “Delivery reliability, manufacturing capabilities and new models of manufacturing efficiency”, *Journal of Manufacturing Technology Management*, Vol. 18 No. 4, pp. 367–386.
- Sayer, R.A. (1992), *Method in Social Science: A Realist Approach*, Psychology Press.
- Schoenherr, T. and Narasimhan, R. (2012), “The fit between capabilities and priorities and its impact on performance improvement: revisiting and extending the theory of production competence”, *International Journal of Production Research*, Vol. 50 No. 14, pp. 3755–3775.
- Schoenherr, T., Power, D., Narasimhan, R. and Samson, D. (2012), “Competitive Capabilities among Manufacturing Plants in Developing, Emerging, and Industrialized Countries: A Comparative Analysis”, *Decision Sciences*, Vol. 43 No. 1, pp. 37–72.

- Schroeder, R.G., Bates, K.A. and Junntila, M.A. (2002), “A resource-based view of manufacturing strategy and the relationship to manufacturing performance”, *Strategic Management Journal*, Vol. 23 No. 2, pp. 105–117.
- Seuring, S. and Müller, M. (2008), “From a literature review to a conceptual framework for sustainable supply chain management”, *Journal of Cleaner Production*, Vol. 16 No. 15, pp. 1699–1710.
- Singh, P.J., Wiengarten, F., Nand, A.A. and Betts, T. (2015), “Beyond the trade-off and cumulative capabilities models: alternative models of operations strategy”, *International Journal of Production Research*, Vol. 53 No. 13, pp. 4001–4020.
- Skinner, W. (1969), *Manufacturing-missing link in corporate strategy*, Harvard Business Review Brighton.
- Slack, N. (2005), “Operations strategy: will it ever realize its potential?”, *Gestão & Produção*, Vol. 12 No. 3, pp. 323–332.
- Slack, N. and Lewis, M. (2020), *Operations Strategy*, Pearson Education.
- Spring, M., Hughes, A., Mason, K. and McCaffrey, P. (2017), “Creating the competitive edge: A new relationship between operations management and industrial policy”, *Journal of Operations Management*, Vol. 49–51, pp. 6–19.
- Sum, C.-C.C., Singh, P.J. and Heng, H.Y. (2012), “An examination of the cumulative capabilities model in selected Asia-Pacific countries”, *Production Planning and Control*, Vol. 23 No. 10–11, pp. 735–753.
- Swamidass, P.M. and Newell, W.T. (1987), “Manufacturing strategy, environmental uncertainty and performance: a path analytic model”, *Management Science*, Vol. 33 No. 4, pp. 509–524.
- Tate, W.L., Ellram, L.M., Schoenherr, T. and Petersen, K.J. (2014), “Global competitive conditions driving the manufacturing location decision”, *Business Horizons*, Vol. 57 No. 3, pp. 381–390.

- Tay, H.L. (2016), “Lean improvement practices: lessons from healthcare service delivery chains”, *IFAC-PapersOnLine*, Vol. 49 No. 12, pp. 1158–1163.
- Teece, D. and Pisano, G. (1994), “The Dynamic Capabilities of Firms: An Introduction”, *Industrial and Corporate Change*, Vol. 3 No. 3, pp. 537–556.
- Teece, D. and Pisano, G. (2003), “The dynamic capabilities of firms”, in : *Handbook on Knowledge Management*, Vol. 2, Springer, Berlin.
- Teece, D.J. (2019), “A capability theory of the firm: an economics and (Strategic) management perspective”, *New Zealand Economic Papers*, Vol. 53 No. 1, pp. 1–43.
- Teece, D.J., Pisano, G. and Shuen, A. (1997), “Dynamic capabilities and strategic management”, *Strategic Management Journal*, Vol. 18 No. 7, pp. 509–533.
- Thürer, M., Godinho Filho, M., Stevenson, M. and Fredendall, L.D. (2014), “Small manufacturers in Brazil: competitive priorities vs. capabilities”, *International Journal of Advanced Manufacturing Technology*, Vol. 74 No. 9–12, pp. 1175–1185.
- de Toni, A. and Tonchia, S. (2001), “Performance measurement systems-models, characteristics and measures”, *International Journal of Operations & Production Management*, Vol. 21 No.1, pp. 46–71.
- de Treville, S., Ketokivi, M. and Singhal, V. (2017), “Competitive manufacturing in a high-cost environment: Introduction to the special issue”, *Journal of Operations Management*, Vol. 49–51, pp. 1–5.
- Vincent, L. (2008), “Differentiating competence, capability and capacity”, *Innovating Perspectives*, Vol. 16 No. 3, pp. 1–2.
- Voss, C., Tsikriktsis, N. and Frohlich, M. (2002), “Case research in operations management”, *International Journal of Operations & Production Management*, Vol. 22 No. 2, pp. 195–219.
- Ward, P.T., Duray, R., Keong Leong, G. and Sum, C.C. (1995), “Business environment, operations strategy, and performance:

- An empirical study of Singapore manufacturers *”, *Journal of Operations Management*, Vol. 13 No. 2, pp. 1–17.
- Ward, P.T., McCreery, J.K., Ritzman, L.P. and Sharma, D. (1998), “Competitive priorities in operations management”, *Decision Sciences*, Vol. 29 No. 4, pp. 1–12.
- Wernerfelt, B. (1984), “A resource-based view of the firm”, *Strategic Management Journal*, Vol. 5 No. 2, pp. 171–180.
- Westkämper, E. (2014), *Towards the Re-Industrialization of Europe*, Springer, Berlin, Heidelberg.
- Williamson, K. (2002), *Research Methods for Students, Academics and Professionals: Information Management and Systems*, Elsevier.
- Yin, R.K. (2017), *Case Study Research and Applications: Design and Methods*, SAGE Publications.
- Yin, Y., Stecke, K.E., Swink, M. and Kaku, I. (2017), “Lessons from *seru* production on manufacturing competitively in a high cost environment”, *Journal of Operations Management*, Vol. 49–51, pp. 67–76.
- Yusuf, Y.Y. and Adeleye, E.O. (2005), “A comparative study of lean and agile manufacturing with a related survey of current practises in the UK”, *International Journal of Production Research*, Vol. 40 No. 17, pp. 4545–4562.
- Zhao, X., Yan Yeung, J.H., Zhou, Q., Yeung, J.H.Y. and Zhou, Q. (2010), “Competitive priorities of enterprises in mainland China”, *Total Quality Management*, Vol. 13 No. 3, pp. 285–300.
- Zheng, C., Qin, X., Eynard, B., Bai, J., Li, J. and Zhang, Y. (2019), “SME-oriented flexible design approach for robotic manufacturing systems”, *Journal of Manufacturing Systems*, Vol. 53 No. April, pp. 62–74.

Appendices

Appendix 1

Guide semi-structured interview for multiple case study A

A. Interviewee's presentation

1. What is your role in the company?
2. What is your main task and responsibility?
3. In which department are you working in?

B. Company's presentation

4. What is the company working on?
5. In which sector is the company operating?
6. What kind of product is the company producing?
7. How many employees are involved in the company?
8. How is the company's organization?

C. Company's strategy

9. What is the business strategy of the company?
10. What is the company's competitive advantage in the market?
11. What is the manufacturing strategy of the company?
12. What are the main customers?
13. Where are the customers situated?
14. What are the main competitors?
15. Where are the competitors situated?

D. Company's priorities and capabilities

16. How does the company maintain a competitive advantage in the market? Why?

17. What are the main priorities of the company (in terms of cost, quality, delivery, flexibility, service, innovation, environment)? Why?
18. Which are the most important priorities? Why?
19. What are the main operations capabilities of the company (in terms of cost, quality, delivery, flexibility, service, innovation, environment)? Why?
20. Which are the most important capabilities? Why?
21. What is the future direction of the company operations' function in relation to the priorities and capabilities discussed above? Why?

E. Company's performance

22. What are the key performance indicators adopted by the company?
23. How are these key performance indicators related to the target priorities and capabilities?

F. Additional comments

24. Would you like to add anything else in relation to our conversation?

Appendix 2

Questionnaire for multiple case study B

Introduction

To stay competitive, companies must be able to identify, develop and continuously improve the capabilities that have the greatest impact on overall competitiveness. This can be achieved by first determining the most important competitive priorities and then building up supporting capabilities. This must be done in a way that ensures that the entire company is strategically aligned and is working towards the same goal.

The purpose of this survey is to find out how you evaluate competitive priorities and capabilities that might be important for your company's competitiveness. The survey takes about 30 minutes to complete and departs from a framework of competitive priorities and capabilities. These capabilities will be evaluated from the following three perspectives:

1. Importance: Rate the capabilities in terms of how important they are for the company's competitiveness (from 1 = not important to 5 = very important).
2. Performance: Rate the capabilities in terms of how well the company is currently performing on them (from 1 = very low performance to 5 = very high performance).
3. Improvement: Rate the capabilities in terms of how much the company is currently working on improving them (from 1 = no improvement efforts to 5 = many improvement efforts).

Part 1: Importance

Rate the capabilities in terms of how important they are for the company's competitiveness (from 1 = not important to 5 = very important).

Capability	Definition	Rating				
		1	2	3	4	5
Cost efficiency	<i>The ability to provide products at low cost</i>					
Resource efficiency	<i>The ability to maximize the utilization of process resources (machinery and human)</i>					
Process efficiency	<i>The ability to maximize the process output</i>					
Product quality	<i>The ability to provide durable, high-performance products</i>					
Service quality	<i>The ability to provide high-performance services</i>					
Process quality	<i>The ability to provide products/ services with consistent quality</i>					
Delivery dependability	<i>The ability to deliver on time</i>					
Brand quality	<i>The ability to build a strong and positive company image</i>					
Supplier dependability	<i>The ability to select and develop reliable suppliers</i>					
Delivery time	<i>The ability to deliver in a short time frame</i>					
Time to market	<i>The ability to have short time frame from product development to market introduction</i>					
Product flexibility	<i>The ability to customize products based on customer requirements</i>					
Product line flexibility	<i>The ability to provide a wide range of products with different features</i>					
Volume flexibility	<i>The ability to respond to changes in market demand</i>					
Production mix flexibility	<i>The ability to change the manufacturing product mix</i>					
Labor flexibility	<i>The ability of employees to perform different types of tasks</i>					
Delivery flexibility	<i>The ability to change delivery times and quantities within the agreed upon delivery time</i>					
Supplier flexibility	<i>The ability to select and develop responsive suppliers</i>					
Product innovation	<i>The ability to develop and introduce new products</i>					
Service innovation	<i>The ability to develop and introduce new services</i>					
Process innovation	<i>The ability to develop and implement new processes</i>					
Technology innovation	<i>The ability to develop and implement new technologies</i>					
Market innovation	<i>The ability to find and exploit new markets and opportunities</i>					
Supply chain innovation	<i>The ability to develop and implement new supply chain solutions</i>					
Product sustainability	<i>The ability to provide sustainable products</i>					
Process sustainability	<i>The ability to manufacture products in a sustainable manner</i>					
Supply chain sustainability	<i>The ability to source and deliver products in a sustainable manner</i>					

Part 2: Performance

Rate the capabilities in terms of how well the company is currently performing on them (from 1 = very low performance to 5 = very high performance).

Capability	Definition	Rating				
		1	2	3	4	5
Cost efficiency	<i>The ability to provide products at low cost</i>					
Resource efficiency	<i>The ability to maximize the utilization of process resources (machinery and human)</i>					
Process efficiency	<i>The ability to maximize the process output</i>					
Product quality	<i>The ability to provide durable, high-performance products</i>					
Service quality	<i>The ability to provide high-performance services</i>					
Process quality	<i>The ability to provide products/ services with consistent quality</i>					
Delivery dependability	<i>The ability to deliver on time</i>					
Brand quality	<i>The ability to build a strong and positive company image</i>					
Supplier dependability	<i>The ability to select and develop reliable suppliers</i>					
Delivery time	<i>The ability to deliver in a short time frame</i>					
Time to market	<i>The ability to have short time frame from product development to market introduction</i>					
Product flexibility	<i>The ability to customize products based on customer requirements</i>					
Product line flexibility	<i>The ability to provide a wide range of products with different features</i>					
Volume flexibility	<i>The ability to respond to changes in market demand</i>					
Production mix flexibility	<i>The ability to change the manufacturing product mix</i>					
Labor flexibility	<i>The ability of employees to perform different types of tasks</i>					
Delivery flexibility	<i>The ability to change delivery times and quantities within the agreed upon delivery time</i>					
Supplier flexibility	<i>The ability to select and develop responsive suppliers</i>					
Product innovation	<i>The ability to develop and introduce new products</i>					
Service innovation	<i>The ability to develop and introduce new services</i>					
Process innovation	<i>The ability to develop and implement new processes</i>					
Technology innovation	<i>The ability to develop and implement new technologies</i>					
Market innovation	<i>The ability to find and exploit new markets and opportunities</i>					
Supply chain innovation	<i>The ability to develop and implement new supply chain solutions</i>					
Product sustainability	<i>The ability to provide sustainable products</i>					
Process sustainability	<i>The ability to manufacture products in a sustainable manner</i>					
Supply chain sustainability	<i>The ability to source and deliver products in a sustainable manner</i>					

Part 3: Improvement

Rate the capabilities in terms of how much the company is currently working on improving them (from 1 = no improvement efforts to 5 = many improvement efforts).

Capability	Definition	Rating				
		1	2	3	4	5
Cost efficiency	<i>The ability to provide products at low cost</i>					
Resource efficiency	<i>The ability to maximize the utilization of process resources (machinery and human)</i>					
Process efficiency	<i>The ability to maximize the process output</i>					
Product quality	<i>The ability to provide durable, high-performance products</i>					
Service quality	<i>The ability to provide high-performance services</i>					
Process quality	<i>The ability to provide products/ services with consistent quality</i>					
Delivery dependability	<i>The ability to deliver on time</i>					
Brand quality	<i>The ability to build a strong and positive company image</i>					
Supplier dependability	<i>The ability to select and develop reliable suppliers</i>					
Delivery time	<i>The ability to deliver in a short time frame</i>					
Time to market	<i>The ability to have short time frame from product development to market introduction</i>					
Product flexibility	<i>The ability to customize products based on customer requirements</i>					
Product line flexibility	<i>The ability to provide a wide range of products with different features</i>					
Volume flexibility	<i>The ability to respond to changes in market demand</i>					
Production mix flexibility	<i>The ability to change the manufacturing product mix</i>					
Labor flexibility	<i>The ability of employees to perform different types of tasks</i>					
Delivery flexibility	<i>The ability to change delivery times and quantities within the agreed upon delivery time</i>					
Supplier flexibility	<i>The ability to select and develop responsive suppliers</i>					
Product innovation	<i>The ability to develop and introduce new products</i>					
Service innovation	<i>The ability to develop and introduce new services</i>					
Process innovation	<i>The ability to develop and implement new processes</i>					
Technology innovation	<i>The ability to develop and implement new technologies</i>					
Market innovation	<i>The ability to find and exploit new markets and opportunities</i>					
Supply chain innovation	<i>The ability to develop and implement new supply chain solutions</i>					
Product sustainability	<i>The ability to provide sustainable products</i>					
Process sustainability	<i>The ability to manufacture products in a sustainable manner</i>					
Supply chain sustainability	<i>The ability to source and deliver products in a sustainable manner</i>					

Appendix 3

Guide semi-structured interview for multiple case study C

A. General information about interviewee

1. What is your role in the company?
 - What is your position within the organization?
 - Can you briefly describe your tasks and responsibilities in the company?

B. Company's strategy and competitive advantage

This section concerns the company's strategy and competitive advantage.

2. Where is your manufacturing located?
 - Who took the decision of manufacturing in Sweden?
 - Why do you think it is important to manufacture in Sweden?
3. How does the relationship with your suppliers and customers work?
 - Where are your suppliers mainly located?
 - Where are your customers mainly located?
4. What do you think is the main competitive advantage of the company?
 - Why does the customer choose you?
 - How do you maintain and support this competitive advantage in the market?

C. Company's priorities in relation to production system

This section concerns the development and implementation of the company's priorities and capabilities in the production system.

5. What are the top three priorities (among cost, quality, time, flexibility, innovation, sustainability) that your company have?
6. Among the top three priorities that your company have, which one do you think is the most important for your company to be competitive?
 - Why do you think it is the most important?
 - Do you have any example based on specific products?
7. Based on the top three priorities that your company have, which capabilities does your company have ?
8. Which priorities (excluding the top three priorities) do you think are important for the company to consider in the future?
 - Why do you think it is important to reach these priorities in the future?
 - How are you planning to reach these priorities in the future?
9. How do you ensure the **top three priorities** in the production system?
 - What solutions/technologies/methods did you implement in the production system to reach better performances in the **top three priorities** of the company?
 - How are they practically implemented in the production system? Do you have any examples?
 - Do you have any example based on specific products?

10. What changes and improvements do you think are needed in the production system that will help you to reach better performances in the **top three priorities** of the company?

- How are you planning to make these improvements?

D. Company's challenges in manufacturing

Please briefly describe the company's challenges for maintaining production in Sweden and for competing from high-cost environment.

11. What are the three main challenges that you experienced to be able to produce competitively in Sweden?

- How do you deal with these challenges in practice?
- Do you think you have the right resources available to deal with these challenges?

E. Company's priorities and performance

This section concerns the company's performance in relation to cost, quality, time, flexibility, innovation, and sustainability.

12. What KPIs do you use which are related to COST? (For example: Raw material cost, aggregate production cost, ROI, etc.)

13. What KPIs do you use which are related to QUALITY? (For example: scrap number, rework number, Overall Equipment effectiveness OEE, etc.)

14. What KPIs do you use which are related to TIME? (For example: cycle time, on time delivery, time to market, etc.)

What KPIs do you use which are related to FLEXIBILITY? (For example: volume flexibility, product variety, mix flexibility, etc.)

15. What KPIs do you use which are related to INNOVATION? (For example: number of innovation projects started, number of new products launched, etc.)
16. What KPIs do you use which are related to SUSTAINABILITY? (For example: carbon footprint, energy consumption, waste reduction rate, supplier environmental sustainability index, etc.)
 - How do you use these KPIs?

F. Concluding remarks

17. What is there more that you would like to add?
18. Where can we find documents related to any of the topic discussed today that we could have access to?
19. We would like to obtain a better overview of the company's strategy and production. Which other people within the company are relevant for participation in further interviews?

Critical Operations Capabilities for Competitive Manufacturing: A High-Cost Environment Perspective

Manufacturing companies operating in a high-cost environment are facing many challenges attempting to achieve a competitive advantage. These challenges have encouraged manufacturing companies to relocate their manufacturing operations from a high-cost to low-cost environment, creating issues for the western social welfare. Manufacturing companies located in a high-cost environment must be able to improve their overall competitiveness to maintain their manufacturing in such environment.

Research has shown that the competitive success of a company depends on its ability to identify, develop and improve those operations capabilities that have the highest impact on their competitiveness. However, the literature provides limited emphasis on critical operations capabilities for competitive manufacturing in a high-cost environment. Therefore, the purpose of this research is to investigate critical operations capabilities and how they contribute to a competitive advantage in a high-cost environment.

To fulfill the purpose, two research questions have been formulated. The first research question is: what are the critical operations capabilities for competitive manufacturing in a high-cost environment? The second research question is: How do critical operations capabilities contribute to competitive advantage in a high-cost environment? The research questions were answered through different studies and the implementation of different research strategies.

This thesis contributes with increased knowledge on critical operations capabilities in a high-cost environment and how they contribute to a competitive advantage. This research has provided an updated and modernized framework of critical operations capabilities in a high-cost environment. Furthermore, this research has also offered an overview on different strategies which are implemented in a high-cost environment for reaching a competitive advantage. Thus, it also included an analysis on challenges and solutions faced by competitive manufacturing in a high-cost environment.



CINZIA SANSONE is currently a PhD student in Production Systems within the department of Industrial Product Development, Production and Design, School of Engineering, Jönköping University. She was awarded the bachelor degree in Industrial Engineering in 2012 at the Università Carlo Cattaneo - LIUC, Italy. In the 2014, she earned her MSc with specialization in Production Development and Management at the Jönköping University. Her research focuses on Production and Supply Chain Management with an emphasis on Strategy.